

# College of Science

## College of Science

### Overview

#### Dean's Welcome

Throughout their College of Science careers, our students grow into complete scholars. We offer diverse research opportunities starting in the freshman year on campus and around the world. We help guide students as they explore and find their perfect internship or career experience. Academic advisors guide and support students as they explore their interests, challenge their abilities and succeed in endeavors that stretch their skills and imaginations. Career counseling activities help students as they target their professional and personal goals and construct a career plan.

Our students succeed thanks to our world-renowned faculty. They not only offer guidance in the lecture halls and labs; they lead by example. Fascinating, world-changing research as well as work in industry as consultants or advisors inspire students.

Our Science Core Curriculum requirements and Learning Beyond the Classroom Certificate encourage development of professional capacities, engagement in community service, exploration of study abroad opportunities and enhancements of cultural awareness. These engagement points develop our future scientists and mathematicians into broad, well-rounded graduates who will work on the grand challenges of science and push the frontiers of knowledge.

The Purdue College of Science experience makes companies like Amazon, Proctor & Gamble, Intel, and Cummins seek our students. Almost 90 percent of our graduates are in graduate or professional schools or beginning their careers six months after graduation.

**Go Boilers!**

Sincerely,  
Jeff Roberts, Dean

## Admissions

<http://www.admissions.purdue.edu/majors/colleges.php?ClgCd=SCI>

## Admission to Teacher Education

Teacher Education Program Guidelines 2016-17

## Advising

## Seeing a College of Science Academic Advisor

The academic advising relationship in the College of Science is a dynamic coaching, teaching and educational collaboration where students and advisors work in partnership in the attainment of personal, academic and professional goals through intentional interactions that foster informed, student-driven decisions. The academic advising experience is seen as essential to the establishment of meaningful educational, career, and life goals that are consistent with each student's personal values, interests and abilities.

Academic advising practice in the College of Science is predicated on the belief that purposeful individualized attention promotes each student's success and increases student retention through the development of academic maturity, the ability to embrace and overcome challenges, and the development of a personal and academic identity. College of Science advisors seek to encourage and inspire student engagement with their university, the global community and the world of scientific discovery.

Students are strongly encouraged to make their advising relationship a central focus in their success plan during their Purdue experience. Contact information may be found at CoS Advising Offices. [Make An Advising Appointment](#)

## Advising Appointment Options

### Scheduled Advising Appointments

Students may schedule 30-minute appointments with their assigned advisors:

- to register for Fall/Spring semesters, Summer terms
- for in-depth advising questions
- for academic/degree planning, graduate/professional school planning and career development
- to discuss and receive support in addressing personal and academic challenges
- for general questions and concerns

Students must be on time for their scheduled appointments. Late arrivals of more than 5 minutes may result in a cancellation of your appointment.

Make an Appointment with your advisor.

### Walk-in Appointments

Walk-in appointments may be used to drop/add courses, resolve scheduling conflicts, complete paperwork, and to address time-sensitive questions. Appointments are kept to 15 minutes and may not be used for registration or degree planning purposes. Walk-in appointments are scheduled on a first come, first served basis and therefore, students are not guaranteed to see their advisor during scheduled walk-in times if the number of students to be seen is greater than the time that has been scheduled. Students may see their assigned advisor only unless their advisor is not available and there is an immediate need. Before visiting your advising office for a walk-in appointment, check walk-in times. Times are updated the Friday before the following week. Note: walk-in times **ARE** subject to change without notice.

### CODO Walk-in Appointments

Students who would like to CODO to the College of Science should consult the Non-College of Science Walk-in Schedule and review College of Science CODO requirements for their intended program before speaking with a Science advisor.

## Advising Policy for Students Who Will Pursue a non-College of Science Program

### Two Semester Advising Policy:

Students who enter the College of Science with immediate plans to pursue a non-science academic program are eligible to receive two semesters of academic advising and PIN releases as they work towards a successful CODO to their intended

program. If CODO requirements are not met by the end of their first year, students will be required to request a CODO to the College of Liberal Arts while they continue to pursue their degree goals.

**Four Semester Advising Policy:**

Students who pursue a College of Science curriculum but who later determine that they would like to pursue an alternate program outside of the College will have four semesters to successfully CODO. A request may be made for approval of the 5th Semester Advising Policy if a student is close to meeting CODO requirements and has provided course recommendations from an advisor in their intended program.

## Contact Information

**Mailing address:**

Purdue University College of Science  
150 N. University St  
West Lafayette, IN 47907

**Directories**

- Science Administration
- Office of Undergraduate Education
- Departments
- Science IT

**Phone and Fax:**

Student Advising Office

- 765-494-1771 (office)
- 765-496-3015 (fax)

Science Administration

- 765-494-1729 (office)
- 765-494-1736 (fax)

Science IT Helpline

- 765-494-4488

## College of Science Administration

### About the Department of Science Administration

During their Purdue career, students will be able to take advantage of the many benefits the College of Science has to offer. From Nobel Prize-winning faculty to undergraduate research opportunities and study abroad opportunities to facilities found in the international spotlight, the College of Science is recognized and renowned.

## Faculty

<http://www.science.purdue.edu/faculty-and-staff/directory.php>

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## Contact Individual College of Science Groups:

- Advising - email
- Graduate Education and International Programs - email
- Dean's Office - email
  - Speech/Appearance request form
- Research - email
- Academic Affairs - email
- Undergraduate Education - email
- Science Diversity - email
- Strategic Relations - email
- Recruiting - email
- K-12 Outreach - email
- Special Events & Alumni Relations - email
- Science Advancement - email
- Science IT - email

## Interdisciplinary Science - Concentration in Biology

## About the Program

The interdisciplinary science major is designed to provide College of Science students with a broad base in the sciences. By combining a primary area of science study, an interdisciplinary science core, a supporting area of academic interest and the core curriculum shared by all College of Science programs, students explore how the disciplines of science come together to identify and solve scientific challenges. Students customize the major by selecting a departmental or interdepartmental primary area based in science and a supporting area that complements or enhances the primary area. This supporting area may be an approved minor from any college or school at the University or a concentration of 18 credits of courses with a unifying theme. There is a primary area representing each department in the College of Science, however, cross-disciplinary areas may be explored and added as appropriate. With the help of either a faculty member or an academic advisor, students are encouraged to petition for approval of their supporting area.

The Interdisciplinary Science Major is designed to give a student a broad base in the sciences with more depth in a Primary Area of Science and a Supporting Area, usually outside of Science. The Core courses are common across the major but the student customizes the major by selecting a departmental or interdepartmental Primary Area based in Science and a Supporting Area which may come from any college or school at the University. There is a Primary Area representing each department in the College of Science and cross-disciplinary areas will be explored and added as appropriate. Several Supporting Areas will be suggested and a student may petition for approval of others.

Students completing the interdisciplinary science major have gone on to a variety of careers - some in, and others out of, the world of science. These careers include medicine, law and other advanced-study professions, scientific sales, technical and scientific writing, computer programming and engineering.

## **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Interdisciplinary Science/Concentration in Biology include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

SCI-INTRD-BS

Code-IDSC, BIOL

120 Credits

Fall 2016

**Departmental/Program Major Courses (86-112 credits)**

**Required Interdisciplinary Core Courses (68-80 credits)**

**Required Biology Courses (7-8 credits)**

**BIOL 11000 - Fundamentals Of Biology I**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Principles of biology, focusing on diversity, ecology, evolution, and the development, structure, and function of organisms. Typically offered Summer Fall Spring.

### **BIOL 11100 - Fundamentals Of Biology II**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Continuation of BIOL 11000. Principles of biology, focusing on cell structure and function, molecular biology, and genetics. Typically offered Fall Spring.

**OR**

### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

## **Required Chemistry Selective Courses (5-10 credits)**

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

### **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

### **CHM 13600 - General Chemistry Honors**

Credit Hours: 4.00. A sophisticated treatment of the principles of chemistry. Atomic structure and bonding, spectroscopy, equilibria, thermodynamics and kinetics. Advanced Placement chemistry credit (level 4 or 5) or admission to the honors program in Science or Engineering or a score of at least 70% on the CHM 11500 test-out exam. Students with a grade of C or better in CHM 13600 who need 8 hours of credit in general chemistry may request credit for CHM 11500. Typically offered Fall.

OR

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

## **Required Computing Option (3-4 credits)**

### **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

### **CS 15900 - Programming Applications For Engineers**

Credit Hours: 3.00. Fundamental principles, concepts, and methods of programming (C and MATLAB), with emphasis on applications in the physical sciences and engineering. Basic problem solving and programming techniques; fundamental algorithms and data structures; and use of programming logic in solving engineering problems. Students are expected to complete assignments in a collaborative learning environment. Typically offered Summer Fall Spring.

### **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

### **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

## **Required Earth, Atmospheric, and Planetary Science Selective Courses (3 credits)**

Select courses COULD satisfy Science Selective for core.

### **EAPS 10000 - Planet Earth**

Credit Hours: 3.00. An introduction to the Geosciences—Earth science, oceanography, atmospheric science and astronomy. The course emphasizes topics (earthquakes, volcanoes, ocean pollution, climate change, severe weather, etc.) that are of general interest and relevance, and the interconnections between various Earth processes. Typically offered Fall Spring. CTL:IPS 1730 Earth Science

## **EAPS 10900 - The Dynamic Earth**

Credit Hours: 3.00. This course covers the formation and development of the solid earth, atmosphere, hydrosphere, and biosphere. The course studies the whole earth as a system of many interacting parts and focuses on the changes within and between these parts. This course is intended for all majors in earth and atmospheric sciences. Typically offered Fall.

## **EAPS 11100 - Physical Geology**

Credit Hours: 3.00. Geologic processes and the development of land forms. Laboratory covers the study of minerals and rocks, the interpretations of topographic and geologic maps, and field investigations. Typically offered Summer Fall Spring. CTL: Physical Geology

## **EAPS 22100 - Survey Of Atmospheric Science**

Credit Hours: 3.00. (NRES 23000) An introductory course for both science and nonscience students. A general study of the atmosphere, basic meteorological principles, and weather systems. Relationships of the changing atmosphere to climate ozone depletion, and other contemporary issues. Typically offered Summer Fall Spring.

## **EAPS 22500 - Science Of The Atmosphere**

Credit Hours: 3.00. An overview of the physics and dynamics of the atmosphere. Quantitative study of the energy balance of the atmosphere, condensation and precipitation processes, atmospheric motion and global circulation, severe storms, atmospheric chemistry. Contemporary issues such as human impact on climate, ozone depletion, numerical weather prediction and climate simulation, and modern measurement systems. Not available to students with credit in EAPS 22100. Intended for Science and Engineering majors only. Prior course work in calculus is required. Typically offered Spring.

## **Required Mathematics Courses (6-10 credits)**

### **MA 16010 - Applied Calculus I**

Credit Hours: 3.00. Topics include trigonometric and exponential functions; limits and differentiation, rules of differentiation, maxima, minima and optimization; curve sketching, integration, anti-derivatives, fundamental theorem of calculus. Properties of definite integrals and numerical methods. Applications to life, managerial and social sciences. Typically offered Fall Spring Summer.

### **MA 16020 - Applied Calculus II**

Credit Hours: 3.00. This course covers techniques of integration; infinite series, convergence tests; differentiation and integration

of functions of several variables; maxima and minima, optimization; differential equations and initial value problems; matrices, determinants, eigenvalues and eigenvectors. Applications. Typically offered Fall Spring Summer.

**OR**

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

## **Required Physics Selective Courses (8 credits)**

### **PHYS 22000 - General Physics**

Credit Hours: 4.00. Mechanics, heat, and sound, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1751  
Algebra-based Physics I

### **PHYS 22100 - General Physics**

Credit Hours: 4.00. Electricity, light, and modern physics, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1752 Algebra-based Physics II

**OR**

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

### **PHYS 25200 - Electricity And Optics Laboratory**

Credit Hours: 1.00. Selected experiments in electric fields, magnetic fields, steady-state and transient d.c. circuits, thermodynamics, and optics. Typically offered Fall Spring Summer.

**OR**

### **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

### **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

## Required Statistics Selective Courses (3 credits)

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

### **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

## Required Biology Primary Area Courses (15-16 credits)

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

### **BIOL 32800 - Principles Of Physiology**

Credit Hours: 4.00. This course is designed to provide students with an introduction to physiology with an emphasis on cellular mechanisms that underlie anatomical and physiological adaptations used by animals to survive in their habitat. Topics covered will range from cellular respiration to the physical limits of animal performance as we deconstruct and then reconstruct the body to examine how animals can live in extreme environments. Goals for this course are for students to gain a foundation in basic physiological principles, to learn about the integrative nature of the systems of animals, and to appreciate how and why animals have evolved and strategies to help them survive in their unique environment. Typically offered Spring.

### **BIOL 36700 - Principles Of Development**

Credit Hours: 2.00. This course deals with the process by which genes in a fertilized egg control cell behavior in the embryo and so determine the nature of the animal or plant. The emphasis is on early development and the laying down of body plan and organ systems in various model systems (*Drosophila*, nematode, *Arabidopsis*, zebrafish, mouse, chick, and frog). Typically offered Fall Spring.

## **BIOL 36701 - Principles Of Development Lab**

Credit Hours: 1.00. This laboratory will offer students the experience working with different model systems to observe developmental processes, examine key regulatory gene expression, and manipulate gene functions used in different biochemical, molecular and genetic approaches. Typically offered Fall Spring.

## **BIOL 39500 - Special Assignments**

Arrange Hours and Credit. Reading, discussions, written reports, seminar presentations, and field or laboratory work provided for enrichment in special areas of the biological sciences. Permission of instructor required. Typically offered Fall Spring Summer.

## **BIOL 41500 - Introduction To Molecular Biology**

Credit Hours: 3.00. An introduction to modern molecular biology techniques and how they are used to address current topics in gene regulation. Emphasis will be placed on experimental procedures and model systems, such as site-directed mutagenesis of isolated genes and their subsequent introduction into prokaryotic and eukaryotic cells. Topics will address the molecular control mechanisms associated with DNA replication, RNA transcription, RNA processing, and differential gene expression. Typically offered Fall.

## **BIOL 41600 - Viruses And Viral Disease**

Credit Hours: 3.00. The objective of this course is to provide students with an introductory understanding of viruses and their impact on human health. The course will be divided into two sections. During the first section, we will discuss the cellular and organismal events that occur following virus infection, including viral entry, replication, modulation of cell biology by viral proteins, the host immune response to infection, evasion of the immune response by viruses, and resulting virus-induced disease. The emphasis of this first section will be on the general strategies used by viruses to establish and maintain infection in a population. In the second section, we will discuss in relative detail our current understanding of select important human viruses including influenza, HIV, smallpox, the herpesviruses, and tumor-causing viruses. The objective of this section will be to understand how the unique aspects of each virus's biology affect the outcome of infection with these pathogens. In addition to virus-associated diseases, we will discuss potential ways that viruses may provide symbiotic benefits to their hosts and thereby shape the course of human evolution. Throughout the course, we will emphasize societal and political aspects of virology and virus-derived technologies, including vaccine development, the use of viruses as gene therapy vectors, and the threat of viral bioterror of bio-error. Typically offered Spring.

## **BIOL 42000 - Eukaryotic Cell Biology**

Credit Hours: 3.00. Composition, structure, regulation, and growth of eukaryotic cells. Typically offered Fall.

## **BIOL 43600 - Neurobiology**

Credit Hours: 3.00. This course will cover key aspects in molecular, cellular, and developmental neurobiology. Topics include: Cell biology of neurons and glia, electrophysiological properties of neurons, electrical and chemical signaling between neurons, synaptic integration and plasticity, development and regeneration of the nervous system, nervous system diseases. Up-to-date research findings and techniques will be included. A basic knowledge of cell biology and protein structure and function is strongly recommended. Typically offered Fall.

## **BIOL 43800 - General Microbiology**

Credit Hours: 3.00. An examination of microbial diversity that emphasizes the interrelationship of bacteria and their environments. This includes aspects of cell composition, metabolism, and growth of microorganisms. Typically offered Fall.

## **Required Supporting Area Courses (18 credits)**

MUST BE APPROVED BY COLLEGE

## **Other Departmental/Program Course Requirements (18-31 credits)**

- Calculus I Option (within major) - select from MA 16100 (satisfies Quantitative Reasoning for core) ♦, MA 16500 (satisfies Quantitative Reasoning for core) ♦
- Calculus Option II (within major) - select from MA 16200 (satisfies Quantitative Reasoning for core), MA 16600 (satisfies Quantitative Reasoning for core)

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00-6.00
- Laboratory Science I Option (within major) (satisfies Science Selective for core)
- Laboratory Science II Option (within major) (satisfies Science Selective for core)
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00

- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Computing Option (within major)
- Teambuilding and Collaboration Experience\* - Credit Hours: 0.00 - 4.00
- Great Issues Option - Credit Hours: 3.00
- Multidisciplinary Experience\* (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information.

## **Electives (9-34 credits)**

### **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or click here.

### **Program Requirements**

#### **Fall 1st Year**

#### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Calculus Option I - Credit Hours: 3.00 - 5.00
- General Chemistry Selective I - Credit Hours: 4.00 - 5.00
- Biology Selective I - Credit Hours: Credit Hours: 4.00
- Free Elective - Credit Hours: 0.00 - 1.00

### **15-18 Credits**

#### **Spring 1st Year**

- Calculus Option II - Credit Hours: 3.00 - 5.00
- Language I Option - Credit Hours: 3.00 - 4.00
- General Chemistry Selective II or Free Elective - Credit Hours: 4.00 - 5.00
- Biology Selective II - Credit Hours: 3.00 - 4.00
- Biology Selective II or Free Elective - Credit Hours: 0.00 - 2.00

### **14-16 Credits**

#### **Fall 2nd Year**

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Language II Option - Credit Hours: 3.00 - 4.00
- Supporting Area Course - Credit Hours: 3.00
- Free Elective - Credit Hours: 0.00 - 1.00

15-16 Credits

Spring 2nd Year

## **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

## **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- Supporting Area Course - Credit Hours: 3.00
- General Education I Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 0.00 - 1.00

15-16 Credits

Fall 3rd Year

- Supporting Area Course - Credit Hours: 3.00
- STAT Option - Credit Hours: 3.00
- Teambuilding and Collaboration Experience - Credit Hours: 3.00 - 4.00
- Computing Option - Credit Hours: 3.00 - 4.00
- General Education II Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15-16 Credits

Spring 3rd Year

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

- EAPS Selective Course - Credit Hours: 3.00
- Supporting Area Course - Credit Hours: 3.00
- General Education III Option - Credit Hours: 3.00
- Technical Writing or Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 1.00

15 Credits

Fall 4th Year

### **BIOL 39500 - Special Assignments**

Arrange Hours and Credit. Reading, discussions, written reports, seminar presentations, and field or laboratory work provided for enrichment in special areas of the biological sciences. Permission of instructor required. Typically offered Fall Spring Summer.

### **BIOL 41500 - Introduction To Molecular Biology**

Credit Hours: 3.00. An introduction to modern molecular biology techniques and how they are used to address current topics in gene regulation. Emphasis will be placed on experimental procedures and model systems, such as site-directed mutagenesis of isolated genes and their subsequent introduction into prokaryotic and eukaryotic cells. Topics will address the molecular control mechanisms associated with DNA replication, RNA transcription, RNA processing, and differential gene expression. Typically offered Fall.

### **BIOL 42000 - Eukaryotic Cell Biology**

Credit Hours: 3.00. Composition, structure, regulation, and growth of eukaryotic cells. Typically offered Fall.

### **BIOL 43600 - Neurobiology**

Credit Hours: 3.00. This course will cover key aspects in molecular, cellular, and developmental neurobiology. Topics include: Cell biology of neurons and glia, electrophysiological properties of neurons, electrical and chemical signaling between neurons, synaptic integration and plasticity, development and regeneration of the nervous system, nervous system diseases. Up-to-date research findings and techniques will be included. A basic knowledge of cell biology and protein structure and function is strongly recommended. Typically offered Fall.

## **BIOL 43800 - General Microbiology**

Credit Hours: 3.00. An examination of microbial diversity that emphasizes the interrelationship of bacteria and their environments. This includes aspects of cell composition, metabolism, and growth of microorganisms. Typically offered Fall.

or Free Elective - Credit Hours: 3.00 - 4.00

- Supporting Area Course - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 3.00
- Physics Selective I - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00 - 6.00

15-16 Credits

Spring 4th Year

## **BIOL 32800 - Principles Of Physiology**

Credit Hours: 4.00. This course is designed to provide students with an introduction to physiology with an emphasis on cellular mechanisms that underlie anatomical and physiological adaptations used by animals to survive in their habitat. Topics covered will range from cellular respiration to the physical limits of animal performance as we deconstruct and then reconstruct the body to examine how animals can live in extreme environments. Goals for this course are for students to gain a foundation in basic physiological principles, to learn about the integrative nature of the systems of animals, and to appreciate how and why animals have evolved and strategies to help them survive in their unique environment. Typically offered Spring.

## **BIOL 36700 - Principles Of Development**

Credit Hours: 2.00. This course deals with the process by which genes in a fertilized egg control cell behavior in the embryo and so determine the nature of the animal or plant. The emphasis is on early development and the laying down of body plan and organ systems in various model systems (Drosophila, nematode, Arabidopsis, zebrafish, mouse, chick, and frog). Typically offered Fall Spring.

## **BIOL 36701 - Principles Of Development Lab**

Credit Hours: 1.00. This laboratory will offer students the experience working with different model systems to observe

developmental processes, examine key regulatory gene expression, and manipulate gene functions used in different biochemical, molecular and genetic approaches. Typically offered Fall Spring.

## **BIOL 41600 - Viruses And Viral Disease**

Credit Hours: 3.00. The objective of this course is to provide students with an introductory understanding of viruses and their impact on human health. The course will be divided into two sections. During the first section, we will discuss the cellular and organismal events that occur following virus infection, including viral entry, replication, modulation of cell biology by viral proteins, the host immune response to infection, evasion of the immune response by viruses, and resulting virus-induced disease. The emphasis of this first section will be on the general strategies used by viruses to establish and maintain infection in a population. In the second section, we will discuss in relative detail our current understanding of select important human viruses including influenza, HIV, smallpox, the herpesviruses, and tumor-causing viruses. The objective of this section will be to understand how the unique aspects of each virus's biology affect the outcome of infection with these pathogens. In addition to virus-associated diseases, we will discuss potential ways that viruses may provide symbiotic benefits to their hosts and thereby shape the course of human evolution. Throughout the course, we will emphasize societal and political aspects of virology and virus-derived technologies, including vaccine development, the use of viruses as gene therapy vectors, and the threat of viral bioterror of bio-error. Typically offered Spring.

or Free Elective - Credit Hours: 3.00

- Supporting Area Course - Credit Hours: 3.00
- Great Issue Option - Credit Hours: 3.00
- Physics Selective II - Credit Hours: 4.00
- Free Elective - Credit Hours: 3.00

## **16-17 Credits**

### **Note**

**120 semester credits required for Bachelor of Science degree.**

**2.0 Graduation GPA required for Bachelor of Science degree.**

## **Degree Requirements**

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## **Critical Course**

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## **Foreign Language Courses**

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## **Interdisciplinary Science - Concentration in Chemistry**

### **About the Program**

The interdisciplinary science major is designed to provide College of Science students with a broad base in the sciences. By combining a primary area of science study, an interdisciplinary science core, a supporting area of academic interest and the core curriculum shared by all College of Science programs, students explore how the disciplines of science come together to identify and solve scientific challenges. Students customize the major by selecting a departmental or interdepartmental primary area based in science and a supporting area that complements or enhances the primary area. This supporting area may be an approved minor from any college or school at the University or a concentration of 18 credits of courses with a unifying theme. There is a primary area representing each department in the College of Science, however, cross-disciplinary areas may be explored and added as appropriate. With the help of either a faculty member or an academic advisor, students are encouraged to petition for approval of their supporting area.

The Interdisciplinary Science Major is designed to give a student a broad base in the sciences with more depth in a Primary Area of Science and a Supporting Area, usually outside of Science. The Core courses are common across the major but the student customizes the major by selecting a departmental or interdepartmental Primary Area based in Science and a Supporting Area which may come from any college or school at the University. There is a Primary Area representing each department in the College of Science and cross-disciplinary areas will be explored and added as appropriate. Several Supporting Areas will be suggested and a student may petition for approval of others.

Students completing the interdisciplinary science major have gone on to a variety of careers - some in, and others out of, the world of science. These careers include medicine, law and other advanced-study professions, scientific sales, technical and scientific writing, computer programming and engineering.

### **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Interdisciplinary Science/Concentration in Chemistry include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

SCI-INTRD-BS  
Code- IDSC, CHEM  
120 Credits  
Fall 2016

**Departmental/Program Major Courses (87-120 credits)**

**Required Interdisciplinary Core Courses (69-79 credits)**

**Required Biology Courses (7-8 credits)**

## **BIOL 11000 - Fundamentals Of Biology I**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Principles of biology, focusing on diversity, ecology, evolution, and the development, structure, and function of organisms. Typically offered Summer Fall Spring.

## **BIOL 11100 - Fundamentals Of Biology II**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Continuation of BIOL 11000. Principles of biology, focusing on cell structure and function, molecular biology, and genetics. Typically offered Fall Spring.

**OR**

## **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

## **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

## **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

## **Required Chemistry Selective Courses (8-10 credits)**

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

## **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

## **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

## **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

## **CHM 13600 - General Chemistry Honors**

Credit Hours: 4.00. A sophisticated treatment of the principles of chemistry. Atomic structure and bonding, spectroscopy, equilibria, thermodynamics and kinetics. Advanced Placement chemistry credit (level 4 or 5) or admission to the honors program in Science or Engineering or a score of at least 70% on the CHM 11500 test-out exam. Students with a grade of C or better in CHM 13600 who need 8 hours of credit in general chemistry may request credit for CHM 11500. Typically offered Fall.

**OR**

## **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

## **Required Computing Option (3-4 credits)**

## **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

## **CS 15900 - Programming Applications For Engineers**

Credit Hours: 3.00. Fundamental principles, concepts, and methods of programming (C and MATLAB), with emphasis on applications in the physical sciences and engineering. Basic problem solving and programming techniques; fundamental algorithms and data structures; and use of programming logic in solving engineering problems. Students are expected to complete assignments in a collaborative learning environment. Typically offered Summer Fall Spring.

## **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

## **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

## **Required Earth, Atmospheric, and Planetary Science Selective Courses (3 credits)**

Select courses COULD satisfy Science Selective for core.

### **EAPS 10000 - Planet Earth**

Credit Hours: 3.00. An introduction to the Geosciences-Earth science, oceanography, atmospheric science and astronomy. The course emphasizes topics (earthquakes, volcanoes, ocean pollution, climate change, severe weather, etc.) that are of general interest and relevance, and the interconnections between various Earth processes. Typically offered Fall Spring. CTL:IPS 1730  
Earth Science

### **EAPS 10900 - The Dynamic Earth**

Credit Hours: 3.00. This course covers the formation and development of the solid earth, atmosphere, hydrosphere, and biosphere. The course studies the whole earth as a system of many interacting parts and focuses on the changes within and between these parts. This course is intended for all majors in earth and atmospheric sciences. Typically offered Fall.

### **EAPS 11100 - Physical Geology**

Credit Hours: 3.00. Geologic processes and the development of land forms. Laboratory covers the study of minerals and rocks, the interpretations of topographic and geologic maps, and field investigations. Typically offered Summer Fall Spring. CTL:  
Physical Geology

### **EAPS 22100 - Survey Of Atmospheric Science**

Credit Hours: 3.00. (NRES 23000) An introductory course for both science and nonscience students. A general study of the atmosphere, basic meteorological principles, and weather systems. Relationships of the changing atmosphere to climate ozone depletion, and other contemporary issues. Typically offered Summer Fall Spring.

### **EAPS 22500 - Science Of The Atmosphere**

Credit Hours: 3.00. An overview of the physics and dynamics of the atmosphere. Quantitative study of the energy balance of the atmosphere, condensation and precipitation processes, atmospheric motion and global circulation, severe storms, atmospheric chemistry. Contemporary issues such as human impact on climate, ozone depletion, numerical weather prediction and climate simulation, and modern measurement systems. Not available to students with credit in EAPS 22100. Intended for Science and Engineering majors only. Prior course work in calculus is required. Typically offered Spring.

## **Required Mathematics Courses (6-10 credits)**

### **MA 16010 - Applied Calculus I**

Credit Hours: 3.00. Topics include trigonometric and exponential functions; limits and differentiation, rules of differentiation, maxima, minima and optimization; curve sketching, integration, anti-derivatives, fundamental theorem of calculus. Properties of definite integrals and numerical methods. Applications to life, managerial and social sciences. Typically offered Fall Spring Summer.

## **MA 16020 - Applied Calculus II**

Credit Hours: 3.00. This course covers techniques of integration; infinite series, convergence tests; differentiation and integration of functions of several variables; maxima and minima, optimization; differential equations and initial value problems; matrices, determinants, eigenvalues and eigenvectors. Applications. Typically offered Fall Spring Summer.

**OR**

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602 Calculus - Long I

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

## **Required Physics Selective Courses (8 credits)**

### **PHYS 22000 - General Physics**

Credit Hours: 4.00. Mechanics, heat, and sound, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1751 Algebra-based Physics I

### **PHYS 22100 - General Physics**

Credit Hours: 4.00. Electricity, light, and modern physics, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1752 Algebra-based Physics II

**OR**

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

### **PHYS 25200 - Electricity And Optics Laboratory**

Credit Hours: 1.00. Selected experiments in electric fields, magnetic fields, steady-state and transient d.c. circuits, thermodynamics, and optics. Typically offered Fall Spring Summer.

**OR**

### **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving

approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

## **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

## **Required Statistics Selective Courses (3 credits)**

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

### **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

## **Required Chemistry Primary Area Courses (16-18 credits)**

## **CHM 25500 - Organic Chemistry**

Credit Hours: 3.00. A study of aliphatic and aromatic hydrocarbons and their simple derivatives in terms of (a) structure, bonding, etc.; (b) general syntheses and reactions; and (c) a logical modern rationale for fundamental phenomena as supported by reactivity orders, orientation effects, stereochemistry, and relative rates. Recommended for biology majors. Typically offered Fall Spring.

## **CHM 25501 - Organic Chemistry Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany CHM 25500, illustrating methods of separation, instrumental methods of analysis, and the more common techniques and methods for preparing various types of organic compounds. Typically offered Fall Spring.

**OR**

## **CHM 26505 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemistry. Typically offered Fall.

## **CHM 26500 - Organic Chemistry Laboratory**

Credit Hours: 2.00. Similar to CHM 26300 except that a larger number and more sophisticated organic syntheses are required. The preparations are designed not only to illustrate the classical reactions discussed in CHM 26100, but to allow for an extrapolation of the principles involved to other systems. Typically offered Fall.

**OR**

- CHM 26505 and

## **CHM 26300 - Organic Chemistry Laboratory**

Credit Hours: 1.00. Laboratory experiments designed to illustrate the lecture material of CHM 26100. Elementary laboratory techniques essential to organic chemistry are introduced, followed by the actual syntheses and purification of compounds discussed in CHM 26100. Typically offered Fall.

**OR**

## **CHM 26100 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The

syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemical engineering. If not a chemical engineering major, see CHM 26505 - Organic Chemistry. Typically offered Fall.

### **MCMP 20400 - Organic Chemistry I**

Credit Hours: 4.00. Organic chemistry; a study of the compounds of carbon on a functional group basis, with particular emphasis on those organic compounds of pharmaceutical and physiological importance; microlaboratory experiments involving the methods of purification, reactions, and synthesis of organic compounds. Typically offered Spring.

### **CHM 25600 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 25500 with various functional groups such as the carboxyl, amino, etc., and including such polyfunctional natural products as carbohydrates and peptides. Typically offered Fall Spring.

### **CHM 25601 - Organic Chemistry Laboratory**

Credit Hours: 1.00. A continuation of CHM 25501. Experiments are designed to illustrate principles discussed in CHM 25600. Typically offered Fall Spring.

**OR**

### **CHM 26605 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26505, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

### **CHM 26600 - Organic Chemistry Laboratory**

Credit Hours: 2.00. A continuation of CHM 26500. All experiments are designed to illustrate the principles discussed in CHM 26200. A major portion of the course is devoted to the methods employed in organic qualitative analysis. The student is expected to identify unknowns and mixtures and is introduced to some modern instrumental techniques. Typically offered Spring.

**OR**

CHM 26605 and

### **CHM 26400 - Organic Chemistry Laboratory**

Credit Hours: 1.00. A continuation of CHM 26300 in that the experiments are designed to illustrate principles discussed in CHM

26200. A major portion of the course is devoted to methods employed in organic qualitative analysis. The student is expected to identify several unknown compounds and mixtures. Typically offered Spring.

**OR**

### **CHM 26200 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26100, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

- CHM 26400 or

### **MCMP 20500 - Organic Chemistry II**

Credit Hours: 4.00. Continuation of MCMP 20400. Typically offered Fall.

### **CHM 24100 - Introductory Inorganic Chemistry**

Credit Hours: 4.00. Descriptive inorganic chemistry dealing in a systematic way with the elements and the structures, properties, and reactions of their compounds. Required of students majoring in chemistry. Typically offered Fall.

### **CHM 37200 - Physical Chemistry**

Credit Hours: 4.00. Principles of physical chemistry with emphasis on chemical thermodynamics and kinetics, illustrated examples from the biological sciences. Intended primarily for students in the life sciences. Typically offered Spring.

## **Required Supporting Area Courses (18 credits)**

MUST BE APPROVED BY COLLEGE

## **Other Departmental/Program Course Requirements (18-31 credits)**

- Calculus I Option (within major) - select from MA 16100 (satisfies Quantitative Reasoning for core) ♦, MA 16500 (satisfies Quantitative Reasoning for core) ♦
- Calculus Option II (within major) - select from MA 16200 (satisfies Quantitative Reasoning for core), MA 16600 (satisfies Quantitative Reasoning for core)

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and

research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00-6.00
- Laboratory Science I Option (within major) (satisfies Science Selective for core)
- Laboratory Science II Option (within major) (satisfies Science Selective for core)
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Computing Option (within major)
- Teambuilding and Collaboration Experience\* - Credit Hours: 0.00 - 4.00
- Great Issues Option - Credit Hours: 3.00
- Multidisciplinary Experience\* (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information.

## **Electives (10-33 credits)**

### **University Core Requirements**

- Human Cultures Humanities

- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

## Program Requirements

### Fall 1st Year

#### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

#### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Calculus Option I - Credit Hours: 3.00 - 5.00
- General Chemistry Selective I - Credit Hours: 4.00 - 5.00
- Biology Selective I - Credit Hours: 4.00
- Free Elective - Credit Hours: 0.00 - 1.00

### 15-18 Credits

### Spring 1st Year

- Calculus Option II - Credit Hours: 3.00 - 5.00
- Language I Option - Credit Hours: 3.00 - 4.00
- General Chemistry Selective II - Credit Hours: 4.00 - 5.00
- Biology Selective II - Credit Hours: 3.00 - 4.00
- Biology Selective II or Free Elective - Credit Hours: 0.00 - 2.00

### 15-18 Credits

## Fall 2nd Year

- Organic Chemistry I with Lab - Credit Hours: 4.00 - 5.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Physics Selective I - Credit Hours: 4.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Free Elective - Credit Hours: 1.00

## 15-17 Credits

## Spring 2nd Year

- Organic Chemistry II with Lab - Credit Hours: 4.00 - 5.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- Supporting Area Course - Credit Hours: 3.00
- Physics Selective II - Credit Hours: 4.00
- Free Elective - Credit Hours: 1.00

## 15-17 Credits

## Fall 3rd Year

- Supporting Course Area - Credit Hours: 3.00
- Supporting Course Area - Credit Hours: 3.00

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Computing Option (recommend CS 17700 meets Teambuilding & Collaboration) - Credit Hours: 3.00 - 4.00
- General Education I Option - Credit Hours: 3.00

15-16 Credits

Spring 3rd Year

### **CHM 24100 - Introductory Inorganic Chemistry**

Credit Hours: 4.00. Descriptive inorganic chemistry dealing in a systematic way with the elements and the structures, properties, and reactions of their compounds. Required of students majoring in chemistry. Typically offered Fall.

- EAPS Selective Course - Credit Hours: 3.00
- Supporting Area Course - Credit Hours: 3.00
- General Education II Option - Credit Hours: 3.00
- Technical Writing or Free Elective - Credit Hours: 3.00

15 Credits

Fall 4th Year

- Supporting Area Course - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 3.00
- General Education III option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00 - 6.00

15-16 Credits

Spring 4th Year

### **CHM 37200 - Physical Chemistry**

Credit Hours: 4.00. Principles of physical chemistry with emphasis on chemical thermodynamics and kinetics, illustrated examples from the biological sciences. Intended primarily for students in the life sciences. Typically offered Spring.

- Great Issue Option - Credit Hours: 3.00
- Supporting Area Course - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

16 Credits

## Note

**120 semester credits required for Bachelor of Science degree.**

**2.0 Graduation GPA required for Bachelor of Science degree.**

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Interdisciplinary Science - Concentration in Computer Science

### About the Program

The interdisciplinary science major is designed to provide College of Science students with a broad base in the sciences. By combining a primary area of science study, an interdisciplinary science core, a supporting area of academic interest and the core curriculum shared by all College of Science programs, students explore how the disciplines of science come together to identify and solve scientific challenges. Students customize the major by selecting a departmental or interdepartmental primary area based in science and a supporting area that complements or enhances the primary area. This supporting area may be an approved minor from any college or school at the University or a concentration of 18 credits of courses with a unifying theme. There is a primary area representing each department in the College of Science, however, cross-disciplinary areas may be explored and added as appropriate. With the help of either a faculty member or an academic advisor, students are encouraged to petition for approval of their supporting area.

The Interdisciplinary Science Major is designed to give a student a broad base in the sciences with more depth in a Primary Area of Science and a Supporting Area, usually outside of Science. The Core courses are common across the major but the student customizes the major by selecting a departmental or interdepartmental Primary Area based in Science and a Supporting Area which may come from any college or school at the University. There is a Primary Area representing each department in the College of Science and cross-disciplinary areas will be explored and added as appropriate. Several Supporting Areas will be suggested and a student may petition for approval of others.

Students completing the interdisciplinary science major have gone on to a variety of careers - some in, and others out of, the world of science. These careers include medicine, law and other advanced-study professions, scientific sales, technical and scientific writing, computer programming and engineering.

## **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Interdisciplinary Science/Concentration in Computer Science include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

SCI-INTRD-BS

Code - IDSC, CS

120 Credits

Fall 2016

### **Departmental/Program Major Courses (90-111 credits)**

#### **Required Interdisciplinary Core Courses (72-80 credits)**

#### **Required Biology Courses (7-8 credits)**

##### **BIOL 11000 - Fundamentals Of Biology I**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Principles of biology, focusing on diversity, ecology, evolution, and the development, structure, and function of organisms. Typically offered Summer Fall Spring.

##### **BIOL 11100 - Fundamentals Of Biology II**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Continuation of BIOL 11000. Principles of biology, focusing on cell structure and function, molecular biology, and genetics. Typically offered Fall Spring.

**OR**

##### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

## **Required Chemistry Selective Courses (5-10 credits)**

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

### **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary

thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

### **CHM 13600 - General Chemistry Honors**

Credit Hours: 4.00. A sophisticated treatment of the principles of chemistry. Atomic structure and bonding, spectroscopy, equilibria, thermodynamics and kinetics. Advanced Placement chemistry credit (level 4 or 5) or admission to the honors program in Science or Engineering or a score of at least 70% on the CHM 11500 test-out exam. Students with a grade of C or better in CHM 13600 who need 8 hours of credit in general chemistry may request credit for CHM 11500. Typically offered Fall.

**OR**

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

## **Required Computer Science Selective Courses (4 credits)**

### **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

## **Required Earth, Atmospheric, and Planetary Science Selective Courses (3 credits)**

Select courses COULD satisfy Science Selective for core.

### **EAPS 10000 - Planet Earth**

Credit Hours: 3.00. An introduction to the Geosciences-Earth science, oceanography, atmospheric science and astronomy. The

course emphasizes topics (earthquakes, volcanoes, ocean pollution, climate change, severe weather, etc.) that are of general interest and relevance, and the interconnections between various Earth processes. Typically offered Fall Spring. CTL:IPS 1730  
Earth Science

### **EAPS 10900 - The Dynamic Earth**

Credit Hours: 3.00. This course covers the formation and development of the solid earth, atmosphere, hydrosphere, and biosphere. The course studies the whole earth as a system of many interacting parts and focuses on the changes within and between these parts. This course is intended for all majors in earth and atmospheric sciences. Typically offered Fall.

### **EAPS 11100 - Physical Geology**

Credit Hours: 3.00. Geologic processes and the development of land forms. Laboratory covers the study of minerals and rocks, the interpretations of topographic and geologic maps, and field investigations. Typically offered Summer Fall Spring. CTL:  
Physical Geology

### **EAPS 22100 - Survey Of Atmospheric Science**

Credit Hours: 3.00. (NRES 23000) An introductory course for both science and nonscience students. A general study of the atmosphere, basic meteorological principles, and weather systems. Relationships of the changing atmosphere to climate ozone depletion, and other contemporary issues. Typically offered Summer Fall Spring.

### **EAPS 22500 - Science Of The Atmosphere**

Credit Hours: 3.00. An overview of the physics and dynamics of the atmosphere. Quantitative study of the energy balance of the atmosphere, condensation and precipitation processes, atmospheric motion and global circulation, severe storms, atmospheric chemistry. Contemporary issues such as human impact on climate, ozone depletion, numerical weather prediction and climate simulation, and modern measurement systems. Not available to students with credit in EAPS 22100. Intended for Science and Engineering majors only. Prior course work in calculus is required. Typically offered Spring.

## **Required Mathematics Courses (8-10 credits)**

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

## **Required Physics Selective Courses (8 credits)**

### **PHYS 22000 - General Physics**

Credit Hours: 4.00. Mechanics, heat, and sound, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1751  
Algebra-based Physics I

### **PHYS 22100 - General Physics**

Credit Hours: 4.00. Electricity, light, and modern physics, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1752  
Algebra-based Physics II

**OR**

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena

extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

### **PHYS 25200 - Electricity And Optics Laboratory**

Credit Hours: 1.00. Selected experiments in electric fields, magnetic fields, steady-state and transient d.c. circuits, thermodynamics, and optics. Typically offered Fall Spring Summer.

**OR**

### **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

### **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

### **Required Statistics Selective Courses (3 credits)**

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

## **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

## **Required Computer Science Primary Area Courses (16 credits)**

### **CS 18200 - Foundations Of Computer Science**

Credit Hours: 3.00. Logic and proofs; sets, functions, relations, sequences and summations; number representations; counting; fundamentals of the analysis of algorithms; graphs and trees; proof techniques; recursion; Boolean logic; finite state machines; pushdown automata; computability and undecidability. Typically offered Spring Fall.

### **CS 24000 - Programming In C**

Credit Hours: 3.00. The UNIX environment, C development cycle, data representation, operators, program structure, recursion, macros, C preprocessor, pointers and addresses, dynamic memory allocation, structures, unions, typedef, bit-fields, pointer/structure applications, UNIX file abstraction, file access, low-level I/O, concurrency. Typically offered Fall Spring.

### **CS 25000 - Computer Architecture**

Credit Hours: 4.00. Digital logic: transistors, gates, and combinatorial circuits; clocks; registers and register banks; arithmetic-logic units; data representation: big-endian and little-endian integers; ones and twos complement arithmetic; signed and unsigned values; Von-Neumann architecture and bottleneck; instruction sets; RISC and CISC designs; instruction pipelines and stalls; rearranging code; memory and address spaces; physical and virtual memory; interleaving; page tables; memory caches; bus architecture; polling and interrupts; DMA; device programming; assembly language; optimizations; parallelism; data pipelining. Typically offered Fall Spring.

## **CS 25100 - Data Structures And Algorithms**

Credit Hours: 3.00. Running time analysis of algorithms and their implementations, one-dimensional data structures, trees, heaps, additional sorting algorithms, binary search trees, hash tables, graphs, directed graphs, weighted graph algorithms, additional topics. Typically offered Fall Spring.

- CS Elective at or above 30000 level - Credit Hours: 3.00

## **Required Supporting Area Courses (18 credits)**

MUST BE APPROVED BY COLLEGE

## **Other Departmental/Program Course Requirements (18-31 credits)**

- Calculus I Option (within major) - select from MA 16100 (satisfies Quantitative Reasoning for core) ♦, MA 16500 (satisfies Quantitative Reasoning for core) ♦
- Calculus Option II (within major) - select from MA 16200 (satisfies Quantitative Reasoning for core), MA 16600 (satisfies Quantitative Reasoning for core)

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00-6.00
- Laboratory Science I Option (within major) (satisfies Science Selective for core)
- Laboratory Science II Option (within major) (satisfies Science Selective for core)
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Computing Option (within major)
- Teambuilding and Collaboration Experience\* - Credit Hours: 0.00 - 4.00
- Great Issues Option - Credit Hours: 3.00
- Multidisciplinary Experience\* (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information.

## **Electives (9-30 credits)**

### **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or click here.

### **Program Requirements**

#### **Fall 1st Year**

#### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a

one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- EAPS Selective Course - Credit Hours: 3.00
- Language I Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 0.00 - 4.00

15-18 Credits

Spring 1st Year

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series,

polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.  
CTL:IMA 1603 Calculus - Long II

## **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00 - 4.00

15-17 Credits

Fall 2nd Year

## **CS 18200 - Foundations Of Computer Science**

Credit Hours: 3.00. Logic and proofs; sets, functions, relations, sequences and summations; number representations; counting; fundamentals of the analysis of algorithms; graphs and trees; proof techniques; recursion; Boolean logic; finite state machines; pushdown automata; computability and undecidability. Typically offered Spring Fall.

## **CS 24000 - Programming In C**

Credit Hours: 3.00. The UNIX environment, C development cycle, data representation, operators, program structure, recursion, macros, C preprocessor, pointers and addresses, dynamic memory allocation, structures, unions, typedef, bit-fields, pointer/structure applications, UNIX file abstraction, file access, low-level I/O, concurrency. Typically offered Fall Spring.

- Supporting Area Course - Credit Hours: 3.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- Technical Presentation (COM 21700) - Credit Hours: 3.00

15-16 Credits

Spring 2nd Year

## **CS 25000 - Computer Architecture**

Credit Hours: 4.00. Digital logic: transistors, gates, and combinatorial circuits; clocks; registers and register banks; arithmetic-logic units; data representation: big-endian and little-endian integers; ones and twos complement arithmetic; signed and unsigned values; Von-Neumann architecture and bottleneck; instruction sets; RISC and CISC designs; instruction pipelines and stalls; rearranging code; memory and address spaces; physical and virtual memory; interleaving; page tables; memory caches; bus architecture; polling and interrupts; DMA; device programming; assembly language; optimizations; parallelism; data pipelining. Typically offered Fall Spring.

## **CS 25100 - Data Structures And Algorithms**

Credit Hours: 3.00. Running time analysis of algorithms and their implementations, one-dimensional data structures, trees, heaps, additional sorting algorithms, binary search trees, hash tables, graphs, directed graphs, weighted graph algorithms, additional topics. Typically offered Fall Spring.

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Supporting Area Course - Credit Hours: 3.00
- General Education I Option - Credit Hours: 3.00

## **16 Credits**

### **Fall 3rd Year**

- CS Elective 30000 level - Credit Hours: 3.00
- Physics Selective I - Credit Hours: 4.00
- General Chemistry Selective I - Credit Hours: 4.00 - 5.00
- General Education II Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 1.00

## **15-16 Credits**

### **Spring 3rd Year**

- Supporting Area Course - Credit Hours: 3.00
- Physics Selective II - Credit Hours: 4.00

- General Chemistry Selective II or free elective - Credit Hours: 4.00 - 5.00
- General Education III Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 1.00

## 15-16 Credits

### Fall 4th Year

- Supporting Area Course - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 3.00
- Biology Selective I - Credit Hours: 4.00
- Supporting Area Course - Credit Hours: 3.00
- Technical Writing or Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 0.00 - 2.00

## 15-18 Credits

### Spring 4th Year

- Great Issue Option - Credit Hours: 3.00
- Supporting Area Course - Credit Hours: 3.00
- Biology Selective II - Credit Hours: 3.00 - 4.00
- Biology Selective II or Free Elective - Credit Hours: 0.00 - 2.00
- Free Elective - Credit Hours: 6.00

## 15-17 Credits

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

### Note

**120 semester credits required for Bachelor of Science degree.**

**2.0 Graduation GPA required for Bachelor of Science degree.**

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## **Interdisciplinary Science - Concentration in Earth, Atmospheric, and Planetary Sciences**

### **About the Program**

The interdisciplinary science major is designed to provide College of Science students with a broad base in the sciences. By combining a primary area of science study, an interdisciplinary science core, a supporting area of academic interest and the core curriculum shared by all College of Science programs, students explore how the disciplines of science come together to identify and solve scientific challenges. Students customize the major by selecting a departmental or interdepartmental primary area based in science and a supporting area that complements or enhances the primary area. This supporting area may be an approved minor from any college or school at the University or a concentration of 18 credits of courses with a unifying theme. There is a primary area representing each department in the College of Science, however, cross-disciplinary areas may be explored and added as appropriate. With the help of either a faculty member or an academic advisor, students are encouraged to petition for approval of their supporting area.

The Interdisciplinary Science Major is designed to give a student a broad base in the sciences with more depth in a Primary Area of Science and a Supporting Area, usually outside of Science. The Core courses are common across the major but the student customizes the major by selecting a departmental or interdepartmental Primary Area based in Science and a Supporting Area which may come from any college or school at the University. There is a Primary Area representing each department in the College of Science and cross-disciplinary areas will be explored and added as appropriate. Several Supporting Areas will be suggested and a student may petition for approval of others.

Students completing the interdisciplinary science major have gone on to a variety of careers - some in, and others out of, the world of science. These careers include medicine, law and other advanced-study professions, scientific sales, technical and scientific writing, computer programming and engineering.

### **Degree Requirements and Supplemental Information.**

The full Program Requirements for 2016-17 Interdisciplinary Science/Concentration in Earth, Atmospheric, and Planetary Science include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

SCI-INTRD-BS

Code- IDSC, EAS

120 Credits

Fall 2016

## Departmental/Program Major Courses (88-110 credits)

### Required Interdisciplinary Core Courses (70-79 credits)

### Required Biology Courses (7-8 credits)

#### **BIOL 11000 - Fundamentals Of Biology I**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Principles of biology, focusing on diversity, ecology, evolution, and the development, structure, and function of organisms. Typically offered Summer Fall Spring.

#### **BIOL 11100 - Fundamentals Of Biology II**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Continuation of BIOL 11000. Principles of biology, focusing on cell structure and function, molecular biology, and genetics. Typically offered Fall Spring.

**OR**

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

#### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

#### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

## Required Chemistry Selective Courses (5-10 credits)

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

### **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

### **CHM 13600 - General Chemistry Honors**

Credit Hours: 4.00. A sophisticated treatment of the principles of chemistry. Atomic structure and bonding, spectroscopy, equilibria, thermodynamics and kinetics. Advanced Placement chemistry credit (level 4 or 5) or admission to the honors program in Science or Engineering or a score of at least 70% on the CHM 11500 test-out exam. Students with a grade of C or better in CHM 13600 who need 8 hours of credit in general chemistry may request credit for CHM 11500. Typically offered Fall.

**OR**

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are

important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

## Required Computing Option (3-4 credits)

### **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

### **CS 15900 - Programming Applications For Engineers**

Credit Hours: 3.00. Fundamental principles, concepts, and methods of programming (C and MATLAB), with emphasis on applications in the physical sciences and engineering. Basic problem solving and programming techniques; fundamental algorithms and data structures; and use of programming logic in solving engineering problems. Students are expected to complete assignments in a collaborative learning environment. Typically offered Summer Fall Spring.

### **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

### **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

## Required Earth, Atmospheric, and Planetary Science Courses (3 credits)

### **EAPS 11100 - Physical Geology**

Credit Hours: 3.00. Geologic processes and the development of land forms. Laboratory covers the study of minerals and rocks, the interpretations of topographic and geologic maps, and field investigations. Typically offered Summer Fall Spring. CTL: Physical Geology

## Required Mathematics Courses (8-10 credits)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602 Calculus - Long I

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

## Required Physics Selective Courses (8 credits)

### **PHYS 22000 - General Physics**

Credit Hours: 4.00. Mechanics, heat, and sound, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1751 Algebra-based Physics I

### **PHYS 22100 - General Physics**

Credit Hours: 4.00. Electricity, light, and modern physics, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1752 Algebra-based Physics II

**OR**

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

### **PHYS 25200 - Electricity And Optics Laboratory**

Credit Hours: 1.00. Selected experiments in electric fields, magnetic fields, steady-state and transient d.c. circuits, thermodynamics, and optics. Typically offered Fall Spring Summer.

**OR**

## **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

## **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

## **Required Statistics Courses (3 credits)**

### **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive

statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

### **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

## **Required Earth, Atmospheric, and Planetary Sciences Primary Area Courses (15 credits)**

### **EAPS 10000 - Planet Earth**

Credit Hours: 3.00. An introduction to the Geosciences-Earth science, oceanography, atmospheric science and astronomy. The course emphasizes topics (earthquakes, volcanoes, ocean pollution, climate change, severe weather, etc.) that are of general interest and relevance, and the interconnections between various Earth processes. Typically offered Fall Spring. CTL:IPS 1730 Earth Science

### **EAPS 10900 - The Dynamic Earth**

Credit Hours: 3.00. This course covers the formation and development of the solid earth, atmosphere, hydrosphere, and biosphere. The course studies the whole earth as a system of many interacting parts and focuses on the changes within and between these parts. This course is intended for all majors in earth and atmospheric sciences. Typically offered Fall.

### **EAPS 22100 - Survey Of Atmospheric Science**

Credit Hours: 3.00. (NRES 23000) An introductory course for both science and nonscience students. A general study of the atmosphere, basic meteorological principles, and weather systems. Relationships of the changing atmosphere to climate ozone depletion, and other contemporary issues. Typically offered Summer Fall Spring.

### **EAPS 22500 - Science Of The Atmosphere**

Credit Hours: 3.00. An overview of the physics and dynamics of the atmosphere. Quantitative study of the energy balance of the atmosphere, condensation and precipitation processes, atmospheric motion and global circulation, severe storms, atmospheric chemistry. Contemporary issues such as human impact on climate, ozone depletion, numerical weather prediction and climate

simulation, and modern measurement systems. Not available to students with credit in EAPS 22100. Intended for Science and Engineering majors only. Prior course work in calculus is required. Typically offered Spring.

## **EAPS 11200 - Earth Through Time**

Credit Hours: 3.00. The history of the planet Earth from its beginnings to the present. This course will explore the causes and effects of processes that have changed the Earth's surface and subsurface through time, the impacts of these changes on the evolution of life, and how scientist interpret Earth history from the geologic record. The laboratory will provide hands-on experience in interpreting various geologic and fossil records. This course may be taken on its own, or as a year-long lab series with EAPS 11100. EAPS 11100 and EAPS 11200 will fulfill the two course sequence laboratory experience outside the major department. Typically offered Spring.

- EAPS 30000 level or higher - Credit Hours: 3.00
- EAPS 30000 level or higher - Credit Hours: 3.00
- EAPS 30000 level or higher - Credit Hours: 3.00

## **Required Supporting Area Courses (18 credits)**

MUST BE APPROVED BY COLLEGE

## **Other Departmental/Program Course Requirements (18-31 credits)**

- Calculus I Option (within major) - select from MA 16100 (satisfies Quantitative Reasoning for core) ♦, MA 16500 (satisfies Quantitative Reasoning for core) ♦
- Calculus Option II (within major) - select from MA 16200 (satisfies Quantitative Reasoning for core), MA 16600 (satisfies Quantitative Reasoning for core)

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00-6.00
- Laboratory Science I Option (within major) (satisfies Science Selective for core)

- Laboratory Science II Option (within major) (satisfies Science Selective for core)
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Computing Option (within major)
- Teambuilding and Collaboration Experience\* - Credit Hours: 0.00 - 4.00
- Great Issues Option - Credit Hours: 3.00
- Multidisciplinary Experience\* (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information.

## **Electives (10-32 credits)**

### **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

### **Degree Requirements**

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

# Program Requirements

## Fall 1st Year

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Fall only course option - EAPS 10000 or EAPS 10900 or free elective - Credit Hours: 3.00 - 4.00
- Language I Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 2.00

## 15-18 Credits

## Spring 1st Year

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.

CTL:IMA 1603 Calculus - Long II

- Spring only course option of EAPS 22100 or free elective - Credit Hours: 3.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 1.00
- Physics Selective I - Credit Hours: 4.00

15-17 Credits

Fall 2nd Year

## **EAPS 11100 - Physical Geology**

Credit Hours: 3.00. Geologic processes and the development of land forms. Laboratory covers the study of minerals and rocks, the interpretations of topographic and geologic maps, and field investigations. Typically offered Summer Fall Spring. CTL:

Physical Geology

- Supporting Area Course- Credit Hours: 3.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- Physics Selective II - Credit Hours: 4.00
- General Education I Option - Credit Hours: 3.00

16-17 Credits

Spring 2nd Year

## **EAPS 11200 - Earth Through Time**

Credit Hours: 3.00. The history of the planet Earth from its beginnings to the present. This course will explore the causes and effects of processes that have changed the Earth's surface and subsurface through time, the impacts of these changes on the evolution of life, and how scientist interpret Earth history from the geologic record. The laboratory will provide hands-on experience in interpreting various geologic and fossil records. This course may be taken on its own, or as a year-long lab series with EAPS 11100. EAPS 11100 and EAPS 11200 will fulfill the two course sequence laboratory experience outside the major department. Typically offered Spring.

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Supporting Area Course - Credit Hours: 3.00
- STAT Option - Credit Hours: 3.00
- Computing Option - Credit Hours: 3.00 - 4.00

## **15-16 Credits**

### **Fall 3rd Year**

- Supporting Area Course - Credit Hours: 3.00
- General Chemistry Selective I - Credit Hours: 4.00 - 5.00
- General Education II Option - Credit Hours: 3.00
- Fall only course option EAPS 22500 or free elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## **16-17 Credits**

### **Spring 3rd Year**

- Supporting Area Course - Credit Hours: 3.00
- General Chemistry Selective II or free elective - Credit Hours: 4.00- 5.00
- General Education III Option - Credit Hours: 3.00
- EAPS 30000 level - CreditHours: 3.00
- Free Elective - Credit Hours: 3.00

## **16-17 Credits**

### **Fall 4th Year**

- Supporting Area Course - Credit Hours: 3.00

- Multidisciplinary Experience - Credit Hours: 3.00
- Biology Selective I - Credit Hours: 4.00
- EAPS 30000 level - Credit Hours: 3.00
- Technical Writing or Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 0.00 - 2.00

## 15-18 Credits

### Spring 4th Year

- Great Issue Option - Credit Hours: 3.00
- Supporting Area Course - Credit Hours: 3.00
- Biology Selective II - Credit Hours: 3.00 - 4.00
- Biology Selective II or Free Elective - Credit Hours: 0.00 - 2.00
- EAPS 30000 level - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## 15-18 Credits

### Note

**120 semester credits required for Bachelor of Science degree.**

**2.0 Graduation GPA required for Bachelor of Science degree.**

### Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

### Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

### **Interdisciplinary Science - Concentration in Mathematics**

## About the Program

The interdisciplinary science major is designed to provide College of Science students with a broad base in the sciences. By combining a primary area of science study, an interdisciplinary science core, a supporting area of academic interest and the core curriculum shared by all College of Science programs, students explore how the disciplines of science come together to identify and solve scientific challenges. Students customize the major by selecting a departmental or interdepartmental primary area based in science and a supporting area that complements or enhances the primary area. This supporting area may be an approved minor from any college or school at the University or a concentration of 18 credits of courses with a unifying theme. There is a primary area representing each department in the College of Science, however, cross-disciplinary areas may be explored and added as appropriate. With the help of either a faculty member or an academic advisor, students are encouraged to petition for approval of their supporting area.

The Interdisciplinary Science Major is designed to give a student a broad base in the sciences with more depth in a Primary Area of Science and a Supporting Area, usually outside of Science. The Core courses are common across the major but the student customizes the major by selecting a departmental or interdepartmental Primary Area based in Science and a Supporting Area which may come from any college or school at the University. There is a Primary Area representing each department in the College of Science and cross-disciplinary areas will be explored and added as appropriate. Several Supporting Areas will be suggested and a student may petition for approval of others.

Students completing the interdisciplinary science major have gone on to a variety of careers - some in, and others out of, the world of science. These careers include medicine, law and other advanced-study professions, scientific sales, technical and scientific writing, computer programming and engineering.

## **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Interdisciplinary Science/Concentration in Mathematics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

SCI-INTRD-BS

Code - IDSC, MATH

120 Credits

Fall 2016

**Departmental/Program Major Courses (89-112 credits)**

**Required Interdisciplinary Core Courses (71-81 credits)**

**Required Biology Courses (7-8 credits)**

**BIOL 11000 - Fundamentals Of Biology I**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in

agriculture and health sciences. Principles of biology, focusing on diversity, ecology, evolution, and the development, structure, and function of organisms. Typically offered Summer Fall Spring.

### **BIOL 11100 - Fundamentals Of Biology II**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Continuation of BIOL 11000. Principles of biology, focusing on cell structure and function, molecular biology, and genetics. Typically offered Fall Spring.

**OR**

### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

## **Required Chemistry Selective Courses (5-10 credits)**

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases,

liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

### **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

### **CHM 13600 - General Chemistry Honors**

Credit Hours: 4.00. A sophisticated treatment of the principles of chemistry. Atomic structure and bonding, spectroscopy, equilibria, thermodynamics and kinetics. Advanced Placement chemistry credit (level 4 or 5) or admission to the honors program in Science or Engineering or a score of at least 70% on the CHM 11500 test-out exam. Students with a grade of C or better in CHM 13600 who need 8 hours of credit in general chemistry may request credit for CHM 11500. Typically offered Fall.

OR

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

## **Required Computing Option (3-4 credits)**

### **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions,

and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

### **CS 15900 - Programming Applications For Engineers**

Credit Hours: 3.00. Fundamental principles, concepts, and methods of programming (C and MATLAB), with emphasis on applications in the physical sciences and engineering. Basic problem solving and programming techniques; fundamental algorithms and data structures; and use of programming logic in solving engineering problems. Students are expected to complete assignments in a collaborative learning environment. Typically offered Summer Fall Spring.

### **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

### **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

## **Required Earth, Atmospheric, and Planetary Science Selective Courses (3 credits)**

Select courses COULD satisfy Science Selective for core.

### **EAPS 10000 - Planet Earth**

Credit Hours: 3.00. An introduction to the Geosciences—Earth science, oceanography, atmospheric science and astronomy. The course emphasizes topics (earthquakes, volcanoes, ocean pollution, climate change, severe weather, etc.) that are of general interest and relevance, and the interconnections between various Earth processes. Typically offered Fall Spring. CTL:IPS 1730 Earth Science

### **EAPS 10900 - The Dynamic Earth**

Credit Hours: 3.00. This course covers the formation and development of the solid earth, atmosphere, hydrosphere, and biosphere. The course studies the whole earth as a system of many interacting parts and focuses on the changes within and between these parts. This course is intended for all majors in earth and atmospheric sciences. Typically offered Fall.

### **EAPS 11100 - Physical Geology**

Credit Hours: 3.00. Geologic processes and the development of land forms. Laboratory covers the study of minerals and rocks, the interpretations of topographic and geologic maps, and field investigations. Typically offered Summer Fall Spring. CTL: Physical Geology

### **EAPS 22100 - Survey Of Atmospheric Science**

Credit Hours: 3.00. (NRES 23000) An introductory course for both science and nonscience students. A general study of the atmosphere, basic meteorological principles, and weather systems. Relationships of the changing atmosphere to climate ozone depletion, and other contemporary issues. Typically offered Summer Fall Spring.

### **EAPS 22500 - Science Of The Atmosphere**

Credit Hours: 3.00. An overview of the physics and dynamics of the atmosphere. Quantitative study of the energy balance of the atmosphere, condensation and precipitation processes, atmospheric motion and global circulation, severe storms, atmospheric chemistry. Contemporary issues such as human impact on climate, ozone depletion, numerical weather prediction and climate simulation, and modern measurement systems. Not available to students with credit in EAPS 22100. Intended for Science and Engineering majors only. Prior course work in calculus is required. Typically offered Spring.

## **Required Mathematics Courses (8-10 credits)**

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course

MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.  
CTL:IMA 1603 Calculus - Long II

## **Required Physics Selective Courses (8 credits)**

### **PHYS 22000 - General Physics**

Credit Hours: 4.00. Mechanics, heat, and sound, for students not specializing in physics. Typically offered Fall Spring Summer.  
CTL:IPS 1751 Algebra-based Physics I

### **PHYS 22100 - General Physics**

Credit Hours: 4.00. Electricity, light, and modern physics, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1752 Algebra-based Physics II

**OR**

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

### **PHYS 25200 - Electricity And Optics Laboratory**

Credit Hours: 1.00. Selected experiments in electric fields, magnetic fields, steady-state and transient d.c. circuits, thermodynamics, and optics. Typically offered Fall Spring Summer.

**OR**

### **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

### **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

## **Required Statistics Selective Courses (3 credits)**

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables,

regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

### **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

## **Required Mathematics Primary Area Courses (16-17 credits)**

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

## **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

## **MA 26200 - Linear Algebra And Differential Equations**

Credit Hours: 4.00. Linear algebra, elements of differential equations. Not open to students with credit in MA 26500 or MA 26600. Typically offered Fall Spring Summer.

## **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

## **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

## **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

## **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

- MA Elective at or above 30000 level

## **Required Supporting Area Courses (18 credits)**

MUST BE APPROVED BY COLLEGE

## Other Departmental/Program Course Requirements (18-31 credits)

- Calculus I Option (within major) - select from MA 16100 (satisfies Quantitative Reasoning for core) ♦, MA 16500 (satisfies Quantitative Reasoning for core) ♦
- Calculus Option II (within major) - select from MA 16200 (satisfies Quantitative Reasoning for core), MA 16600 (satisfies Quantitative Reasoning for core)

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00-6.00
- Laboratory Science I Option (within major) (satisfies Science Selective for core)
- Laboratory Science II Option (within major) (satisfies Science Selective for core)
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Computing Option (within major)
- Teambuilding and Collaboration Experience\* - Credit Hours: 0.00 - 4.00
- Great Issues Option - Credit Hours: 3.00

- Multidisciplinary Experience\* (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00  
\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information.

## Electives (8-31 credits)

## University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

## Program Requirements

### Fall 1st Year

#### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

#### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

#### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00
- Physics Selective I - Credit Hours: 4.00
- Free Elective - Credit Hours: 1.00

15-18 Credits

Spring 1st Year

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.  
CTL:IMA 1603 Calculus - Long II

- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Physics Selective II - Credit Hours: 4.00
- Free Elective - Credit Hours: 1.00

15-17 Credits

Fall 2nd Year

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

- Supporting Area Course - Credit Hours: 3.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- EAPS Selective - Credit Hours: 3.00
- Teambuilding and Collaboration Experience - Credit Hours: 0.00
- Computing Option - Credit Hours: 3.00 - 4.00

16-18 Credits

Spring 2nd Year

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors

related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

## **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

- Supporting Area Course - Credit Hours: 3.00
- Technical Presentation (COM 21700) - Credit Hours: 3.00
- General Education I Option - Credit Hours: 3.00

15 Credits

Fall 3rd Year

## **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

## **MA 26200 - Linear Algebra And Differential Equations**

Credit Hours: 4.00. Linear algebra, elements of differential equations. Not open to students with credit in MA 26500 or MA 26600. Typically offered Fall Spring Summer.

- Supporting Area Course - Credit Hours: 3.00
- General Chemistry Selective I - Credit Hours: 4.00 - 5.00
- General Education II Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 1.00

14-16 Credits

Spring 3rd Year

- MA Elective 30000+ - Credit Hours: 3.00
- Supporting Area Course - Credit Hours: 3.00

- General Chemistry Selective II or free elective - Credit Hours: 4.00 - 5.00
- General Education III Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## 16-17 Credits

### Fall 4th Year

#### **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

#### **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

#### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

#### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

- Supporting Area Course - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 3.00
- Biology Selective I - Credit Hours: 4.00
- Technical Writing or Free Elective - Credit Hours: 3.00

## 16 Credits

### Spring 4th Year

- Great Issue Option - Credit Hours: 3.00
- Supporting Area Course - Credit Hours: 3.00
- Biology Selective II - Credit Hours: 3.00 - 4.00
- Biology Selective II or Free Elective - Credit Hours: 2.00
- Free Elective - Credit Hours: 3.00

## 14-15 Credits

## Note

**120 semester credits required for Bachelor of Science degree.**

**2.0 Graduation GPA required for Bachelor of Science degree.**

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Interdisciplinary Science - Concentration in Physics

## About the Program

The interdisciplinary science major is designed to provide College of Science students with a broad base in the sciences. By combining a primary area of science study, an interdisciplinary science core, a supporting area of academic interest and the core curriculum shared by all College of Science programs, students explore how the disciplines of science come together to identify and solve scientific challenges. Students customize the major by selecting a departmental or interdepartmental primary area based in science and a supporting area that complements or enhances the primary area. This supporting area may be an approved minor from any college or school at the University or a concentration of 18 credits of courses with a unifying theme. There is a primary area representing each department in the College of Science, however, cross-disciplinary areas may be explored and added as appropriate. With the help of either a faculty member or an academic advisor, students are encouraged to petition for approval of their supporting area.

The Interdisciplinary Science Major is designed to give a student a broad base in the sciences with more depth in a Primary Area of Science and a Supporting Area, usually outside of Science. The Core courses are common across the major but the student customizes the major by selecting a departmental or interdepartmental Primary Area based in Science and a Supporting Area which may come from any college or school at the University. There is a Primary Area representing each department in the College of Science and cross-disciplinary areas will be explored and added as appropriate. Several Supporting Areas will be suggested and a student may petition for approval of others.

Students completing the interdisciplinary science major have gone on to a variety of careers - some in, and others out of, the world of science. These careers include medicine, law and other advanced-study professions, scientific sales, technical and scientific writing, computer programming and engineering.

## **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Interdisciplinary Science/Concentration in Physics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

SCI-INTRD-BS

Code- IDSC, PHYS

120 Credits

Fall 2016

### **Departmental/Program Major Courses (86-109 credits)**

### **Required Interdisciplinary Core Courses (68-78 credits)**

### **Required Biology Courses (7-8 credits)**

#### **BIOL 11000 - Fundamentals Of Biology I**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Principles of biology, focusing on diversity, ecology, evolution, and the development, structure, and function of organisms. Typically offered Summer Fall Spring.

#### **BIOL 11100 - Fundamentals Of Biology II**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Continuation of BIOL 11000. Principles of biology, focusing on cell structure and function, molecular biology, and genetics. Typically offered Fall Spring.

OR

### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

## **Required Chemistry Selective Courses (5-10 credits)**

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

## **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

## **CHM 13600 - General Chemistry Honors**

Credit Hours: 4.00. A sophisticated treatment of the principles of chemistry. Atomic structure and bonding, spectroscopy, equilibria, thermodynamics and kinetics. Advanced Placement chemistry credit (level 4 or 5) or admission to the honors program in Science or Engineering or a score of at least 70% on the CHM 11500 test-out exam. Students with a grade of C or better in CHM 13600 who need 8 hours of credit in general chemistry may request credit for CHM 11500. Typically offered Fall.

**OR**

## **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

## **Required Computing Option (3-4 credits)**

### **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

### **CS 15900 - Programming Applications For Engineers**

Credit Hours: 3.00. Fundamental principles, concepts, and methods of programming (C and MATLAB), with emphasis on applications in the physical sciences and engineering. Basic problem solving and programming techniques; fundamental

algorithms and data structures; and use of programming logic in solving engineering problems. Students are expected to complete assignments in a collaborative learning environment. Typically offered Summer Fall Spring.

### **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

### **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

## **Required Earth, Atmospheric, and Planetary Science Selective Courses (3 credits)**

Select courses COULD satisfy Science Selective for core.

### **EAPS 10000 - Planet Earth**

Credit Hours: 3.00. An introduction to the Geosciences-Earth science, oceanography, atmospheric science and astronomy. The course emphasizes topics (earthquakes, volcanoes, ocean pollution, climate change, severe weather, etc.) that are of general interest and relevance, and the interconnections between various Earth processes. Typically offered Fall Spring. CTL:IPS 1730 Earth Science

### **EAPS 10900 - The Dynamic Earth**

Credit Hours: 3.00. This course covers the formation and development of the solid earth, atmosphere, hydrosphere, and biosphere. The course studies the whole earth as a system of many interacting parts and focuses on the changes within and between these parts. This course is intended for all majors in earth and atmospheric sciences. Typically offered Fall.

### **EAPS 11100 - Physical Geology**

Credit Hours: 3.00. Geologic processes and the development of land forms. Laboratory covers the study of minerals and rocks,

the interpretations of topographic and geologic maps, and field investigations. Typically offered Summer Fall Spring. CTL: Physical Geology

### **EAPS 22100 - Survey Of Atmospheric Science**

Credit Hours: 3.00. (NRES 23000) An introductory course for both science and nonscience students. A general study of the atmosphere, basic meteorological principles, and weather systems. Relationships of the changing atmosphere to climate ozone depletion, and other contemporary issues. Typically offered Summer Fall Spring.

### **EAPS 22500 - Science Of The Atmosphere**

Credit Hours: 3.00. An overview of the physics and dynamics of the atmosphere. Quantitative study of the energy balance of the atmosphere, condensation and precipitation processes, atmospheric motion and global circulation, severe storms, atmospheric chemistry. Contemporary issues such as human impact on climate, ozone depletion, numerical weather prediction and climate simulation, and modern measurement systems. Not available to students with credit in EAPS 22100. Intended for Science and Engineering majors only. Prior course work in calculus is required. Typically offered Spring.

## **Required Mathematics Courses (8-10 credits)**

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

## **Required Physics Courses (8 credits)**

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

### **PHYS 25200 - Electricity And Optics Laboratory**

Credit Hours: 1.00. Selected experiments in electric fields, magnetic fields, steady-state and transient d.c. circuits, thermodynamics, and optics. Typically offered Fall Spring Summer.

## **Required Statistics Courses (3 credits)**

### **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

### **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

## **Required Physics Primary Area Courses (13-14 credits)**

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100. Typically offered Fall Spring Summer.

## **PHYS 34200 - Modern Physics**

Credit Hours: 3.00. A survey of basic concepts and phenomena in atomic, nuclear, and solid-state physics. Typically offered Fall.

## **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure; elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

- PHYS Elective at or above 30000 level - Credit Hours: 3.00
- PHYS Elective at or above 30000 level - Credit Hours: 3.00

## **Required Supporting Area Courses (18 credits)**

MUST BE APPROVED BY COLLEGE.

## **Other Departmental/Program Course Requirements (18-31 credits)**

- Calculus I Option (within major) - select from MA 16100 (satisfies Quantitative Reasoning for core) ♦, MA 16500 (satisfies Quantitative Reasoning for core) ♦
- Calculus Option II (within major) - select from MA 16200 (satisfies Quantitative Reasoning for core), MA 16600 (satisfies Quantitative Reasoning for core)

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00-6.00
- Laboratory Science I Option (within major) (satisfies Science Selective for core)

- Laboratory Science II Option (within major) (satisfies Science Selective for core)
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Computing Option (within major)
- Teambuilding and Collaboration Experience\* - Credit Hours: 0.00 - 4.00
- Great Issues Option - Credit Hours: 3.00
- Multidisciplinary Experience\* (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information.

## **Electives (11-34 credits)**

### **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

### **Program Requirements**

#### **Fall 1st Year**

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

## **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

- Language I Selective - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 1.00

15-18 Credits

## Spring 1st Year

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

### **PHYS 25200 - Electricity And Optics Laboratory**

Credit Hours: 1.00. Selected experiments in electric fields, magnetic fields, steady-state and transient d.c. circuits, thermodynamics, and optics. Typically offered Fall Spring Summer.

- Language II Selective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 1.00

15-17 Credits

## Fall 2nd Year

## **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

## **PHYS 34200 - Modern Physics**

Credit Hours: 3.00. A survey of basic concepts and phenomena in atomic, nuclear, and solid-state physics. Typically offered Fall.

## **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure; elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

- Language Selective III - Credit Hours: 3.00 - 4.00
- Supporting Area Course - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## **15-17 Credits**

### **Spring 2nd Year**

- PHYS 30000+ - Credit Hours: 3.00
- Supporting Area Course - Credit Hours: 3.00
- General Education I Selective - Credit Hours: 3.00
- Computing Selective - Credit Hours: 3.00 - 4.00

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Teambuilding Experience - Credit Hours: 0.00

## **15-16 Credits**

### **Fall 3rd Year**

- PHYS 30000+ Credit Hours: 3.00
- Supporting Area Course - Credit Hours: 3.00
- General Chemistry Selective I - Credit Hours: 4.00 - 5.00
- General Education II Selective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## 16-17 Credits

### Spring 3rd Year

- EAPS Selective - Credit Hours: 3.00
- Supporting Area Course - Credit Hours: 3.00
- General Chemistry Selective II or free elective - Credit Hours: 4.00 - 5.00
- General Education III Selective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## 16-17 Credits

### Fall 4th Year

- STAT Selective - Credit Hours: 3.00
- Supporting Area Course - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 0.00 - 4.00
- Biology Selective I - Credit Hours: 4.00
- Technical Writing or Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

## 15-18 Credits

### Spring 4th Year

- Great Issue Selective - Credit Hours: 3.00
- Supporting Area Course - Credit Hours: 3.00
- Biology Selective II - Credit Hours: 3.00 - 4.00
- Biology Selective II or Free Elective - Credit Hours: 0.00 - 2.00
- Free Elective - Credit Hours: 6.00

## 15-18 Credits

## Note

**120 semester credits required for Bachelor of Science degree.**

**2.0 Graduation GPA required for Bachelor of Science degree.**

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Interdisciplinary Science - Concentration in Statistics

### About the Program

The interdisciplinary science major is designed to provide College of Science students with a broad base in the sciences. By combining a primary area of science study, an interdisciplinary science core, a supporting area of academic interest and the core curriculum shared by all College of Science programs, students explore how the disciplines of science come together to identify and solve scientific challenges. Students customize the major by selecting a departmental or interdepartmental primary area based in science and a supporting area that complements or enhances the primary area. This supporting area may be an approved minor from any college or school at the University or a concentration of 18 credits of courses with a unifying theme. There is a primary area representing each department in the College of Science, however, cross-disciplinary areas may be explored and added as appropriate. With the help of either a faculty member or an academic advisor, students are encouraged to petition for approval of their supporting area.

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Students completing the interdisciplinary science major have gone on to a variety of careers - some in, and others out of, the world of science. These careers include medicine, law and other advanced-study professions, scientific sales, technical and scientific writing, computer programming and engineering.

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Interdisciplinary Science/Concentration in Statistics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

SCI-INTRD-BS

Code-IDSC, STAT

120 Credits

Fall 2016

## Departmental/Program Major Courses (85-108 credits)

### Required Interdisciplinary Core Courses (67-77 credits)

### Required Biology Courses (7-8 credits)

#### **BIOL 11000 - Fundamentals Of Biology I**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Principles of biology, focusing on diversity, ecology, evolution, and the development, structure, and function of organisms. Typically offered Summer Fall Spring.

#### **BIOL 11100 - Fundamentals Of Biology II**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Continuation of BIOL 11000. Principles of biology, focusing on cell structure and function, molecular biology, and genetics. Typically offered Fall Spring.

**OR**

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

#### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

## **Required Chemistry Selective Courses (5-10 credits)**

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

### **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

### **CHM 13600 - General Chemistry Honors**

Credit Hours: 4.00. A sophisticated treatment of the principles of chemistry. Atomic structure and bonding, spectroscopy, equilibria, thermodynamics and kinetics. Advanced Placement chemistry credit (level 4 or 5) or admission to the honors program in Science or Engineering or a score of at least 70% on the CHM 11500 test-out exam. Students with a grade of C or better in CHM 13600 who need 8 hours of credit in general chemistry may request credit for CHM 11500. Typically offered Fall.

OR

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

## Required Computing Option (3-4 credits)

### **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

### **CS 15900 - Programming Applications For Engineers**

Credit Hours: 3.00. Fundamental principles, concepts, and methods of programming (C and MATLAB), with emphasis on applications in the physical sciences and engineering. Basic problem solving and programming techniques; fundamental algorithms and data structures; and use of programming logic in solving engineering problems. Students are expected to complete assignments in a collaborative learning environment. Typically offered Summer Fall Spring.

### **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

## **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

## **Required Earth, Atmospheric, and Planetary Science Selective Courses (3 credits)**

Select courses COULD satisfy Science Selective for core.

### **EAPS 10000 - Planet Earth**

Credit Hours: 3.00. An introduction to the Geosciences—Earth science, oceanography, atmospheric science and astronomy. The course emphasizes topics (earthquakes, volcanoes, ocean pollution, climate change, severe weather, etc.) that are of general interest and relevance, and the interconnections between various Earth processes. Typically offered Fall Spring. CTL:IPS 1730 Earth Science

### **EAPS 10900 - The Dynamic Earth**

Credit Hours: 3.00. This course covers the formation and development of the solid earth, atmosphere, hydrosphere, and biosphere. The course studies the whole earth as a system of many interacting parts and focuses on the changes within and between these parts. This course is intended for all majors in earth and atmospheric sciences. Typically offered Fall.

### **EAPS 11100 - Physical Geology**

Credit Hours: 3.00. Geologic processes and the development of land forms. Laboratory covers the study of minerals and rocks, the interpretations of topographic and geologic maps, and field investigations. Typically offered Summer Fall Spring. CTL: Physical Geology

### **EAPS 22100 - Survey Of Atmospheric Science**

Credit Hours: 3.00. (NRES 23000) An introductory course for both science and nonscience students. A general study of the atmosphere, basic meteorological principles, and weather systems. Relationships of the changing atmosphere to climate ozone depletion, and other contemporary issues. Typically offered Summer Fall Spring.

## **EAPS 22500 - Science Of The Atmosphere**

Credit Hours: 3.00. An overview of the physics and dynamics of the atmosphere. Quantitative study of the energy balance of the atmosphere, condensation and precipitation processes, atmospheric motion and global circulation, severe storms, atmospheric chemistry. Contemporary issues such as human impact on climate, ozone depletion, numerical weather prediction and climate simulation, and modern measurement systems. Not available to students with credit in EAPS 22100. Intended for Science and Engineering majors only. Prior course work in calculus is required. Typically offered Spring.

## **Required Mathematics Courses (8-10 credits)**

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602 Calculus - Long I

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

## **Required Physics Selective Courses (8 credits)**

## **PHYS 22000 - General Physics**

Credit Hours: 4.00. Mechanics, heat, and sound, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1751 Algebra-based Physics I

## **PHYS 22100 - General Physics**

Credit Hours: 4.00. Electricity, light, and modern physics, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1752 Algebra-based Physics II

**OR**

## **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

## **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

## **PHYS 25200 - Electricity And Optics Laboratory**

Credit Hours: 1.00. Selected experiments in electric fields, magnetic fields, steady-state and transient d.c. circuits, thermodynamics, and optics. Typically offered Fall Spring Summer.

**OR**

## **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

## **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

## **Required Statistics Selective Courses (3 credits)**

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

### **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

## Required Statistics Primary Area Courses (12-13 credits)

### **STAT 22500 - Introduction To Probability Models**

Credit Hours: 3.00. An introduction to basic probability. Emphasis is placed on formulation of models and applications. Probability calculus, standard distributions, random variables, and moments. Credit cannot be given for more than one of STAT 22500, STAT 31100, or STAT 41600. Typically offered Summer Fall Spring.

### **STAT 31100 - Introductory Probability**

Credit Hours: 3.00. Formulation of probability problems, discrete and continuous random variables, expectation, standard distributions, applications to statistical problems, and problems in the physical sciences. Credit cannot be given for more than one of STAT 22500, 31100, or STAT 41600. Prerequisite: two semesters of college calculus. Typically offered Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

### **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

### **STAT 51300 - Statistical Quality Control**

Credit Hours: 3.00. A strong background in control charts including adaptations, acceptance sampling for attributes and variables data, standard acceptance plans, sequential analysis, statistics of combinations, moments and probability distributions, applications. Offered in alternate years. Typically offered Fall Spring.

### **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2n$ ,  $3n$ ,  $2m \times 3n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

- STAT 51300 or STAT 51400
- NOTE: STAT 51300 and STAT 51400 can only be taken one time each to meet primary area course requirements.

## **Required Supporting Area Courses (18 credits)**

MUST BE APPROVED BY COLLEGE.

## **Other Departmental/Program Course Requirements (18-31 credits)**

- Calculus I Option (within major) - select from MA 16100 (satisfies Quantitative Reasoning for core) ♦, MA 16500 (satisfies Quantitative Reasoning for core) ♦
- Calculus Option II (within major) - select from MA 16200 (satisfies Quantitative Reasoning for core), MA 16600 (satisfies Quantitative Reasoning for core)

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and

research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00-6.00
- Laboratory Science I Option (within major) (satisfies Science Selective for core)
- Laboratory Science II Option (within major) (satisfies Science Selective for core)
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Computing Option (within major)
- Teambuilding and Collaboration Experience\* - Credit Hours: 0.00 - 4.00
- Great Issues Option - Credit Hours: 3.00
- Multidisciplinary Experience\* (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information.

## **Electives (2-35 credits)**

## **University Core Requirements**

- Human Cultures Humanities

- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

## Program Requirements

### Fall 1st Year

#### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

#### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

#### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

#### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00

- Physics Selective I - Credit Hours: 4.00
- Free Elective - Credit Hours: 1.00

15-18 Credits

Spring 1st Year

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Physics Selective II - Credit Hours: 4.00
- Free Elective - Credit Hours: 1.00

15-17 Credits

Fall 2nd Year

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics.

Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

### **STAT 51300 - Statistical Quality Control**

Credit Hours: 3.00. A strong background in control charts including adaptations, acceptance sampling for attributes and variables data, standard acceptance plans, sequential analysis, statistics of combinations, moments and probability distributions, applications. Offered in alternate years. Typically offered Fall Spring.

### **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2n$ ,  $3n$ ,  $2m \times 3n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

- Supporting Area Course - Credit Hours: 3.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- EAPS Selective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15-17 Credits

Spring 2nd Year

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Supporting Area Course - Credit Hours: 3.00
- Computing Option - Credit Hours: 3.00 - 4.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- General Education I Option - Credit Hours: 3.00
- Teambuilding and Collaboration Experience - Credit Hours: 3.00 - 4.00

## 15-16 Credits

### Fall 3rd Year

#### **STAT 22500 - Introduction To Probability Models**

Credit Hours: 3.00. An introduction to basic probability. Emphasis is placed on formulation of models and applications. Probability calculus, standard distributions, random variables, and moments. Credit cannot be given for more than one of STAT 22500, STAT 31100, or STAT 41600. Typically offered Summer Fall Spring.

#### **STAT 31100 - Introductory Probability**

Credit Hours: 3.00. Formulation of probability problems, discrete and continuous random variables, expectation, standard distributions, applications to statistical problems, and problems in the physical sciences. Credit cannot be given for more than one of STAT 22500, 31100, or STAT 41600. Prerequisite: two semesters of college calculus. Typically offered Spring.

#### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

#### **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

- Supporting Area Course - Credit Hours: 3.00
- General Chemistry Selective I - Credit Hours: 4.00 - 5.00
- General Education II Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

15-16 Credits

Spring 3rd Year

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

### **STAT 51300 - Statistical Quality Control**

Credit Hours: 3.00. A strong background in control charts including adaptations, acceptance sampling for attributes and variables data, standard acceptance plans, sequential analysis, statistics of combinations, moments and probability distributions, applications. Offered in alternate years. Typically offered Fall Spring.

### **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2n$ ,  $3n$ ,  $2m \times 3n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

- Supporting Area Course - Credit Hours: 3.00
- General Chemistry Selective II or Free Elective - Credit Hours: 4.00 - 5.00
- General Education III Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

16-17 Credits

Fall 4th Year

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and

random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

- Supporting Area Course - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 3.00
- Biology Selective I - Credit Hours: 4.00
- Technical Writing or Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 0.00 -2.00

15-18 Credits

Spring 4th Year

### **STAT 51300 - Statistical Quality Control**

Credit Hours: 3.00. A strong background in control charts including adaptations, acceptance sampling for attributes and variables data, standard acceptance plans, sequential analysis, statistics of combinations, moments and probability distributions, applications. Offered in alternate years. Typically offered Fall Spring.

### **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2n$ ,  $3n$ ,  $2m \times 3n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

- Supporting Area Course - Credit Hours: 3.00
- Great Issue Option - Credit Hours: 3.00
- Biology Selective II - Credit Hours: 3.00 - 4.00
- Biology Selective II or Free Elective - Credit Hours: 0.00 - 2.00
- Free Elective - Credit Hours - 3.00

15-18 Credits

## **Degree Requirements**

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## **Critical Course**

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Science Education - Biology Concentration, BS

### About the Program

A College of Science degree in Science Education prepares future science teachers for certification at the middle and high school level. Students customize their focus by selecting a major area of study in biology, chemistry, physics, or earth and space science within an interdisciplinary science framework. The Science Education degree ensures students are thoroughly educated in their content discipline and modern theories of learning and education. Graduates are in high demand as STEM education and careers continue to grow in demand.

#### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Science Education - Biology include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

SCI-EDU-BS  
Code: SIED Conc: BIED  
122 Credits

### Departmental/Program Major Courses

#### Required Science Education Core Courses (24-30 Credits)

#### Required Chemistry Selective Courses (4-5 credits)

#### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students

majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **CHM 12300 - General Chemistry For Engineers I**

Credit Hours: 4.00. Stoichiometry; atomic structure and chemical bonding; gases, liquids, and solids; thermochemistry; chemical kinetics; solutions; aqueous solution chemistry; introduction to equilibria. Although intended for students in the Schools of Engineering and this course will also satisfy requirements for chemistry majors in place of CHM 11500 or CHM 12500. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

**OR**

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

### **Required Computing Option (3-4 credits)**

#### **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

#### **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

## **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

## **Required Calculus Selective Courses (6-10 credits)**

### **MA 16010 - Applied Calculus I**

Credit Hours: 3.00. Topics include trigonometric and exponential functions; limits and differentiation, rules of differentiation, maxima, minima and optimization; curve sketching, integration, anti-derivatives, fundamental theorem of calculus. Properties of definite integrals and numerical methods. Applications to life, managerial and social sciences. Typically offered Fall Spring Summer.

### **MA 16020 - Applied Calculus II**

Credit Hours: 3.00. This course covers techniques of integration; infinite series, convergence tests; differentiation and integration of functions of several variables; maxima and minima, optimization; differential equations and initial value problems; matrices, determinants, eigenvalues and eigenvectors. Applications. Typically offered Fall Spring Summer.

**OR**

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

## **Required Physics Selective Courses (8 credits)**

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753  
Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

## **PHYS 25200 - Electricity And Optics Laboratory**

Credit Hours: 1.00. Selected experiments in electric fields, magnetic fields, steady-state and transient d.c. circuits, thermodynamics, and optics. Typically offered Fall Spring Summer.

## **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

## **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

## **Required Statistics Selective Courses (3 credits)**

### **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

## Educational Program Course Requirements (36 credits)

Professional Education GPA Average  $\geq 3.00$  - no grade lower than C-

### **EDCI 27000 - Introduction To Educational Technology And Computing**

Credit Hours: 3.00. Addresses fundamentals of educational technology, including the integration of instructional design, media, computers and related technologies within the classroom setting. Typically offered Fall Spring Summer.

### **EDCI 20500 - Exploring Teaching As A Career**

Credit Hours: 3.00. Students will become familiar with the work of teachers and begin to develop their educational philosophies through examining what it means to teach and to learn and the nature and purpose of schools. Students will critically evaluate teaching as their chosen profession. This course includes a required weekly field-based experience in an elementary, middle, or high school classroom. Typically offered Fall Spring.

### **EDCI 28500 - Multiculturalism And Education**

Credit Hours: 3.00. This course integrates an understanding of multiculturalism with principles of democratic education. Historical, sociological, cultural, political, philosophical, and pedagogical foundations of multiculturalism are explored and related to issues of pedagogy in a pluralistic society. This course is taken concurrently with EDCI 20500, which includes a school-based Theory into Practice field experience. Some discussion topics and assignments will be based on that field experience. It is highly recommended that EDCI 27000 be taken with or before taking this course. Typically offered Fall Spring Summer.

### **EDPS 23500 - Learning And Motivation**

Credit Hours: 3.00. Introduction to concepts of learning and motivation in educational contexts (i.e., Educational Psychology). Influence of development, culture, and individual differences on learning and motivation. Uses of assessment and technology in promoting learning and motivation. A field-based experiential component is included. Typically offered Fall Spring Summer.

### **EDPS 26500 - The Inclusive Classroom**

Credit Hours: 3.00. Characteristics of students with special needs/talents; strategies for helping students learn and develop in general educational settings. Emphasis placed upon research evidence, case studies, problem-based learning, and development of a plan for an inclusive classroom. A field-based component is included. Typically offered Spring Summer Fall.

### **EDST 20010 - Educational Policies And Laws**

Credit Hours: 1.00 to 3.00. The interactive course will provide an understanding of the history of schooling in the United States. A special emphasis will be placed on reviewing historical and contemporary educational policies and educational laws as each subject is critical to understanding social, historical, and cultural issues in the United States. Focus will also be on contemporary applications of historical ideas in the classroom and in school systems. Typically offered Fall Spring.

### **EDPS 32700 - Assessment Literacy**

Credit Hours: 1.00 to 3.00. Evaluating the impact of instruction on student performance is one of the most important skills for an educator. Effective teachers ask themselves, "How do I know if students are truly learning? Are they meeting educational objectives in the content area?" Using well-chosen assessment approaches, teachers can address these questions. In this course, students will acquire assessment literacy: the ability to gather accurate information about student achievement, and use that information to make instructional decisions that will improve learning. Course activities will focus on assessment tasks relevant to P- 12 classroom settings. Typically offered Fall Spring.

### **EDCI 30900 - Reading In Middle And Secondary Schools: Methods And Problems**

Credit Hours: 3.00. For prospective teachers at junior and senior high schools. An overview of reading processes, fundamentals of reading instruction, factors that influence the ability to read text materials, strategies and materials for identifying and reducing reading problems, school resources, and programs for normal and deficient readers. Concurrent enrollment with program-specified methods course. Typically offered Fall Spring.

### **EDCI 42400 - The Teaching Of Earth And Physical Science In The Secondary Schools**

Credit Hours: 3.00. The methods and materials needed for the teaching of chemistry, earth-space, physics, and general science in the secondary schools, including field experience. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. May be taken for two credits (no field experience) by students who are enrolled in another methods course with field experience. Typically offered Fall.

### **EDCI 42100 - The Teaching Of Biology In Secondary Schools**

Credit Hours: 3.00. The rationale, objectives, methods, and materials of teaching biology and life science in junior and senior high schools. Extensive use of multimedia resources in planning specifically for the student teaching experience. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Fall.

### **EDCI 42800 - Teaching Science In The Middle And Junior High School**

Credit Hours: 2.00. Designed to prepare preservice teachers to teach science in the middle and junior high school (grades 5-9). No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Spring.

## **EDCI 49800 - Supervised Teaching**

Credit Hours: 8.00 to 16.00. Teaching full time in a school classroom under the supervision of the teacher in charge of the class and a University supervisor. Completion of education methods courses and other Gate requirements for the major area and admittance to teacher education required. Typically offered Fall Spring Summer.

## **Other Departmental /Program Course Requirements (21-27)**

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* - (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 3.00 - 4.00
- Language II Option\* - (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 3.00 - 4.00
- Technical Writing Option and Technical Presenting Option - (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- General Education I Option - (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education II Option - (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00

## **Biology Concentration (37-38 credits)**

Overall GPA for Biology Concentration courses with the Departmental/Program Major Courses must be  $\geq 2.5$

## **CHM 25500 - Organic Chemistry**

Credit Hours: 3.00. A study of aliphatic and aromatic hydrocarbons and their simple derivatives in terms of (a) structure, bonding, etc.; (b) general syntheses and reactions; and (c) a logical modern rationale for fundamental phenomena as supported by reactivity orders, orientation effects, stereochemistry, and relative rates. Recommended for biology majors. Typically offered Fall Spring.

### **CHM 25501 - Organic Chemistry Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany CHM 25500, illustrating methods of separation, instrumental methods of analysis, and the more common techniques and methods for preparing various types of organic compounds. Typically offered Fall Spring.

or

### **CHM 26505 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemistry. Typically offered Fall.

### **CHM 26300 - Organic Chemistry Laboratory**

Credit Hours: 1.00. Laboratory experiments designed to illustrate the lecture material of CHM 26100. Elementary laboratory techniques essential to organic chemistry are introduced, followed by the actual syntheses and purification of compounds discussed in CHM 26100. Typically offered Fall.

### **CHM 25600 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 25500 with various functional groups such as the carboxyl, amino, etc., and including such polyfunctional natural products as carbohydrates and peptides. Typically offered Fall Spring.

### **CHM 25601 - Organic Chemistry Laboratory**

Credit Hours: 1.00. A continuation of CHM 25501. Experiments are designed to illustrate principles discussed in CHM 25600. Typically offered Fall Spring.

or

### **CHM 26605 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26505, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

### **CHM 26400 - Organic Chemistry Laboratory**

Credit Hours: 1.00. A continuation of CHM 26300 in that the experiments are designed to illustrate principles discussed in CHM 26200. A major portion of the course is devoted to methods employed in organic qualitative analysis. The student is expected to identify several unknown compounds and mixtures. Typically offered Spring.

### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

### **BIOL 14501 - First Year Biology Laboratory With Neuro Research Project**

Credit Hours: 2.00. This laboratory course has been designed under the goals of the Center for Authentic Science Practice in Education (CASPiE) which aims to expose students to novel research as a means to teach them laboratory science. This course is designed to engage students in authentic research while acquiring necessary skills and concepts to be successful as a biology major. Our topic is Neuroanatomy of Auditory Pathways. We will begin with a series of skills and knowledge building weeks and then transition into independent research projects that culminate in a public presentation of the data in a poster session. In this course, students will learn the fundamentals in neurobiology as well as use sophisticated analysis and instrumentation to answer a research question. Critical thinking in experimental design as well as interpretation and communication of data will be stressed. The goals for this course are to gain a foundation in basic biological measurements and techniques, hone the analytical skills, appreciate the excitement of scientific discovery, and have fun along the way. Permission of department required. Typically offered Fall.

### **IT 22600 - Biotechnology Laboratory I**

Credit Hours: 2.00. Focuses on nucleic acid manipulation. Modules include, making a eukaryotic library, identifying clones, sub-cloning into a bacterial expression vector and verification of the clone's identity by restriction analysis and DNA sequencing. Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures. Typically offered Summer Fall Spring.

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

## **Biology Selectives (10 credits)**

LINK, One course may satisfy multiple requirements - MUST BE A TOTAL OF 10 CREDITS

- Intermediate Biology Selective - Credit Hours: 3.00 - 4.00
- Group A Selective - Credit Hours: 2.00 - 3.00
- Group B Selective - Credit Hours: 2.00 - 3.00
- 500 Level Biology Selective - Credit Hours: 3.00 - 4.00
- Biology Lab Selective - Credit Hours: 2.00 - 4.00

## **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science

- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

#### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

#### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Calc I Option\*<sup>^</sup> (MA 16010) - Credit Hours: 3.00
- Language I Option - Credit Hours: 3.00 \*

15 Credits

### Spring 2nd Year

## **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

- Organic CHM I Selective^ - Credit Hours: 4.00
- Calc II Option\*^ (MA 16020) - Credit Hours: 3.00
- Language II Option - Credit Hours: 3.00

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

16-17 Credits

Fall 2nd Year

## **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

## **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

- Organic CHM II Selective^ - Credit Hours: 4.00
- General Education I Option - Credit Hours: 3.00
- Technical Writing and Technical Presenting (COM 21700\*) - Credit Hours: 3.00

15 Credits

Spring 2nd Year

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

### **EDST 20010 - Educational Policies And Laws**

Credit Hours: 1.00 to 3.00. The interactive course will provide an understanding of the history of schooling in the United States. A special emphasis will be placed on reviewing historical and contemporary educational policies and educational laws as each subject is critical to understanding social, historical, and cultural issues in the United States. Focus will also be on contemporary applications of historical ideas in the classroom and in school systems. Typically offered Fall Spring.

### **EDCI 27000 - Introduction To Educational Technology And Computing**

Credit Hours: 3.00. Addresses fundamentals of educational technology, including the integration of instructional design, media, computers and related technologies within the classroom setting. Typically offered Fall Spring Summer.

- General Education II Option - Credit Hours: 3.00

14 Credits

## Fall 3rd Year

- Intermediate Biology Selective^ - Credit Hours: 3.00 - 4.00
- Group A Selective^ - Credit Hours: 2.00 - 3.00
- PHYS I Selective^ - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00

### **EDCI 20500 - Exploring Teaching As A Career**

Credit Hours: 3.00. Students will become familiar with the work of teachers and begin to develop their educational philosophies through examining what it means to teach and to learn and the nature and purpose of schools. Students will critically evaluate teaching as their chosen profession. This course includes a required weekly field-based experience in an elementary, middle, or high school classroom. Typically offered Fall Spring.

### **EDCI 28500 - Multiculturalism And Education**

Credit Hours: 3.00. This course integrates an understanding of multiculturalism with principles of democratic education. Historical, sociological, cultural, political, philosophical, and pedagogical foundations of multiculturalism are explored and related to issues of pedagogy in a pluralistic society. This course is taken concurrently with EDCI 20500, which includes a school-based Theory into Practice field experience. Some discussion topics and assignments will be based on that field experience. It is highly recommended that EDCI 27000 be taken with or before taking this course. Typically offered Fall Spring Summer.

18-20 Credits

## Spring 3rd Year

- Group B Selective^ - Credit Hours: 3.00
- PHYS II Selective^ - Credit Hours: 4.00
- CS Option^ - Credit Hours: 3.00 - 4.00

### **EDPS 23500 - Learning And Motivation**

Credit Hours: 3.00. Introduction to concepts of learning and motivation in educational contexts (i.e., Educational Psychology). Influence of development, culture, and individual differences on learning and motivation. Uses of assessment and technology in promoting learning and motivation. A field-based experiential component is included. Typically offered Fall Spring Summer.

### **EDPS 26500 - The Inclusive Classroom**

Credit Hours: 3.00. Characteristics of students with special needs/talents; strategies for helping students learn and develop in

general educational settings. Emphasis placed upon research evidence, case studies, problem-based learning, and development of a plan for an inclusive classroom. A field-based component is included. Typically offered Spring Summer Fall.

## 16-17 Credits

### Fall 4th Year

- Biology Lab Selective(s)^ - Credit Hours: 2.00 - 4.00

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- 500 Level Biology Selective^ - Credit Hours: 3.00 - 4.00

### **EDCI 42100 - The Teaching Of Biology In Secondary Schools**

Credit Hours: 3.00. The rationale, objectives, methods, and materials of teaching biology and life science in junior and senior high schools. Extensive use of multimedia resources in planning specifically for the student teaching experience. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Fall.

### **EDPS 32700 - Assessment Literacy**

Credit Hours: 1.00 to 3.00. Evaluating the impact of instruction on student performance is one of the most important skills for an educator. Effective teachers ask themselves, "How do I know if students are truly learning? Are they meeting educational objectives in the content area?" Using well-chosen assessment approaches, teachers can address these questions. In this course, students will acquire assessment literacy: the ability to gather accurate information about student achievement, and use that information to make instructional decisions that will improve learning. Course activities will focus on assessment tasks relevant to P- 12 classroom settings. Typically offered Fall Spring.

## 13-16 Credits

### Spring 4th Year

### **EDCI 42800 - Teaching Science In The Middle And Junior High School**

Credit Hours: 2.00. Designed to prepare preservice teachers to teach science in the middle and junior high school (grades 5-9). No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Spring.

## **EDCI 30900 - Reading In Middle And Secondary Schools: Methods And Problems**

Credit Hours: 3.00. For prospective teachers at junior and senior high schools. An overview of reading processes, fundamentals of reading instruction, factors that influence the ability to read text materials, strategies and materials for identifying and reducing reading problems, school resources, and programs for normal and deficient readers. Concurrent enrollment with program-specified methods course. Typically offered Fall Spring.

## **EDCI 49800 - Supervised Teaching**

Credit Hours: 8.00 to 16.00. Teaching full time in a school classroom under the supervision of the teacher in charge of the class and a University supervisor. Completion of education methods courses and other Gate requirements for the major area and admittance to teacher education required. Typically offered Fall Spring Summer.

15 Credits

## **Note**

*Note: This degree is intended to give students many options. Students need to consult with a College of Science Academic Advisor regarding requirements.*

\*Satisfies a University Core Requirement

122 semester credits required for Bachelor of Science degree.

2.0 average in BIOL courses required to graduate.

2.5 average in Biology concentration ^ courses required to graduate

3.0 average in Professional Education courses required to graduate (No grade below a C-)

## **Degree Requirements**

The student is ultimately responsible for knowing and completing all degree requirements.

Degree Works is knowledge source for specific requirements and completion

## **Foreign Language Courses**

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Science Education - Chemistry Concentration, BS

### About the Program

A College of Science degree in Science Education prepares future science teachers for certification at the middle and high school level. Students customize their focus by selecting a major area of study in biology, chemistry, physics, or earth and space science within an interdisciplinary science framework. The Science Education degree ensures students are thoroughly educated in their content discipline and modern theories of learning and education. Graduates are in high demand as STEM education and careers continue to grow in demand.

#### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Science Education - Chemistry include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

SCI-EDU-BS  
Code: SIED Conc: CHED  
131 Credits

### Departmental/Program Major Courses

#### Required Science Education Core Courses (24-30 Credits)

#### Required Chemistry Selective Courses (4-5 credits)

#### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students

majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **CHM 12300 - General Chemistry For Engineers I**

Credit Hours: 4.00. Stoichiometry; atomic structure and chemical bonding; gases, liquids, and solids; thermochemistry; chemical kinetics; solutions; aqueous solution chemistry; introduction to equilibria. Although intended for students in the Schools of Engineering and this course will also satisfy requirements for chemistry majors in place of CHM 11500 or CHM 12500. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

**OR**

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

### **Required Computing Option (3-4 credits)**

#### **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

#### **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

## **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

## **Required Calculus Selective Courses (6-10 credits)**

### **MA 16010 - Applied Calculus I**

Credit Hours: 3.00. Topics include trigonometric and exponential functions; limits and differentiation, rules of differentiation, maxima, minima and optimization; curve sketching, integration, anti-derivatives, fundamental theorem of calculus. Properties of definite integrals and numerical methods. Applications to life, managerial and social sciences. Typically offered Fall Spring Summer.

### **MA 16020 - Applied Calculus II**

Credit Hours: 3.00. This course covers techniques of integration; infinite series, convergence tests; differentiation and integration of functions of several variables; maxima and minima, optimization; differential equations and initial value problems; matrices, determinants, eigenvalues and eigenvectors. Applications. Typically offered Fall Spring Summer.

**OR**

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

## **Required Physics Selective Courses (8 credits)**

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753  
Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

## **PHYS 25200 - Electricity And Optics Laboratory**

Credit Hours: 1.00. Selected experiments in electric fields, magnetic fields, steady-state and transient d.c. circuits, thermodynamics, and optics. Typically offered Fall Spring Summer.

## **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

## **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

## **Required Statistics Selective Courses (3 credits)**

### **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

## Educational Program Course Requirements (36 credits)

Professional Education GPA Average  $\geq$  3.00 - no grade lower than C-

### **EDCI 27000 - Introduction To Educational Technology And Computing**

Credit Hours: 3.00. Addresses fundamentals of educational technology, including the integration of instructional design, media, computers and related technologies within the classroom setting. Typically offered Fall Spring Summer.

### **EDCI 20500 - Exploring Teaching As A Career**

Credit Hours: 3.00. Students will become familiar with the work of teachers and begin to develop their educational philosophies through examining what it means to teach and to learn and the nature and purpose of schools. Students will critically evaluate teaching as their chosen profession. This course includes a required weekly field-based experience in an elementary, middle, or high school classroom. Typically offered Fall Spring.

### **EDCI 28500 - Multiculturalism And Education**

Credit Hours: 3.00. This course integrates an understanding of multiculturalism with principles of democratic education. Historical, sociological, cultural, political, philosophical, and pedagogical foundations of multiculturalism are explored and related to issues of pedagogy in a pluralistic society. This course is taken concurrently with EDCI 20500, which includes a school-based Theory into Practice field experience. Some discussion topics and assignments will be based on that field experience. It is highly recommended that EDCI 27000 be taken with or before taking this course. Typically offered Fall Spring Summer.

### **EDPS 23500 - Learning And Motivation**

Credit Hours: 3.00. Introduction to concepts of learning and motivation in educational contexts (i.e., Educational Psychology). Influence of development, culture, and individual differences on learning and motivation. Uses of assessment and technology in promoting learning and motivation. A field-based experiential component is included. Typically offered Fall Spring Summer.

### **EDPS 26500 - The Inclusive Classroom**

Credit Hours: 3.00. Characteristics of students with special needs/talents; strategies for helping students learn and develop in general educational settings. Emphasis placed upon research evidence, case studies, problem-based learning, and development of a plan for an inclusive classroom. A field-based component is included. Typically offered Spring Summer Fall.

### **EDST 20010 - Educational Policies And Laws**

Credit Hours: 1.00 to 3.00. The interactive course will provide an understanding of the history of schooling in the United States. A special emphasis will be placed on reviewing historical and contemporary educational policies and educational laws as each subject is critical to understanding social, historical, and cultural issues in the United States. Focus will also be on contemporary applications of historical ideas in the classroom and in school systems. Typically offered Fall Spring.

### **EDPS 32700 - Assessment Literacy**

Credit Hours: 1.00 to 3.00. Evaluating the impact of instruction on student performance is one of the most important skills for an educator. Effective teachers ask themselves, "How do I know if students are truly learning? Are they meeting educational objectives in the content area?" Using well-chosen assessment approaches, teachers can address these questions. In this course, students will acquire assessment literacy: the ability to gather accurate information about student achievement, and use that information to make instructional decisions that will improve learning. Course activities will focus on assessment tasks relevant to P- 12 classroom settings. Typically offered Fall Spring.

### **EDCI 30900 - Reading In Middle And Secondary Schools: Methods And Problems**

Credit Hours: 3.00. For prospective teachers at junior and senior high schools. An overview of reading processes, fundamentals of reading instruction, factors that influence the ability to read text materials, strategies and materials for identifying and reducing reading problems, school resources, and programs for normal and deficient readers. Concurrent enrollment with program-specified methods course. Typically offered Fall Spring.

### **EDCI 42400 - The Teaching Of Earth And Physical Science In The Secondary Schools**

Credit Hours: 3.00. The methods and materials needed for the teaching of chemistry, earth-space, physics, and general science in the secondary schools, including field experience. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. May be taken for two credits (no field experience) by students who are enrolled in another methods course with field experience. Typically offered Fall.

### **EDCI 42100 - The Teaching Of Biology In Secondary Schools**

Credit Hours: 3.00. The rationale, objectives, methods, and materials of teaching biology and life science in junior and senior high schools. Extensive use of multimedia resources in planning specifically for the student teaching experience. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Fall.

### **EDCI 42800 - Teaching Science In The Middle And Junior High School**

Credit Hours: 2.00. Designed to prepare preservice teachers to teach science in the middle and junior high school (grades 5-9). No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Spring.

## **EDCI 49800 - Supervised Teaching**

Credit Hours: 8.00 to 16.00. Teaching full time in a school classroom under the supervision of the teacher in charge of the class and a University supervisor. Completion of education methods courses and other Gate requirements for the major area and admittance to teacher education required. Typically offered Fall Spring Summer.

## **Other Departmental /Program Course Requirements (25-28)**

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* - (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 3.00 - 4.00
- Language II Option\* - (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 3.00 - 4.00
- Technical Writing Option and Technical Presenting Option - (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- General Education I Option - (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education II Option - (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- Science, Technology & Society for University Core - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00

## **CHM 19400 - Freshman Chemistry Orientation**

Credit Hours: 1.00. Designed to provide incoming chemistry majors with the academic, survival, and computational skills to make a successful transition from high school to college. Discussion of opportunities within the chemistry department including degree options, co-op program, undergraduate research, careers in chemistry, use of spreadsheet software, graphing packages, and drawing programs for chemical structures. Attendance and performance on assigned projects are the basis of the assigned grades. Typically offered Fall Spring.

## **Chemistry Concentration (39-40 credits)**

Overall GPA for Chemistry Concentration courses (courses denoted \*: all courses required, but only one course is calculated into GPA) with the Departmental/Program Major Courses must be  $\geq 2.5$

### **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

### **CHM 13600 - General Chemistry Honors**

Credit Hours: 4.00. A sophisticated treatment of the principles of chemistry. Atomic structure and bonding, spectroscopy, equilibria, thermodynamics and kinetics. Advanced Placement chemistry credit (level 4 or 5) or admission to the honors program in Science or Engineering or a score of at least 70% on the CHM 11500 test-out exam. Students with a grade of C or better in CHM 13600 who need 8 hours of credit in general chemistry may request credit for CHM 11500. Typically offered Fall.

### **CHM 26505 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemistry. Typically offered Fall.

### **CHM 26100 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemical engineering. If not a chemical engineering major, see CHM 26505 - Organic Chemistry. Typically offered Fall.

### **CHM 26500 - Organic Chemistry Laboratory**

Credit Hours: 2.00. Similar to CHM 26300 except that a larger number and more sophisticated organic syntheses are required. The preparations are designed not only to illustrate the classical reactions discussed in CHM 26100, but to allow for an extrapolation of the principles involved to other systems. Typically offered Fall.

### **CHM 26300 - Organic Chemistry Laboratory**

Credit Hours: 1.00. Laboratory experiments designed to illustrate the lecture material of CHM 26100. Elementary laboratory techniques essential to organic chemistry are introduced, followed by the actual syntheses and purification of compounds discussed in CHM 26100. Typically offered Fall.

### **CHM 26700 - Organic Chemistry Laboratory Honors**

Credit Hours: 2.00. Laboratory experiments designed to accompany the lecture material of CHM 26100, but at an advanced level. Modern instrumentation is introduced to supplement the usual elementary laboratory techniques of organic chemistry. Multistep syntheses are employed to illustrate and supplement the reactions discussed in CHM 26100. Typically offered Fall.

### **CHM 26605 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26505, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

### **CHM 26200 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26100, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

### **CHM 26600 - Organic Chemistry Laboratory**

Credit Hours: 2.00. A continuation of CHM 26500. All experiments are designed to illustrate the principles discussed in CHM

26200. A major portion of the course is devoted to the methods employed in organic qualitative analysis. The student is expected to identify unknowns and mixtures and is introduced to some modern instrumental techniques. Typically offered Spring.

### **CHM 26400 - Organic Chemistry Laboratory**

Credit Hours: 1.00. A continuation of CHM 26300 in that the experiments are designed to illustrate principles discussed in CHM 26200. A major portion of the course is devoted to methods employed in organic qualitative analysis. The student is expected to identify several unknown compounds and mixtures. Typically offered Spring.

### **CHM 26800 - Organic Chemistry Laboratory Honors**

Credit Hours: 2.00. A continuation of CHM 26700. Experiments, more sophisticated than those in CHM 26600, are designed to illustrate and extend the concepts presented in CHM 26200. A major portion of the course is devoted to organic qualitative analysis. The student is expected to identify unknown compounds by classical methods as well as by the use of modern instrumentation like infrared gas chromatography and nuclear magnetic resonance. Typically offered Spring.

### **CHM 29400 - Sophomore Chemistry Seminar**

Credit Hours: 1.00. Discussion of undergraduate research opportunities, upper-division courses, career opportunities, laboratory safety, use of the library and chemical information, and topics of current interest in chemistry. Required of sophomores majoring in any chemistry curriculum. Typically offered Fall.

### **CHM 32100 - Analytical Chemistry I**

Credit Hours: 4.00. Quantitative measurements on complex chemical systems that show matrix effects or require isolation of a component prior to its determination; general approaches to quantitative problems at the trace level; critical comparisons of competitive procedures with emphasis on principles of separation processes, including chromatography; recognition and evaluation of possible sources of error; approaches for optimizing conditions so as to minimize time and/or effort required to attain prescribed levels of accuracy and precision. Required of students majoring in chemistry. Typically offered Fall.

### **CHM 32300 - Analytical Chemistry I Honors**

Credit Hours: 4.00. Open to students in the chemistry honors program. Topical coverage similar to CHM 32100. Laboratory will include a group of core experiments plus special experiments designed by students and staff to study original problems related to analytical chemistry. Typically offered Fall.

### **CHM 24100 - Introductory Inorganic Chemistry**

Credit Hours: 4.00. Descriptive inorganic chemistry dealing in a systematic way with the elements and the structures, properties, and reactions of their compounds. Required of students majoring in chemistry. Typically offered Fall.

## **CHM 34200 - Inorganic Chemistry**

Credit Hours: 3.00. Interpretation and correlation of the reactions and properties of inorganic compounds in terms of their electronic and molecular structures. A survey of the preparations and reactivities of important compounds of the representative elements, with an emphasis on group trends. The elementary chemistry of the transition metals, including magnetic and spectral properties of coordination compounds. Typically offered Spring.

## **CHM 37300 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of matter. Properties of gases, liquids, and solids; equations of state; thermodynamics; energy, heat, and work; entropy; spontaneity and equilibrium; chemical potential; chemical equilibrium; phase diagrams; colligative properties. Typically offered Summer Fall.

## **CHM 37400 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of molecules. Wave properties of matter; quantum mechanics of translation, rotation, and vibration; atomic structure; molecular orbitals; quantum states; statistical mechanics; chemical kinetics; collision theory; transition state theory. Typically offered Spring.

## **CHM 33300 - Principles Of Biochemistry**

Credit Hours: 3.00. Structure and function of biologically important molecules. Intended for students in life sciences. Typically offered Fall Spring.

## **CHM 53300 - Introductory Biochemistry**

Credit Hours: 3.00. A rigorous one-semester introduction to biochemistry. Typically offered Fall.

## **BCHM 56100 - General Biochemistry I**

Credit Hours: 3.00. This course provides upper-division undergraduate and graduate students with basic understanding of biochemical and structural properties of amino acids, nucleic acids, lipids, and carbohydrates. This course allows students to connect the relationship between structure and function of biomolecules. In addition, students learn to understand enzyme properties, enzyme mechanism of action, and enzyme regulation. Typically offered Fall.

## **Physical Chemistry Laboratory (2 credits)**

## **CHM 37301 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37300. Typically offered Fall.

## **CHM 37401 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37400. Typically offered Spring.

or

## **CHM 37600 - Physical Chemistry Laboratory**

Credit Hours: 2.00. Laboratory portion of CHM 37300 and CHM 37400. Typically offered Fall Spring.

## **Electives (0-7 credits)**

## **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society
- Written Communication
- Oral Communication
- Quantitative Reasoning

## **Program Requirements**

### **Fall 1st Year**

- Chemistry I (CHM 12500\*<sup>^</sup> recommended) - Credit Hours: 5.00
- \*<sup>^</sup> Calc I Option - Credit Hours: 5.00

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

### **CHM 19400 - Freshman Chemistry Orientation**

Credit Hours: 1.00. Designed to provide incoming chemistry majors with the academic, survival, and computational skills to make a successful transition from high school to college. Discussion of opportunities within the chemistry department including degree options, co-op program, undergraduate research, careers in chemistry, use of spreadsheet software, graphing packages, and drawing programs for chemical structures. Attendance and performance on assigned projects are the basis of the assigned grades. Typically offered Fall Spring.

### **EDCI 27000 - Introduction To Educational Technology And Computing**

Credit Hours: 3.00. Addresses fundamentals of educational technology, including the integration of instructional design, media, computers and related technologies within the classroom setting. Typically offered Fall Spring Summer.

18 Credits

### **Spring 1st Year**

- Chemistry II (CHM 12600^ recommended) - Credit Hours: 5.00
- ^ Calc II Option - Credit Hours: 5.00
- Technical Writing/Technical Presentation (COM 21700\* recommended) - Credit Hours: 3.00

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

17 Credits

## Fall 2nd Year

### **CHM 26505 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemistry. Typically offered Fall.

### **CHM 26100 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemical engineering. If not a chemical engineering major, see CHM 26505 - Organic Chemistry. Typically offered Fall.

### **CHM 26300 - Organic Chemistry Laboratory**

Credit Hours: 1.00. Laboratory experiments designed to illustrate the lecture material of CHM 26100. Elementary laboratory techniques essential to organic chemistry are introduced, followed by the actual syntheses and purification of compounds discussed in CHM 26100. Typically offered Fall.

- ^ Calc III Option - Credit Hours: 4.00

### **EDCI 20500 - Exploring Teaching As A Career**

Credit Hours: 3.00. Students will become familiar with the work of teachers and begin to develop their educational philosophies through examining what it means to teach and to learn and the nature and purpose of schools. Students will critically evaluate teaching as their chosen profession. This course includes a required weekly field-based experience in an elementary, middle, or high school classroom. Typically offered Fall Spring.

### **EDCI 28500 - Multiculturalism And Education**

Credit Hours: 3.00. This course integrates an understanding of multiculturalism with principles of democratic education. Historical, sociological, cultural, political, philosophical, and pedagogical foundations of multiculturalism are explored and related to issues of pedagogy in a pluralistic society. This course is taken concurrently with EDCI 20500, which includes a school-based Theory into Practice field experience. Some discussion topics and assignments will be based on that field experience. It is highly recommended that EDCI 27000 be taken with or before taking this course. Typically offered Fall Spring Summer.

## **CHM 29400 - Sophomore Chemistry Seminar**

Credit Hours: 1.00. Discussion of undergraduate research opportunities, upper-division courses, career opportunities, laboratory safety, use of the library and chemical information, and topics of current interest in chemistry. Required of sophomores majoring in any chemistry curriculum. Typically offered Fall.

15 Credits

Spring 2nd Year

## **CHM 26605 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26505, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

## **CHM 26200 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26100, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

## **CHM 26400 - Organic Chemistry Laboratory**

Credit Hours: 1.00. A continuation of CHM 26300 in that the experiments are designed to illustrate principles discussed in CHM 26200. A major portion of the course is devoted to methods employed in organic qualitative analysis. The student is expected to identify several unknown compounds and mixtures. Typically offered Spring.

## **CHM 26600 - Organic Chemistry Laboratory**

Credit Hours: 2.00. A continuation of CHM 26500. All experiments are designed to illustrate the principles discussed in CHM 26200. A major portion of the course is devoted to the methods employed in organic qualitative analysis. The student is expected to identify unknowns and mixtures and is introduced to some modern instrumental techniques. Typically offered Spring.

## **CHM 26800 - Organic Chemistry Laboratory Honors**

Credit Hours: 2.00. A continuation of CHM 26700. Experiments, more sophisticated than those in CHM 26600, are designed to illustrate and extend the concepts presented in CHM 26200. A major portion of the course is devoted to organic qualitative analysis. The student is expected to identify unknown compounds by classical methods as well as by the use of modern instrumentation like infrared gas chromatography and nuclear magnetic resonance. Typically offered Spring.

### **CHM 24100 - Introductory Inorganic Chemistry**

Credit Hours: 4.00. Descriptive inorganic chemistry dealing in a systematic way with the elements and the structures, properties, and reactions of their compounds. Required of students majoring in chemistry. Typically offered Fall.

- Physics Option (PHYS 27200^ recommended) - Credit Hours: 4.00

### **EDST 20010 - Educational Policies And Laws**

Credit Hours: 1.00 to 3.00. The interactive course will provide an understanding of the history of schooling in the United States. A special emphasis will be placed on reviewing historical and contemporary educational policies and educational laws as each subject is critical to understanding social, historical, and cultural issues in the United States. Focus will also be on contemporary applications of historical ideas in the classroom and in school systems. Typically offered Fall Spring.

- Language I Option - Credit Hours: 3.00 \*

16 Credits

Fall 3rd Year

### **CHM 37300 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of matter. Properties of gases, liquids, and solids; equations of state; thermodynamics; energy, heat, and work; entropy; spontaneity and equilibrium; chemical potential; chemical equilibrium; phase diagrams; colligative properties. Typically offered Summer Fall.

### **CHM 37301 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37300. Typically offered Fall.

### **EDPS 23500 - Learning And Motivation**

Credit Hours: 3.00. Introduction to concepts of learning and motivation in educational contexts (i.e., Educational Psychology).

Influence of development, culture, and individual differences on learning and motivation. Uses of assessment and technology in promoting learning and motivation. A field-based experiential component is included. Typically offered Fall Spring Summer.

### **EDPS 26500 - The Inclusive Classroom**

Credit Hours: 3.00. Characteristics of students with special needs/talents; strategies for helping students learn and develop in general educational settings. Emphasis placed upon research evidence, case studies, problem-based learning, and development of a plan for an inclusive classroom. A field-based component is included. Typically offered Spring Summer Fall.

### **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

- General Education I Option - Credit Hours: 3.00

16 Credits

Spring 3rd Year

### **CHM 34200 - Inorganic Chemistry**

Credit Hours: 3.00. Interpretation and correlation of the reactions and properties of inorganic compounds in terms of their electronic and molecular structures. A survey of the preparations and reactivities of important compounds of the representative elements, with an emphasis on group trends. The elementary chemistry of the transition metals, including magnetic and spectral properties of coordination compounds. Typically offered Spring.

### **CHM 37400 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of molecules. Wave properties of matter; quantum mechanics of translation, rotation, and vibration; atomic structure; molecular orbitals; quantum states; statistical mechanics; chemical kinetics; collision theory; transition state theory. Typically offered Spring.

### **CHM 37401 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37400. Typically offered Spring.

- General Education II Option - Credit Hours: 3.00
- Language II Option - Credit Hours: 3.00
- Science, Technology, & Society - Credit Hours: 3.00 \*

## **EDPS 32700 - Assessment Literacy**

Credit Hours: 1.00 to 3.00. Evaluating the impact of instruction on student performance is one of the most important skills for an educator. Effective teachers ask themselves, "How do I know if students are truly learning? Are they meeting educational objectives in the content area?" Using well-chosen assessment approaches, teachers can address these questions. In this course, students will acquire assessment literacy: the ability to gather accurate information about student achievement, and use that information to make instructional decisions that will improve learning. Course activities will focus on assessment tasks relevant to P- 12 classroom settings. Typically offered Fall Spring.

18 Credits

Fall 4th Year

## **CHM 32100 - Analytical Chemistry I**

Credit Hours: 4.00. Quantitative measurements on complex chemical systems that show matrix effects or require isolation of a component prior to its determination; general approaches to quantitative problems at the trace level; critical comparisons of competitive procedures with emphasis on principles of separation processes, including chromatography; recognition and evaluation of possible sources of error; approaches for optimizing conditions so as to minimize time and/or effort required to attain prescribed levels of accuracy and precision. Required of students majoring in chemistry. Typically offered Fall.

## **CHM 32300 - Analytical Chemistry I Honors**

Credit Hours: 4.00. Open to students in the chemistry honors program. Topical coverage similar to CHM 32100. Laboratory will include a group of core experiments plus special experiments designed by students and staff to study original problems related to analytical chemistry. Typically offered Fall.

## **CHM 33300 - Principles Of Biochemistry**

Credit Hours: 3.00. Structure and function of biologically important molecules. Intended for students in life sciences. Typically offered Fall Spring.

## **CHM 53300 - Introductory Biochemistry**

Credit Hours: 3.00. A rigorous one-semester introduction to biochemistry. Typically offered Fall.

## **BCHM 56100 - General Biochemistry I**

Credit Hours: 3.00. This course provides upper-division undergraduate and graduate students with basic understanding of biochemical and structural properties of amino acids, nucleic acids, lipids, and carbohydrates. This course allows students to connect the relationship between structure and function of biomolecules. In addition, students learn to understand enzyme properties, enzyme mechanism of action, and enzyme regulation. Typically offered Fall.

## **EDCI 42400 - The Teaching Of Earth And Physical Science In The Secondary Schools**

Credit Hours: 3.00. The methods and materials needed for the teaching of chemistry, earth-space, physics, and general science in the secondary schools, including field experience. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. May be taken for two credits (no field experience) by students who are enrolled in another methods course with field experience. Typically offered Fall.

- Computing Option - Credit Hours: 3.00 - 4.00
- Great Issues Option - Credit Hours: 3.00

16-17 Credits

Spring 4th Year

## **EDCI 42800 - Teaching Science In The Middle And Junior High School**

Credit Hours: 2.00. Designed to prepare preservice teachers to teach science in the middle and junior high school (grades 5-9). No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Spring.

## **EDCI 30900 - Reading In Middle And Secondary Schools: Methods And Problems**

Credit Hours: 3.00. For prospective teachers at junior and senior high schools. An overview of reading processes, fundamentals of reading instruction, factors that influence the ability to read text materials, strategies and materials for identifying and reducing reading problems, school resources, and programs for normal and deficient readers. Concurrent enrollment with program-specified methods course. Typically offered Fall Spring.

## **EDCI 49800 - Supervised Teaching**

Credit Hours: 8.00 to 16.00. Teaching full time in a school classroom under the supervision of the teacher in charge of the class and a University supervisor. Completion of education methods courses and other Gate requirements for the major area and admittance to teacher education required. Typically offered Fall Spring Summer.

15 Credits

### **Note**

*Note: This degree is intended to give students many options. Students need to consult with a College of Science Academic Advisor regarding requirements.*

\*Satisfies a University Core Requirement

131 semester credits (minimum) required for Bachelor of Science degree.

2.0 average in CHM courses required to graduate.

2.5 average in CHM concentration ^ courses required to graduate

3.0 average in Professional Education courses required to graduate (No grade below a C-)

### **Degree Requirements**

The student is ultimately responsible for knowing and completing all degree requirements.

Degree Works is knowledge source for specific requirements and completion

### **Foreign Language Courses**

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

### **Critical Course**

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## **Science Education - Earth Space Science Concentration, BS**

# About the Program

A College of Science degree in Science Education prepares future science teachers for certification at the middle and high school level. Students customize their focus by selecting a major area of study in biology, chemistry, physics, or earth and space science within an interdisciplinary science framework. The Science Education degree ensures students are thoroughly educated in their content discipline and modern theories of learning and education. Graduates are in high demand as STEM education and careers continue to grow in demand.

## Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Science Education - Earth Space Science include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

SCI-EDU-BS  
Code: SIED Conc: ESSE  
129 Credits

## Departmental/Program Major Courses

### Required Science Education Core Courses (24-30 Credits)

### Required Chemistry Selective Courses (4-5 credits)

#### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

#### **CHM 12300 - General Chemistry For Engineers I**

Credit Hours: 4.00. Stoichiometry; atomic structure and chemical bonding; gases, liquids, and solids; thermochemistry; chemical kinetics; solutions; aqueous solution chemistry; introduction to equilibria. Although intended for students in the Schools of Engineering and this course will also satisfy requirements for chemistry majors in place of CHM 11500 or CHM 12500. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

#### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

**OR**

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

### **Required Computing Option (3-4 credits)**

#### **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

#### **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

#### **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses.

Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

## Required Calculus Selective Courses (6-10 credits)

### **MA 16010 - Applied Calculus I**

Credit Hours: 3.00. Topics include trigonometric and exponential functions; limits and differentiation, rules of differentiation, maxima, minima and optimization; curve sketching, integration, anti-derivatives, fundamental theorem of calculus. Properties of definite integrals and numerical methods. Applications to life, managerial and social sciences. Typically offered Fall Spring Summer.

### **MA 16020 - Applied Calculus II**

Credit Hours: 3.00. This course covers techniques of integration; infinite series, convergence tests; differentiation and integration of functions of several variables; maxima and minima, optimization; differential equations and initial value problems; matrices, determinants, eigenvalues and eigenvectors. Applications. Typically offered Fall Spring Summer.

**OR**

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

## **Required Physics Selective Courses (8 credits)**

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

### **PHYS 25200 - Electricity And Optics Laboratory**

Credit Hours: 1.00. Selected experiments in electric fields, magnetic fields, steady-state and transient d.c. circuits, thermodynamics, and optics. Typically offered Fall Spring Summer.

### **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag

and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

## **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

## **Required Statistics Selective Courses (3 credits)**

### **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

## **Educational Program Course Requirements (36 credits)**

Professional Education GPA Average  $\geq 3.00$  - no grade lower than C-

### **EDCI 27000 - Introduction To Educational Technology And Computing**

Credit Hours: 3.00. Addresses fundamentals of educational technology, including the integration of instructional design, media, computers and related technologies within the classroom setting. Typically offered Fall Spring Summer.

### **EDCI 20500 - Exploring Teaching As A Career**

Credit Hours: 3.00. Students will become familiar with the work of teachers and begin to develop their educational philosophies through examining what it means to teach and to learn and the nature and purpose of schools. Students will critically evaluate teaching as their chosen profession. This course includes a required weekly field-based experience in an elementary, middle, or high school classroom. Typically offered Fall Spring.

### **EDCI 28500 - Multiculturalism And Education**

Credit Hours: 3.00. This course integrates an understanding of multiculturalism with principles of democratic education. Historical, sociological, cultural, political, philosophical, and pedagogical foundations of multiculturalism are explored and related to issues of pedagogy in a pluralistic society. This course is taken concurrently with EDCI 20500, which includes a school-based Theory into Practice field experience. Some discussion topics and assignments will be based on that field experience. It is highly recommended that EDCI 27000 be taken with or before taking this course. Typically offered Fall Spring Summer.

### **EDPS 23500 - Learning And Motivation**

Credit Hours: 3.00. Introduction to concepts of learning and motivation in educational contexts (i.e., Educational Psychology). Influence of development, culture, and individual differences on learning and motivation. Uses of assessment and technology in promoting learning and motivation. A field-based experiential component is included. Typically offered Fall Spring Summer.

### **EDPS 26500 - The Inclusive Classroom**

Credit Hours: 3.00. Characteristics of students with special needs/talents; strategies for helping students learn and develop in general educational settings. Emphasis placed upon research evidence, case studies, problem-based learning, and development of a plan for an inclusive classroom. A field-based component is included. Typically offered Spring Summer Fall.

### **EDST 20010 - Educational Policies And Laws**

Credit Hours: 1.00 to 3.00. The interactive course will provide an understanding of the history of schooling in the United States. A special emphasis will be placed on reviewing historical and contemporary educational policies and educational laws as each subject is critical to understanding social, historical, and cultural issues in the United States. Focus will also be on contemporary applications of historical ideas in the classroom and in school systems. Typically offered Fall Spring.

### **EDPS 32700 - Assessment Literacy**

Credit Hours: 1.00 to 3.00. Evaluating the impact of instruction on student performance is one of the most important skills for an educator. Effective teachers ask themselves, "How do I know if students are truly learning? Are they meeting educational objectives in the content area?" Using well-chosen assessment approaches, teachers can address these questions. In this course, students will acquire assessment literacy: the ability to gather accurate information about student achievement, and use that information to make instructional decisions that will improve learning. Course activities will focus on assessment tasks relevant to P- 12 classroom settings. Typically offered Fall Spring.

## **EDCI 30900 - Reading In Middle And Secondary Schools: Methods And Problems**

Credit Hours: 3.00. For prospective teachers at junior and senior high schools. An overview of reading processes, fundamentals of reading instruction, factors that influence the ability to read text materials, strategies and materials for identifying and reducing reading problems, school resources, and programs for normal and deficient readers. Concurrent enrollment with program-specified methods course. Typically offered Fall Spring.

## **EDCI 42400 - The Teaching Of Earth And Physical Science In The Secondary Schools**

Credit Hours: 3.00. The methods and materials needed for the teaching of chemistry, earth-space, physics, and general science in the secondary schools, including field experience. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. May be taken for two credits (no field experience) by students who are enrolled in another methods course with field experience. Typically offered Fall.

## **EDCI 42100 - The Teaching Of Biology In Secondary Schools**

Credit Hours: 3.00. The rationale, objectives, methods, and materials of teaching biology and life science in junior and senior high schools. Extensive use of multimedia resources in planning specifically for the student teaching experience. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Fall.

## **EDCI 42800 - Teaching Science In The Middle And Junior High School**

Credit Hours: 2.00. Designed to prepare preservice teachers to teach science in the middle and junior high school (grades 5-9). No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Spring.

## **EDCI 49800 - Supervised Teaching**

Credit Hours: 8.00 to 16.00. Teaching full time in a school classroom under the supervision of the teacher in charge of the class and a University supervisor. Completion of education methods courses and other Gate requirements for the major area and admittance to teacher education required. Typically offered Fall Spring Summer.

## **Other Departmental /Program Course Requirements (24-27)**

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 3.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 3.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00
- UCC Science, Technology & Society - Credit Hours: 3.00

## **Earth Space Science Concentration (39 credits)**

Overall GPA for Earth Space Science Concentration courses with the Departmental/Program Major Courses must be  $\geq 2.5$

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

### **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and

buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

### **CHM 13600 - General Chemistry Honors**

Credit Hours: 4.00. A sophisticated treatment of the principles of chemistry. Atomic structure and bonding, spectroscopy, equilibria, thermodynamics and kinetics. Advanced Placement chemistry credit (level 4 or 5) or admission to the honors program in Science or Engineering or a score of at least 70% on the CHM 11500 test-out exam. Students with a grade of C or better in CHM 13600 who need 8 hours of credit in general chemistry may request credit for CHM 11500. Typically offered Fall.

### **EAPS 11200 - Earth Through Time**

Credit Hours: 3.00. The history of the planet Earth from its beginnings to the present. This course will explore the causes and effects of processes that have changed the Earth's surface and subsurface through time, the impacts of these changes on the evolution of life, and how scientist interpret Earth history from the geologic record. The laboratory will provide hands-on experience in interpreting various geologic and fossil records. This course may be taken on its own, or as a year-long lab series with EAPS 11100. EAPS 11100 and EAPS 11200 will fulfill the two course sequence laboratory experience outside the major department. Typically offered Spring.

### **EAPS 10900 - The Dynamic Earth**

Credit Hours: 3.00. This course covers the formation and development of the solid earth, atmosphere, hydrosphere, and biosphere. The course studies the whole earth as a system of many interacting parts and focuses on the changes within and between these parts. This course is intended for all majors in earth and atmospheric sciences. Typically offered Fall.

### **EAPS 31900 - Exploring Earth Through Time**

Credit Hours: 3.00. The course will explore the history of the Earth from its beginning 4.5 billion years ago to the present. Our understanding and insight into the history of the Earth has greatly expanded during the last several decades. Emphasis will be placed on the relationships of tectonic processes that shaped the surface of the Earth and the evolution of the Earth's biosphere. The course will also examine how the role of evolution of life has played in the history of the atmosphere and oceans. Typically offered Spring.

### **EAPS 11800 - Introduction To Earth Sciences**

Credit Hours: 3.00. Introduction to a range of topics in Earth Science, including: Origin and geological history of Earth, including geological records of climate and evolution; Earth materials (minerals and rocks); Chemical and physical composition and structure of the Earth; Rock weathering, erosion, and sedimentary processes; Geological timescale; Geologic structures including their map and field expression; Tectonic processes; The hydrological cycle with emphasis on groundwater and physical and chemical oceanography; Energy and mineral resources; Astrobiology. (Required for Geology and Geophysics and Earth and Space Science Teaching majors.) Typically offered Spring.

## **EAPS 13700 - Freshman Seminar In Earth And Atmospheric Sciences**

Credit Hours: 1.00. Seminar presented by guests in different fields of the Earth and Atmospheric Sciences to expose students to the range of topics included in the department and in possible career paths. Typically offered Fall Spring.

## **EAPS 24300 - Earth Materials I**

Credit Hours: 4.00. Elements of crystallography, physical and chemical properties of rock-forming minerals, and minerals of economic importance. Origin and occurrence of minerals. Prior course work in dynamic earth or physical geology is required. Typically offered Fall.

## **EAPS 39000 - Geologic Field Methods**

Credit Hours: 3.00. Introduction to geologic mapping principles on quadrangle (7 1/2 min., 15 min., 1:250,000 scales) maps. Application of aerial photography, GPS, and GIS techniques. Emphasis on construction of cross sections, measurement of stratigraphic sections, and preparation of geologic reports. Several weekend field exercises will be required. Typically offered Spring.

## **EAPS 35300 - Earth Surface Processes**

Credit Hours: 3.00. Introduction to a variety of topics in sediment transport and deposition, emphasizing linkages between active processes, landscape evolution, and the rock record. Topics include: introductory fluid mechanics; sediment transport by water, ice, and wind, and the development of fluvial bedforms, glacial landscapes, and sand dunes; groundwater geochemistry and the development of karst and caves. Each major topic is accompanied by field projects that emphasize local geologic history. A weekend field trip is required. (Required for Geoscience and Earth Science teaching majors.) Typically offered Fall.

## **EAPS 35400 - Plate Tectonics**

Credit Hours: 3.00. This course will explore plate tectonic processes from the scale of plate motions to the individual stresses that deform rocks. Emphasis will be focused on sources of stress and how this stress is manifested in the lithosphere through faulting, folding, earthquake generation, and plate motions. Seismic waves and what information they provide about the interior of the Earth will be discussed. Additionally, extensional, compressional, and transform plate boundaries will be covered. This course is an introduction to geophysical processes and serves as a stepping-stone to upper level geophysics course such as EAPS 35200 and EAPS 45000. Typically offered Fall Spring.

- EAPS/ASTR Elective (could satisfy Science, Technology & Society for University Core) - Credit Hours: 3.00
- EAPS/ASTR Elective - Credit Hours: 3.00
- EAPS/ASTR Elective - Credit Hours: 3.00

## **EAPS 49000 - Field Geology In Rocky Mountains**

Credit Hours: 6.00. Field studies in sedimentary, igneous, and metamorphic terrains. Studies may involve geologic mapping, stratigraphic section measuring, structural analysis and interpretation, geomorphic interpretation, and interpretation of geologic history. Field excursions include visits to several classical geologic localities in the Colorado Plateau, Great Basin, and Rocky Mountains with discussions and interpretations of features observed. Transportation fee plus room and board at field station required. Rigorous field work requires physical conditioning. Six-week session, including field excursion. Prior course work in earth materials, surface processes, and plate tectonics is required. Permission of instructor required. Typically offered Summer.

## Electives (0-10 credits)

## University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

#### **EAPS 11800 - Introduction To Earth Sciences**

Credit Hours: 3.00. Introduction to a range of topics in Earth Science, including: Origin and geological history of Earth, including geological records of climate and evolution; Earth materials (minerals and rocks); Chemical and physical composition and structure of the Earth; Rock weathering, erosion, and sedimentary processes; Geological timescale; Geologic structures including their map and field expression; Tectonic processes; The hydrological cycle with emphasis on groundwater and physical and chemical oceanography; Energy and mineral resources; Astrobiology. (Required for Geology and Geophysics and Earth and Space Science Teaching majors.) Typically offered Spring.

#### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

16 Credits

Spring 1st Year

## **EAPS 11200 - Earth Through Time**

Credit Hours: 3.00. The history of the planet Earth from its beginnings to the present. This course will explore the causes and effects of processes that have changed the Earth's surface and subsurface through time, the impacts of these changes on the evolution of life, and how scientist interpret Earth history from the geologic record. The laboratory will provide hands-on experience in interpreting various geologic and fossil records. This course may be taken on its own, or as a year-long lab series with EAPS 11100. EAPS 11100 and EAPS 11200 will fulfill the two course sequence laboratory experience outside the major department. Typically offered Spring.

## **EAPS 10900 - The Dynamic Earth**

Credit Hours: 3.00. This course covers the formation and development of the solid earth, atmosphere, hydrosphere, and biosphere. The course studies the whole earth as a system of many interacting parts and focuses on the changes within and between these parts. This course is intended for all majors in earth and atmospheric sciences. Typically offered Fall.

## **EAPS 31900 - Exploring Earth Through Time**

Credit Hours: 3.00. The course will explore the history of the Earth from its beginning 4.5 billion years ago to the present. Our understanding and insight into the history of the Earth has greatly expanded during the last several decades. Emphasis will be placed on the relationships of tectonic processes that shaped the surface of the Earth and the evolution of the Earth's biosphere.

The course will also examine how the role of evolution of life has played in the history of the atmosphere and oceans. Typically offered Spring.

### **EAPS 13700 - Freshman Seminar In Earth And Atmospheric Sciences**

Credit Hours: 1.00. Seminar presented by guests in different fields of the Earth and Atmospheric Sciences to expose students to the range of topics included in the department and in possible career paths. Typically offered Fall Spring.

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

- General Education I Option - Credit Hours: 3.00

16 Credits

Fall 2nd Year

### **EAPS 24300 - Earth Materials I**

Credit Hours: 4.00. Elements of crystallography, physical and chemical properties of rock-forming minerals, and minerals of economic importance. Origin and occurrence of minerals. Prior course work in dynamic earth or physical geology is required. Typically offered Fall.

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

## **PHYS 22000 - General Physics**

Credit Hours: 4.00. Mechanics, heat, and sound, for students not specializing in physics. Typically offered Fall Spring Summer.  
CTL:IPS 1751 Algebra-based Physics I

## **EDCI 20500 - Exploring Teaching As A Career**

Credit Hours: 3.00. Students will become familiar with the work of teachers and begin to develop their educational philosophies through examining what it means to teach and to learn and the nature and purpose of schools. Students will critically evaluate teaching as their chosen profession. This course includes a required weekly field-based experience in an elementary, middle, or high school classroom. Typically offered Fall Spring.

## **EDCI 28500 - Multiculturalism And Education**

Credit Hours: 3.00. This course integrates an understanding of multiculturalism with principles of democratic education. Historical, sociological, cultural, political, philosophical, and pedagogical foundations of multiculturalism are explored and related to issues of pedagogy in a pluralistic society. This course is taken concurrently with EDCI 20500, which includes a school-based Theory into Practice field experience. Some discussion topics and assignments will be based on that field experience. It is highly recommended that EDCI 27000 be taken with or before taking this course. Typically offered Fall Spring Summer.

14 Credits

Spring 2nd Year

## **EAPS 35400 - Plate Tectonics**

Credit Hours: 3.00. This course will explore plate tectonic processes from the scale of plate motions to the individual stresses that deform rocks. Emphasis will be focused on sources of stress and how this stress is manifested in the lithosphere through faulting, folding, earthquake generation, and plate motions. Seismic waves and what information they provide about the interior of the Earth will be discussed. Additionally, extensional, compressional, and transform plate boundaries will be covered. This course is an introduction to geophysical processes and serves as a stepping-stone to upper level geophysics course such as EAPS 35200 and EAPS 45000. Typically offered Fall Spring.

## **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction,

and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **PHYS 22100 - General Physics**

Credit Hours: 4.00. Electricity, light, and modern physics, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1752 Algebra-based Physics II

### **EDPS 23500 - Learning And Motivation**

Credit Hours: 3.00. Introduction to concepts of learning and motivation in educational contexts (i.e., Educational Psychology). Influence of development, culture, and individual differences on learning and motivation. Uses of assessment and technology in promoting learning and motivation. A field-based experiential component is included. Typically offered Fall Spring Summer.

### **EDPS 26500 - The Inclusive Classroom**

Credit Hours: 3.00. Characteristics of students with special needs/talents; strategies for helping students learn and develop in general educational settings. Emphasis placed upon research evidence, case studies, problem-based learning, and development of a plan for an inclusive classroom. A field-based component is included. Typically offered Spring Summer Fall.

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

16 Credits

Fall 3rd Year

### **EAPS 35300 - Earth Surface Processes**

Credit Hours: 3.00. Introduction to a variety of topics in sediment transport and deposition, emphasizing linkages between active processes, landscape evolution, and the rock record. Topics include: introductory fluid mechanics; sediment transport by water, ice, and wind, and the development of fluvial bedforms, glacial landscapes, and sand dunes; groundwater geochemistry and the development of karst and caves. Each major topic is accompanied by field projects that emphasize local geologic history. A weekend field trip is required. (Required for Geoscience and Earth Science teaching majors.) Typically offered Fall.

- STAT Statistics - Credit Hours: 3.00 \*
- C S Computer Programming - Credit Hours: 4.00

## **EDST 20010 - Educational Policies And Laws**

Credit Hours: 1.00 to 3.00. The interactive course will provide an understanding of the history of schooling in the United States. A special emphasis will be placed on reviewing historical and contemporary educational policies and educational laws as each subject is critical to understanding social, historical, and cultural issues in the United States. Focus will also be on contemporary applications of historical ideas in the classroom and in school systems. Typically offered Fall Spring.

## **EDPS 32700 - Assessment Literacy**

Credit Hours: 1.00 to 3.00. Evaluating the impact of instruction on student performance is one of the most important skills for an educator. Effective teachers ask themselves, "How do I know if students are truly learning? Are they meeting educational objectives in the content area?" Using well-chosen assessment approaches, teachers can address these questions. In this course, students will acquire assessment literacy: the ability to gather accurate information about student achievement, and use that information to make instructional decisions that will improve learning. Course activities will focus on assessment tasks relevant to P- 12 classroom settings. Typically offered Fall Spring.

- Language I Option - Credit Hours: 3.00

16 Credits

Spring 3rd Year

## **EAPS 39000 - Geologic Field Methods**

Credit Hours: 3.00. Introduction to geologic mapping principles on quadrangle (7 1/2 min., 15 min., 1:250,000 scales) maps. Application of aerial photography, GPS, and GIS techniques. Emphasis on construction of cross sections, measurement of stratigraphic sections, and preparation of geologic reports. Several weekend field exercises will be required. Typically offered Spring.

- EAPS/ASTR Elective - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00 \*
- Language II Option - Credit Hours: 3.00

## **EDCI 27000 - Introduction To Educational Technology And Computing**

Credit Hours: 3.00. Addresses fundamentals of educational technology, including the integration of instructional design, media, computers and related technologies within the classroom setting. Typically offered Fall Spring Summer.

15 Credits

## Summer 3rd Year

### **EAPS 49000 - Field Geology In Rocky Mountains**

Credit Hours: 6.00. Field studies in sedimentary, igneous, and metamorphic terrains. Studies may involve geologic mapping, stratigraphic section measuring, structural analysis and interpretation, geomorphic interpretation, and interpretation of geologic history. Field excursions include visits to several classical geologic localities in the Colorado Plateau, Great Basin, and Rocky Mountains with discussions and interpretations of features observed. Transportation fee plus room and board at field station required. Rigorous field work requires physical conditioning. Six-week session, including field excursion. Prior course work in earth materials, surface processes, and plate tectonics is required. Permission of instructor required. Typically offered Summer.

6 Credits

## Fall 4th Year

### **EDCI 42400 - The Teaching Of Earth And Physical Science In The Secondary Schools**

Credit Hours: 3.00. The methods and materials needed for the teaching of chemistry, earth-space, physics, and general science in the secondary schools, including field experience. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. May be taken for two credits (no field experience) by students who are enrolled in another methods course with field experience. Typically offered Fall.

- EAPS/ASTR Elective - Credit Hours: 3.00
- EAPS/ASTR Elective - Credit Hours: 3.00
- Science, Technology, Society (STS) or Free Elective - Credit Hours: 3.00
- General Education II Option - Credit Hours: 3.00

15 Credits

## Spring 4th Year

### **EDCI 42800 - Teaching Science In The Middle And Junior High School**

Credit Hours: 2.00. Designed to prepare preservice teachers to teach science in the middle and junior high school (grades 5-9). No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Spring.

## **EDCI 30900 - Reading In Middle And Secondary Schools: Methods And Problems**

Credit Hours: 3.00. For prospective teachers at junior and senior high schools. An overview of reading processes, fundamentals of reading instruction, factors that influence the ability to read text materials, strategies and materials for identifying and reducing reading problems, school resources, and programs for normal and deficient readers. Concurrent enrollment with program-specified methods course. Typically offered Fall Spring.

## **EDCI 49800 - Supervised Teaching**

Credit Hours: 8.00 to 16.00. Teaching full time in a school classroom under the supervision of the teacher in charge of the class and a University supervisor. Completion of education methods courses and other Gate requirements for the major area and admittance to teacher education required. Typically offered Fall Spring Summer.

15 Credits

## **Note**

*Note: This degree is intended to give students many options. Students need to consult with a College of Science Academic Advisor regarding requirements.*

\*Satisfies a University Core Requirement

Students must earn a "C-" or better in all required ^ courses.

129 semester credits (minimum) required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

2.0 average in EAPS major classes required to graduate.

## **Degree Requirements**

The student is ultimately responsible for knowing and completing all degree requirements.

Degree Works is knowledge source for specific requirements and completion

## **Foreign Language Courses**

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## **Critical Course**

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Science Education - Physics Concentration, BS

### About the Program

A College of Science degree in Science Education prepares future science teachers for certification at the middle and high school level. Students customize their focus by selecting a major area of study in biology, chemistry, physics, or earth and space science within an interdisciplinary science framework. The Science Education degree ensures students are thoroughly educated in their content discipline and modern theories of learning and education. Graduates are in high demand as STEM education and careers continue to grow in demand.

#### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Science Education - Physics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

SCI-SIED-BS  
Code-SIED, PHED  
127 Credits

### Departmental/Program Major Courses

#### Required Science Education Core Courses (24-30 Credits)

#### Required Chemistry Selective Courses (4-5 credits)

##### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

##### **CHM 12300 - General Chemistry For Engineers I**

Credit Hours: 4.00. Stoichiometry; atomic structure and chemical bonding; gases, liquids, and solids; thermochemistry; chemical

kinetics; solutions; aqueous solution chemistry; introduction to equilibria. Although intended for students in the Schools of Engineering and this course will also satisfy requirements for chemistry majors in place of CHM 11500 or CHM 12500. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

**OR**

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

### **Required Computing Option (3-4 credits)**

#### **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

#### **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

## **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

## **Required Calculus Selective Courses (6-10 credits)**

### **MA 16010 - Applied Calculus I**

Credit Hours: 3.00. Topics include trigonometric and exponential functions; limits and differentiation, rules of differentiation, maxima, minima and optimization; curve sketching, integration, anti-derivatives, fundamental theorem of calculus. Properties of definite integrals and numerical methods. Applications to life, managerial and social sciences. Typically offered Fall Spring Summer.

### **MA 16020 - Applied Calculus II**

Credit Hours: 3.00. This course covers techniques of integration; infinite series, convergence tests; differentiation and integration of functions of several variables; maxima and minima, optimization; differential equations and initial value problems; matrices, determinants, eigenvalues and eigenvectors. Applications. Typically offered Fall Spring Summer.

**OR**

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602 Calculus - Long I

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

## **Required Physics Selective Courses (8 credits)**

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

### **PHYS 25200 - Electricity And Optics Laboratory**

Credit Hours: 1.00. Selected experiments in electric fields, magnetic fields, steady-state and transient d.c. circuits, thermodynamics, and optics. Typically offered Fall Spring Summer.

## **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

## **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

## **Required Statistics Selective Courses (3 credits)**

### **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

## **Educational Program Course Requirements (36 credits)**

Professional Education GPA Average  $\geq 3.00$  - no grade lower than C-

### **EDCI 27000 - Introduction To Educational Technology And Computing**

Credit Hours: 3.00. Addresses fundamentals of educational technology, including the integration of instructional design, media, computers and related technologies within the classroom setting. Typically offered Fall Spring Summer.

### **EDCI 20500 - Exploring Teaching As A Career**

Credit Hours: 3.00. Students will become familiar with the work of teachers and begin to develop their educational philosophies through examining what it means to teach and to learn and the nature and purpose of schools. Students will critically evaluate teaching as their chosen profession. This course includes a required weekly field-based experience in an elementary, middle, or high school classroom. Typically offered Fall Spring.

### **EDCI 28500 - Multiculturalism And Education**

Credit Hours: 3.00. This course integrates an understanding of multiculturalism with principles of democratic education. Historical, sociological, cultural, political, philosophical, and pedagogical foundations of multiculturalism are explored and related to issues of pedagogy in a pluralistic society. This course is taken concurrently with EDCI 20500, which includes a school-based Theory into Practice field experience. Some discussion topics and assignments will be based on that field experience. It is highly recommended that EDCI 27000 be taken with or before taking this course. Typically offered Fall Spring Summer.

### **EDPS 23500 - Learning And Motivation**

Credit Hours: 3.00. Introduction to concepts of learning and motivation in educational contexts (i.e., Educational Psychology). Influence of development, culture, and individual differences on learning and motivation. Uses of assessment and technology in promoting learning and motivation. A field-based experiential component is included. Typically offered Fall Spring Summer.

### **EDPS 26500 - The Inclusive Classroom**

Credit Hours: 3.00. Characteristics of students with special needs/talents; strategies for helping students learn and develop in general educational settings. Emphasis placed upon research evidence, case studies, problem-based learning, and development of a plan for an inclusive classroom. A field-based component is included. Typically offered Spring Summer Fall.

### **EDST 20010 - Educational Policies And Laws**

Credit Hours: 1.00 to 3.00. The interactive course will provide an understanding of the history of schooling in the United States. A special emphasis will be placed on reviewing historical and contemporary educational policies and educational laws as each subject is critical to understanding social, historical, and cultural issues in the United States. Focus will also be on contemporary applications of historical ideas in the classroom and in school systems. Typically offered Fall Spring.

### **EDPS 32700 - Assessment Literacy**

Credit Hours: 1.00 to 3.00. Evaluating the impact of instruction on student performance is one of the most important skills for an educator. Effective teachers ask themselves, "How do I know if students are truly learning? Are they meeting educational objectives in the content area?" Using well-chosen assessment approaches, teachers can address these questions. In this course, students will acquire assessment literacy: the ability to gather accurate information about student achievement, and use that information to make instructional decisions that will improve learning. Course activities will focus on assessment tasks relevant to P- 12 classroom settings. Typically offered Fall Spring.

### **EDCI 30900 - Reading In Middle And Secondary Schools: Methods And Problems**

Credit Hours: 3.00. For prospective teachers at junior and senior high schools. An overview of reading processes, fundamentals of reading instruction, factors that influence the ability to read text materials, strategies and materials for identifying and reducing reading problems, school resources, and programs for normal and deficient readers. Concurrent enrollment with program-specified methods course. Typically offered Fall Spring.

### **EDCI 42400 - The Teaching Of Earth And Physical Science In The Secondary Schools**

Credit Hours: 3.00. The methods and materials needed for the teaching of chemistry, earth-space, physics, and general science in the secondary schools, including field experience. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. May be taken for two credits (no field experience) by students who are enrolled in another methods course with field experience. Typically offered Fall.

### **EDCI 42100 - The Teaching Of Biology In Secondary Schools**

Credit Hours: 3.00. The rationale, objectives, methods, and materials of teaching biology and life science in junior and senior high schools. Extensive use of multimedia resources in planning specifically for the student teaching experience. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Fall.

### **EDCI 42800 - Teaching Science In The Middle And Junior High School**

Credit Hours: 2.00. Designed to prepare preservice teachers to teach science in the middle and junior high school (grades 5-9). No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Spring.

### **EDCI 49800 - Supervised Teaching**

Credit Hours: 8.00 to 16.00. Teaching full time in a school classroom under the supervision of the teacher in charge of the class and a University supervisor. Completion of education methods courses and other Gate requirements for the major area and admittance to teacher education required. Typically offered Fall Spring Summer.

## Other Departmental /Program Course Requirements (30-36)

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 3.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 3.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00
- Science, Technology and Society requirement for UCC - Credit Hours: 1.00 - 3.00

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

## PHYS Major Selectives (9-10 credits)

- PHYS/ASTR  $\geq$  300 level - Credit Hours: 3.00

## **PHYS 53600 - Electronic Techniques For Research**

Credit Hours: 4.00. A summary of principles of modern electronics currently used in research. Coursework will include broad coverage of the field and selected topics in electronics instrumentation. Typically offered Spring.

## **PHYS 58000 - Computational Physics**

Credit Hours: 3.00. Introduction to computationally based problem solving in physics, emphasis on understanding and applying various numerical algorithms to different types of physics problems. Topics will include chaos in mechanical systems, stochastic systems including percolation and fractal structures, molecular dynamics and the properties of simple fluids, Monte Carlo methods and phase transitions, and time dependent as well as time independent problems in quantum mechanics. Typically offered Fall.

- Science/Engineering  $\geq$  300 level (met by Statistics Option) - Credit Hours: 0.00
- Science/Engineering  $\geq$  300 level (could be met by Great Issues Option) - Credit Hours: 3.00

## **Physics Concentration (30-31 credits)**

Overall GPA for Physics Concentration courses with the Departmental/Program Major Courses must be  $\geq$  2.5

## **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

## **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

## **CHM 12400 - General Chemistry For Engineers II**

Credit Hours: 4.00. A continuation of CHM 12300. Chemical equilibria; elementary thermodynamics; electrochemistry; phase diagrams; and nuclear chemistry. Examples will be taken from alloys and ceramics; semiconductors; organic chemistry; and polymers. Although intended for students in the Schools of Engineering this course will also satisfy requirements for chemistry majors in place of CHM 11600 or CHM 12600 or CHM 13600. Typically offered Spring.

## **CHM 13600 - General Chemistry Honors**

Credit Hours: 4.00. A sophisticated treatment of the principles of chemistry. Atomic structure and bonding, spectroscopy, equilibria, thermodynamics and kinetics. Advanced Placement chemistry credit (level 4 or 5) or admission to the honors program in Science or Engineering or a score of at least 70% on the CHM 11500 test-out exam. Students with a grade of C or better in CHM 13600 who need 8 hours of credit in general chemistry may request credit for CHM 11500. Typically offered Fall.

### **PHYS 30600 - Mathematical Methods Of Physics I**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include one-and multi-variable calculus, complex numbers and functions of a complex variable, and vector calculus. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 30700 - Mathematical Methods Of Physics II**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include vectors, matrices and normal modes as well as ordinary and partial differential equations. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 31000 - Intermediate Mechanics**

Credit Hours: 4.00. For students familiar with calculus. Elements of vector algebra; statics of particles and rigid bodies; theory of couples; principle of virtual work; kinematics; dynamics of particles and rigid bodies; work, power, and energy. Typically offered Fall.

### **PHYS 33000 - Intermediate Electricity And Magnetism**

Credit Hours: 3.00. Electrostatics; electric currents; magnetostatics; electromagnetic induction; Maxwell's equation; electromagnetic waves. Typically offered Fall Spring.

### **PHYS 34000 - Modern Physics Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany PHYS 34200 or PHYS 34400. Typically offered Fall Spring.

### **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure;

elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

### **PHYS 36000 - Quantum Mechanics**

Credit Hours: 3.00. Historical development of quantum mechanics, wave packets, uncertainty principle, Schrodinger equation, operators, the hydrogen atom, electron spin, angular momentum, perturbation theory, and other selected topics. Typically offered Spring.

### **PHYS 42200 - Waves And Oscillations**

Credit Hours: 3.00. Physics of waves and oscillations including sound, elastic waves, and electromagnetic waves such as light. Topics range from the theory of simple harmonic oscillators, transverse modes of a continuous string, and physical optics including interference, Fresnel and Fraunhofer diffraction, and resolution, to diffraction of X-rays and electrons by crystals. Optionally includes topics such as nonlinear waves and surface waves. Typically offered Fall Spring.

### **PHYS 45000 - Intermediate Laboratory**

Credit Hours: 2.00. Laboratory primarily intended for junior year physics majors. Assorted experiments in optics and other fields using lasers, photodiodes, computers, and other modern technology. Typically offered Fall Spring.

## University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

17 Credits

Spring 1st Year

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

- Language I Option - Credit Hours: 3.00 - 4.00 \*

16-17 Credits

Fall 2nd Year

## **PHYS 30600 - Mathematical Methods Of Physics I**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include one- and multi-variable calculus, complex numbers and functions of a complex variable, and vector calculus. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

## **PHYS 34000 - Modern Physics Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany PHYS 34200 or PHYS 34400. Typically offered Fall Spring.

## **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure; elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

## **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals.

Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

- Language II Option - Credit Hours: 3.00 - 4.00

15-16 Credits

Spring 2nd Year

### **PHYS 30700 - Mathematical Methods Of Physics II**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include vectors, matrices and normal modes as well as ordinary and partial differential equations. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 42200 - Waves And Oscillations**

Credit Hours: 3.00. Physics of waves and oscillations including sound, elastic waves, and electromagnetic waves such as light. Topics range from the theory of simple harmonic oscillators, transverse modes of a continuous string, and physical optics including interference, Fresnel and Fraunhofer diffraction, and resolution, to diffraction of X-rays and electrons by crystals. Optionally includes topics such as nonlinear waves and surface waves. Typically offered Fall Spring.

### **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

### **EDCI 20500 - Exploring Teaching As A Career**

Credit Hours: 3.00. Students will become familiar with the work of teachers and begin to develop their educational philosophies through examining what it means to teach and to learn and the nature and purpose of schools. Students will critically evaluate teaching as their chosen profession. This course includes a required weekly field-based experience in an elementary, middle, or high school classroom. Typically offered Fall Spring.

### **EDCI 28500 - Multiculturalism And Education**

Credit Hours: 3.00. This course integrates an understanding of multiculturalism with principles of democratic education. Historical, sociological, cultural, political, philosophical, and pedagogical foundations of multiculturalism are explored and related to issues of pedagogy in a pluralistic society. This course is taken concurrently with EDCI 20500, which includes a school-based Theory into Practice field experience. Some discussion topics and assignments will be based on that field experience. It is highly recommended that EDCI 27000 be taken with or before taking this course. Typically offered Fall Spring Summer.

### **EDCI 27000 - Introduction To Educational Technology And Computing**

Credit Hours: 3.00. Addresses fundamentals of educational technology, including the integration of instructional design, media, computers and related technologies within the classroom setting. Typically offered Fall Spring Summer.

18 Credits

Fall 3rd Year

### **PHYS 31000 - Intermediate Mechanics**

Credit Hours: 4.00. For students familiar with calculus. Elements of vector algebra; statics of particles and rigid bodies; theory of couples; principle of virtual work; kinematics; dynamics of particles and rigid bodies; work, power, and energy. Typically offered Fall.

### **PHYS 33000 - Intermediate Electricity And Magnetism**

Credit Hours: 3.00. Electrostatics; electric currents; magnetostatics; electromagnetic induction; Maxwell's equation; electromagnetic waves. Typically offered Fall Spring.

### **PHYS 45000 - Intermediate Laboratory**

Credit Hours: 2.00. Laboratory primarily intended for junior year physics majors. Assorted experiments in optics and other fields using lasers, photodiodes, computers, and other modern technology. Typically offered Fall Spring.

### **EDPS 23500 - Learning And Motivation**

Credit Hours: 3.00. Introduction to concepts of learning and motivation in educational contexts (i.e., Educational Psychology). Influence of development, culture, and individual differences on learning and motivation. Uses of assessment and technology in promoting learning and motivation. A field-based experiential component is included. Typically offered Fall Spring Summer.

## **EDPS 26500 - The Inclusive Classroom**

Credit Hours: 3.00. Characteristics of students with special needs/talents; strategies for helping students learn and develop in general educational settings. Emphasis placed upon research evidence, case studies, problem-based learning, and development of a plan for an inclusive classroom. A field-based component is included. Typically offered Spring Summer Fall.

- General Education II Option - Credit Hours: 3.00

18 Credits

Spring 3rd Year

## **PHYS 36000 - Quantum Mechanics**

Credit Hours: 3.00. Historical development of quantum mechanics, wave packets, uncertainty principle, Schrodinger equation, operators, the hydrogen atom, electron spin, angular momentum, perturbation theory, and other selected topics. Typically offered Spring.

## **PHYS 53600 - Electronic Techniques For Research**

Credit Hours: 4.00. A summary of principles of modern electronics currently used in research. Coursework will include broad coverage of the field and selected topics in electronics instrumentation. Typically offered Spring.

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- General Education III Option - Credit Hours: 3.00
- Science, Technology, and Society - Credit Hours: 1.00 - 3.00

13-16 Credits

Fall 4th Year

- PHYS, ASTR  $\geq$  300 level - Credit Hours: 3.00

## **EDCI 42400 - The Teaching Of Earth And Physical Science In The Secondary Schools**

Credit Hours: 3.00. The methods and materials needed for the teaching of chemistry, earth-space, physics, and general science in the secondary schools, including field experience. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. May be taken for two credits (no field experience) by students who are enrolled in another methods course with field experience. Typically offered Fall.

- Great Issues Option (Sci, Engr selective) - Credit Hours: 3.00
- CS Option - Credit Hours: 3.00 - 4.00

## **EDST 20010 - Educational Policies And Laws**

Credit Hours: 1.00 to 3.00. The interactive course will provide an understanding of the history of schooling in the United States. A special emphasis will be placed on reviewing historical and contemporary educational policies and educational laws as each subject is critical to understanding social, historical, and cultural issues in the United States. Focus will also be on contemporary applications of historical ideas in the classroom and in school systems. Typically offered Fall Spring.

## **EDPS 32700 - Assessment Literacy**

Credit Hours: 1.00 to 3.00. Evaluating the impact of instruction on student performance is one of the most important skills for an educator. Effective teachers ask themselves, "How do I know if students are truly learning? Are they meeting educational objectives in the content area?" Using well-chosen assessment approaches, teachers can address these questions. In this course, students will acquire assessment literacy: the ability to gather accurate information about student achievement, and use that information to make instructional decisions that will improve learning. Course activities will focus on assessment tasks relevant to P- 12 classroom settings. Typically offered Fall Spring.

15-16 Credits

Spring 4th Year

## **EDCI 42800 - Teaching Science In The Middle And Junior High School**

Credit Hours: 2.00. Designed to prepare preservice teachers to teach science in the middle and junior high school (grades 5-9). No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Spring.

## **EDCI 30900 - Reading In Middle And Secondary Schools: Methods And Problems**

Credit Hours: 3.00. For prospective teachers at junior and senior high schools. An overview of reading processes, fundamentals of reading instruction, factors that influence the ability to read text materials, strategies and materials for identifying and reducing reading problems, school resources, and programs for normal and deficient readers. Concurrent enrollment with program-specified methods course. Typically offered Fall Spring.

## **EDCI 49800 - Supervised Teaching**

Credit Hours: 8.00 to 16.00. Teaching full time in a school classroom under the supervision of the teacher in charge of the class and a University supervisor. Completion of education methods courses and other Gate requirements for the major area and admittance to teacher education required. Typically offered Fall Spring Summer.

15 Credits

### **Note**

*Note: This degree is intended to give students many options. Students need to consult with a College of Science Academic Advisor regarding requirements.*

\*Satisfies a University Core Requirement

127 semester credits required for Bachelor of Science degree.

2.0 average in PHYS/ ASTR courses required to graduate.

2.5 average in Physics Concentration ^ courses required to graduate

3.0 average in Professional Education courses required to graduate (No grade below a C-)

### **Degree Requirements**

The student is ultimately responsible for knowing and completing all degree requirements.

Degree Works is knowledge source for specific requirements and completion

### **Foreign Language Courses**

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

### **Critical Course**

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## **Learning Beyond the Classroom Certificate**

Learning Beyond the Classroom (LBC) is open only to students majoring in the College of Science. It is a voluntary program aimed at encouraging you, the College of Science student, to engage in activities that provide hands-on experience and

opportunities to apply classroom knowledge. Successful completion of the LBC program will be noted on your official Purdue transcript. You will also receive a certificate of completion.

Participation in LBC involves attending, organizing, or leading activities that fall into three general categories: career and professional development; service, citizenship and leadership; and experience with domestic and international diversity. Progress in each of the three areas is tracked by a point system. Points are earned by submitting reports on participation in activities. The number of points earned varies with the intensity of the activity.

Completing the LBC certificate requires that you:

- Participate in at least one intensive activity lasting an extended period of time, such as semester-long study abroad, full-time summer internship, two (consecutive) semesters of undergraduate research and academic year resident assistant. Such an activity is worth 10 points.
- Accumulate a total of 24 points, with at least 4 points in each of 3 categories.
- Include either (a) 3 credits of approved coursework with grades of P or C- or higher (one or more courses totaling 3 credits can meet this requirement) or (b) a semester-long study abroad program (worth 10 points) or some combination of spring break (4 points) and/or summer study abroad activities (6 points), totaling 10 points.

In most cases, a maximum of 6 points per year and 10 points in total may be earned for any particular activity. It is estimated that completion of the certificate will take approximately 30 hours over your college career in addition to the intense 10-point activity described above.

[http://science.purdue.edu/Current\\_Students/learning-beyond-the-classroom/details.html](http://science.purdue.edu/Current_Students/learning-beyond-the-classroom/details.html)

## Department of Biological Sciences

### About the Biological Sciences Program

Discovery. This word captures our purpose, commitment, and vision. As a leading department in a major research university, our mission is to effectively integrate learning, discovery, and engagement. The best learning is experiential, and leads to a clear understanding of how discoveries are made, how science is conducted, and how ideas are communicated. The best learning is facilitated by faculty who are active in research and who can engage students in the excitement of biology. And the best learning results in alumni who are well-prepared to successfully pursue their chosen careers.

As we discover the many facets of biocomplexity, from vast ecosystems to the structure and function of individual molecules, we remain committed to our mission. Our faculty, staff, and students are engaged with the communities of science and education, the worlds of industry and business, and our alumni and friends. To each individual who joins us, we promise opportunities to experience the excitement of discovery in biology. We encourage you to become a part of our team-as a student, alumnus, corporate partner, scientific collaborator, or a member of our faculty and staff. Join us on our journey of learning, discovery, and engagement. Discover Biology at Purdue!

### Faculty

<https://www.bio.purdue.edu/People/faculty/index.php>

### Contact Information

The Department of Biological Sciences address is:  
915 W. State Street West Lafayette, IN 47907-2054

## **Main Office**

**Contact person:** Amanda Jenkins

Phone Number: (765) 494-4408

Fax No. is: (765) 494-0876

# **Graduate Information**

For Graduate Information please see Biological Sciences Graduate Program Information.

## **Biochemistry (Biology), BS**

# **About the Program**

Biochemistry investigates the chemical and molecular foundations of life processes. A student may study the transfer of genetic information into biological structures, the conversion of nutrients into cell constituents and their utilization as sources of energy, the storage of memory, and the chemical nature of neural processes. Laboratory techniques include electrophoresis, chromatography, Western blotting, protein sequence analysis, and peptide mapping. Understanding the development and application of enzymatic assays is fundamental to this field of study. This rigorous curriculum is excellent preparation for a number of careers in both academic and industrial research, including cancer and AIDS research, medicine, veterinary medicine, dentistry, structural biology, genetics, and medicinal chemistry and drug development.

Biochemistry (Biology) Website

### **Summary of Program Requirements**

The Summary of Program Requirements for 2016-17 Biochemistry is a comprehensive list of those categories which a student must fulfill in order to earn their degree. Unlike the full Detailed Program Requirements listed below, complete lists of selectives for any given category are not shown. These summaries are intended to be printer-friendly and less expansive in detail.

### **Detailed Program Requirements**

Please see below for detailed program requirements and possible selective fulfillments.

BIOLOGY-BS

Code-BIBI

120 Credits

## **Departmental/Program Major Courses**

\*A 2.0 average is required in these courses

**\*Required Major Courses (41-44 credits)**

## **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

## **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

## **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

## **BIOL 14501 - First Year Biology Laboratory With Neuro Research Project**

Credit Hours: 2.00. This laboratory course has been designed under the goals of the Center for Authentic Science Practice in Education (CASPiE) which aims to expose students to novel research as a means to teach them laboratory science. This course is designed to engage students in authentic research while acquiring necessary skills and concepts to be successful as a biology major. Our topic is Neuroanatomy of Auditory Pathways. We will begin with a series of skills and knowledge building weeks and then transition into independent research projects that culminate in a public presentation of the data in a poster session. In this course, students will learn the fundamentals in neurobiology as well as use sophisticated analysis and instrumentation to answer a research question. Critical thinking in experimental design as well as interpretation and communication of data will be stressed. The goals for this course are to gain a foundation in basic biological measurements and techniques, hone the analytical skills, appreciate the excitement of scientific discovery, and have fun along the way. Permission of department required. Typically offered Fall.

## **IT 22600 - Biotechnology Laboratory I**

Credit Hours: 2.00. Focuses on nucleic acid manipulation. Modules include, making a eukaryotic library, identifying clones, sub-cloning into a bacterial expression vector and verification of the clone's identity by restriction analysis and DNA sequencing. Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures. Typically offered Summer Fall Spring.

## **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

### **BIOL 39500 - Special Assignments**

Arrange Hours and Credit. Reading, discussions, written reports, seminar presentations, and field or laboratory work provided for enrichment in special areas of the biological sciences. Permission of instructor required. Typically offered Fall Spring Summer.

### **BIOL 41500 - Introduction To Molecular Biology**

Credit Hours: 3.00. An introduction to modern molecular biology techniques and how they are used to address current topics in gene regulation. Emphasis will be placed on experimental procedures and model systems, such as site-directed mutagenesis of isolated genes and their subsequent introduction into prokaryotic and eukaryotic cells. Topics will address the molecular control mechanisms associated with DNA replication, RNA transcription, RNA processing, and differential gene expression. Typically offered Fall.

### **BIOL 42000 - Eukaryotic Cell Biology**

Credit Hours: 3.00. Composition, structure, regulation, and growth of eukaryotic cells. Typically offered Fall.

- Base Lab requirement (Req #14) - Credit Hours: 2.00 - 4.00

### **BIOL 59500 - Special Assignments**

Arrange Hours and Credit. Special work, such as directed reading, independent study or research, supervised library, laboratory, or field work, or presentation of material not available in the formal courses of the department. The field in which work is offered will be indicated in the student's record. Permission of instructor required. Typically offered Fall Spring Summer.

### **BCHM 56100 - General Biochemistry I**

Credit Hours: 3.00. This course provides upper-division undergraduate and graduate students with basic understanding of biochemical and structural properties of amino acids, nucleic acids, lipids, and carbohydrates. This course allows students to connect the relationship between structure and function of biomolecules. In addition, students learn to understand enzyme properties, enzyme mechanism of action, and enzyme regulation. Typically offered Fall.

### **BCHM 56200 - General Biochemistry II**

Credit Hours: 3.00. This course provides upper-division undergraduate and graduate students with an understanding of core metabolic pathways. Anabolic and catabolic processes of metabolic pathways are studied. Biochemical and structural knowledge is used to determine how enzymes and coenzymes are needed to regulate and control metabolic pathways. Typically offered Spring.

- Biology Selective (Req #13) - Credit Hours: 2.00 - 3.00

## **Other Departmental /Program Course Requirements (70-82 credits)**

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Organic CHM 1 Selective - Credit Hours: 4.00
- Organic CHM 2 Selective - Credit Hours: 4.00

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Computer Science Selective - Credit Hours: 3.00 - 4.00

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language & Culture 1 Selective - Credit Hours: 3.00
- Language & Culture 2 Selective - Credit Hours: 3.00
- Language & Culture 3 Selective - Credit Hours: 3.00

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- General Education 1 Selective (satisfies Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education 2 Selective (satisfies Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education 3 Selective - Credit Hours: 3.00
- Teambuilding & Collaboration Selective - Credit Hours: 0.00 - 3.00
- Great Issues Selective - Credit Hours: 3.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00

Analytical Chemistry Selective - Select from (3-4 credits)

## **BCHM 22100 - Analytical Biochemistry**

Credit Hours: 3.00. Discussion of qualitative and quantitative analysis of biological compounds including pH measurement and control, spectrophotometry, measurement of radioactivity; theoretical basis of various separation techniques, including chromatography and electrophoresis; application of these methods to separation and analysis of biological compounds.

Laboratory sessions will provide practical experience in the use of these methods. This course is designed for biochemistry majors. Typically offered Fall Spring.

### **CHM 32100 - Analytical Chemistry I**

Credit Hours: 4.00. Quantitative measurements on complex chemical systems that show matrix effects or require isolation of a component prior to its determination; general approaches to quantitative problems at the trace level; critical comparisons of competitive procedures with emphasis on principles of separation processes, including chromatography; recognition and evaluation of possible sources of error; approaches for optimizing conditions so as to minimize time and/or effort required to attain prescribed levels of accuracy and precision. Required of students majoring in chemistry. Typically offered Fall.

### **Physical Chemistry Selective - Select from (4-6 credits)**

#### **CHM 37200 - Physical Chemistry**

Credit Hours: 4.00. Principles of physical chemistry with emphasis on chemical thermodynamics and kinetics, illustrated examples from the biological sciences. Intended primarily for students in the life sciences. Typically offered Spring.

or

#### **CHM 37300 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of matter. Properties of gases, liquids, and solids; equations of state; thermodynamics; energy, heat, and work; entropy; spontaneity and equilibrium; chemical potential; chemical equilibrium; phase diagrams; colligative properties. Typically offered Summer Fall.

#### **CHM 37400 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of molecules. Wave properties of matter; quantum mechanics of translation, rotation, and vibration; atomic structure; molecular orbitals; quantum states; statistical mechanics; chemical kinetics; collision theory; transition state theory. Typically offered Spring.

### **PHYS 1 Selective - Select from (4 credits)**

(satisfies Science Selective for core)

#### **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving

approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 2 Selective - Select from (4 credits)**

### **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **Calculus 1 Selective - Select from (4-5 credits)**

(satisfies Quantitative Reasoning Selective for core)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## Calculus 2 Selective - Select from (4-5 credits)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

### **MA 17300 - Calculus And Analytic Geometry II**

Credit Hours: 5.00. Calculus of transcendental functions, techniques of integration, conic sections, polar coordinates, parametric equations, infinite series. Admission restricted to those who have established credit in Calculus I. Typically offered Fall.

## Electives (0-9 credits)

## University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

# Program Requirements

## Fall 1st Year

### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Calculus I Selective - Credit Hours: 4.00 - 5.00
- Language/Culture 1 Selective - Credit Hours: 3.00

### **BIOL 11500 - Biology Resource Seminar**

Credit Hours: 1.00. This course is designed to help integrate new biology students into the Department of Biological Sciences, to help them adjust to university life, and to assist them in developing academic and intellectual survival skills using the medium of introductory Biology courses. The course meets twice a week in groups of 20-25 students. Each section is led by an academic advisor and an undergraduate teaching intern. The class periods have an on-going emphasis on connecting students to one another as resources while learning information, critical thinking skills and problem-solving strategies. Topics include bioethics, time management, available academic resources, biology majors and curricula and career development. Students are exposed to opportunities in undergraduate research, summer internships, the study abroad program, and teaching internships. Throughout the course, students are encouraged to plan their college education rather than merely choose their courses. Permission of department required. Typically offered Fall.

17-18 Credits

## Spring 1st Year

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

- Organic Chem 1 Selective - Credit Hours: 4.00
- Calculus II Selective - Credit Hours: 4.00 - 5.00
- Language/Culture 2 Selective - Credit Hours: 3.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

17-19 Credits

## Fall 2nd Year

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

- Organic Chem 2 Selective - Credit Hours: 4.00

- Language/Culture 3 Selective - Credit Hours: 3.00

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

15 Credits

Spring 2nd Year

## **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

## **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

- PHYS 1 Selective - Credit Hours: 4.00

## **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

## **BIOL 29300 - Sophomore Seminar: Planning Your Future In Biology**

Credit Hours: 1.00. Biology 29300 is a one-credit course designed for sophomores in the Department of Biological Sciences. This course will help students maximum the remainder of their undergraduate career. The course will cover biology career information and suggestions for professional development. Students will learn about the various disciplines that make up modern Biological Sciences. Students will learn about opportunities in undergraduate research and tour a research laboratory. In-depth presentations from biology alumni from a variety of fields are featured. Assignments include a Plan of Study, a resume, and a written paper evaluating the career path of one alumni speaker and describing the student's response to the presentation. Typically offered Spring.

- General Education 1 Selective - Credit Hours: 3.00

15 Credits

Fall 3rd Year

### **BCHM 56100 - General Biochemistry I**

Credit Hours: 3.00. This course provides upper-division undergraduate and graduate students with basic understanding of biochemical and structural properties of amino acids, nucleic acids, lipids, and carbohydrates. This course allows students to connect the relationship between structure and function of biomolecules. In addition, students learn to understand enzyme properties, enzyme mechanism of action, and enzyme regulation. Typically offered Fall.

### **BIOL 39500 - Special Assignments**

Arrange Hours and Credit. Reading, discussions, written reports, seminar presentations, and field or laboratory work provided for enrichment in special areas of the biological sciences. Permission of instructor required. Typically offered Fall Spring Summer.

- PHYS 2 Selective - Credit Hours: 4.00
- General Education 2 Selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

16 Credits

Spring 3rd Year

### **BCHM 56200 - General Biochemistry II**

Credit Hours: 3.00. This course provides upper-division undergraduate and graduate students with an understanding of core metabolic pathways. Anabolic and catabolic processes of metabolic pathways are studied. Biochemical and structural knowledge is used to determine how enzymes and coenzymes are needed to regulate and control metabolic pathways. Typically offered Spring.

- Computer Science Selective - Credit Hours: 3.00 - 4.00

### **BIOL 41500 - Introduction To Molecular Biology**

Credit Hours: 3.00. An introduction to modern molecular biology techniques and how they are used to address current topics in gene regulation. Emphasis will be placed on experimental procedures and model systems, such as site-directed mutagenesis of

isolated genes and their subsequent introduction into prokaryotic and eukaryotic cells. Topics will address the molecular control mechanisms associated with DNA replication, RNA transcription, RNA processing, and differential gene expression. Typically offered Fall.

### **BIOL 39300 - Preparing For Your Future In Biology**

Credit Hours: 1.00. Biology 39300 is a one-credit course for junior and seniors in the Department of Biological Sciences. This course will help students begin to prepare for life after Purdue. Students will learn about interviewing, job searching, graduate and professional school searching, resumes, industrial practices, and how to evaluate job/school offers. Construct a polished image on top of your solid biology foundation! Get the job or get admitted to the school you want. Typically offered Spring.

- General Education 3 Selective - Credit Hours: 3.00
- Elective - Credit Hours: 1.00

14-15 Credits

Fall 4th Year

### **BIOL 42000 - Eukaryotic Cell Biology**

Credit Hours: 3.00. Composition, structure, regulation, and growth of eukaryotic cells. Typically offered Fall.

### **BIOL 59500 - Special Assignments**

Arrange Hours and Credit. Special work, such as directed reading, independent study or research, supervised library, laboratory, or field work, or presentation of material not available in the formal courses of the department. The field in which work is offered will be indicated in the student's record. Permission of instructor required. Typically offered Fall Spring Summer.

- Analytical Chemistry Selective - Credit Hours: 3.00 - 4.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00
- Biology Selective (Req #13) - Credit Hours: 2.00 - 3.00

12-16 Credits

Spring 4th Year

- Physical Chemistry Selective - Credit Hours: 4.00

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Great Issues Selective - Credit Hours: 3.00
- Base Lab Requirement (Req #14) - Credit Hours: 2.00 - 4.00
- Free Elective - Credit Hours: 2.00

## 14-16 Credits

## Note

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Biochemistry Honors, BS

## About the Program

Biochemistry investigates the chemical and molecular foundations of life processes. A student may study the transfer of genetic information into biological structures, the conversion of nutrients into cell constituents and their utilization as sources of energy, the storage of memory, and the chemical nature of neural processes. Laboratory techniques include electrophoresis, chromatography, Western blotting, protein sequence analysis, and peptide mapping. Understanding the development and application of enzymatic assays is fundamental to this field of study. This rigorous curriculum is excellent preparation for a

number of careers in both academic and industrial research, including cancer and AIDS research, medicine, veterinary medicine, dentistry, structural biology, genetics, and medicinal chemistry and drug development.

Biochemistry (Biology) Website

### **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Biochemistry Honors include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

BIOLOGY-BS

Code-BIOH

120 Credits

## **Departmental/Program Major Courses (41-44 credits)**

\*A 2.0 average is required in these courses

### **\*Required Major Courses (39-41 credits)**

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

#### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

#### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

#### **BIOL 14501 - First Year Biology Laboratory With Neuro Research Project**

Credit Hours: 2.00. This laboratory course has been designed under the goals of the Center for Authentic Science Practice in Education (CASPiE) which aims to expose students to novel research as a means to teach them laboratory science. This course is designed to engage students in authentic research while acquiring necessary skills and concepts to be successful as a biology

major. Our topic is Neuroanatomy of Auditory Pathways. We will begin with a series of skills and knowledge building weeks and then transition into independent research projects that culminate in a public presentation of the data in a poster session. In this course, students will learn the fundamentals in neurobiology as well as use sophisticated analysis and instrumentation to answer a research question. Critical thinking in experimental design as well as interpretation and communication of data will be stressed. The goals for this course are to gain a foundation in basic biological measurements and techniques, hone the analytical skills, appreciate the excitement of scientific discovery, and have fun along the way. Permission of department required. Typically offered Fall.

### **IT 22600 - Biotechnology Laboratory I**

Credit Hours: 2.00. Focuses on nucleic acid manipulation. Modules include, making a eukaryotic library, identifying clones, sub-cloning into a bacterial expression vector and verification of the clone's identity by restriction analysis and DNA sequencing. Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures. Typically offered Summer Fall Spring.

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and

ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

### **BIOL 39500 - Special Assignments**

Arrange Hours and Credit. Reading, discussions, written reports, seminar presentations, and field or laboratory work provided for enrichment in special areas of the biological sciences. Permission of instructor required. Typically offered Fall Spring Summer.

### **BIOL 41500 - Introduction To Molecular Biology**

Credit Hours: 3.00. An introduction to modern molecular biology techniques and how they are used to address current topics in gene regulation. Emphasis will be placed on experimental procedures and model systems, such as site-directed mutagenesis of isolated genes and their subsequent introduction into prokaryotic and eukaryotic cells. Topics will address the molecular control mechanisms associated with DNA replication, RNA transcription, RNA processing, and differential gene expression. Typically offered Fall.

### **BIOL 42000 - Eukaryotic Cell Biology**

Credit Hours: 3.00. Composition, structure, regulation, and growth of eukaryotic cells. Typically offered Fall.

- Base Lab Requirement (Req #14) - Credit Hours: 2.00 - 4.00

### **BIOL 59500 - Special Assignments**

Arrange Hours and Credit. Special work, such as directed reading, independent study or research, supervised library, laboratory, or field work, or presentation of material not available in the formal courses of the department. The field in which work is offered will be indicated in the student's record. Permission of instructor required. Typically offered Fall Spring Summer.

### **BCHM 56100 - General Biochemistry I**

Credit Hours: 3.00. This course provides upper-division undergraduate and graduate students with basic understanding of biochemical and structural properties of amino acids, nucleic acids, lipids, and carbohydrates. This course allows students to connect the relationship between structure and function of biomolecules. In addition, students learn to understand enzyme properties, enzyme mechanism of action, and enzyme regulation. Typically offered Fall.

### **BCHM 56200 - General Biochemistry II**

Credit Hours: 3.00. This course provides upper-division undergraduate and graduate students with an understanding of core metabolic pathways. Anabolic and catabolic processes of metabolic pathways are studied. Biochemical and structural knowledge

is used to determine how enzymes and coenzymes are needed to regulate and control metabolic pathways. Typically offered Spring.

### \*Major Selectives - Select course for each requirement (2-3 credits)

- Biology Selective (Req #13) - Credit Hours: 2.00 - 3.00

## Other Departmental /Program Course Requirements (67-88 credits)

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Organic CHM 1 Selective - Credit Hours: 4.00
- Organic CHM 2 Selective - Credit Hours: 4.00

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction

to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Computer Science Selective - Credit Hours: 3.00 - 4.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language & Culture 1 Selective - Credit Hours: 3.00
- Language & Culture 2 Selective - Credit Hours: 3.00
- Language & Culture 3 Selective - Credit Hours: 3.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- General Education 1 Selective (satisfies Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education 2 Selective (satisfies Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education 3 Selective - Credit Hours: 3.00
- Teambuilding & Collaboration Selective - Credit Hours: 0.00 - 3.00
- Great Issues Selective - Credit Hours: 3.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00

Analytical Chemistry Selective - Select from (0-4 credits)

### **BCHM 22100 - Analytical Biochemistry**

Credit Hours: 3.00. Discussion of qualitative and quantitative analysis of biological compounds including pH measurement and control, spectrophotometry, measurement of radioactivity; theoretical basis of various separation techniques, including chromatography and electrophoresis; application of these methods to separation and analysis of biological compounds. Laboratory sessions will provide practical experience in the use of these methods. This course is designed for biochemistry majors. Typically offered Fall Spring.

## **CHM 32100 - Analytical Chemistry I**

Credit Hours: 4.00. Quantitative measurements on complex chemical systems that show matrix effects or require isolation of a component prior to its determination; general approaches to quantitative problems at the trace level; critical comparisons of competitive procedures with emphasis on principles of separation processes, including chromatography; recognition and evaluation of possible sources of error; approaches for optimizing conditions so as to minimize time and/or effort required to attain prescribed levels of accuracy and precision. Required of students majoring in chemistry. Typically offered Fall.

## **Physical Chemistry Selective - Select from (0-6 credits)**

### **CHM 37200 - Physical Chemistry**

Credit Hours: 4.00. Principles of physical chemistry with emphasis on chemical thermodynamics and kinetics, illustrated examples from the biological sciences. Intended primarily for students in the life sciences. Typically offered Spring.

or

### **CHM 37300 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of matter. Properties of gases, liquids, and solids; equations of state; thermodynamics; energy, heat, and work; entropy; spontaneity and equilibrium; chemical potential; chemical equilibrium; phase diagrams; colligative properties. Typically offered Summer Fall.

### **CHM 37400 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of molecules. Wave properties of matter; quantum mechanics of translation, rotation, and vibration; atomic structure; molecular orbitals; quantum states; statistical mechanics; chemical kinetics; collision theory; transition state theory. Typically offered Spring.

## **Biochemistry Honors Selective (4-6 credits)**

### **CHM 32100 - Analytical Chemistry I**

Credit Hours: 4.00. Quantitative measurements on complex chemical systems that show matrix effects or require isolation of a component prior to its determination; general approaches to quantitative problems at the trace level; critical comparisons of competitive procedures with emphasis on principles of separation processes, including chromatography; recognition and evaluation of possible sources of error; approaches for optimizing conditions so as to minimize time and/or effort required to attain prescribed levels of accuracy and precision. Required of students majoring in chemistry. Typically offered Fall.

or

## **CHM 37300 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of matter. Properties of gases, liquids, and solids; equations of state; thermodynamics; energy, heat, and work; entropy; spontaneity and equilibrium; chemical potential; chemical equilibrium; phase diagrams; colligative properties. Typically offered Summer Fall.

## **CHM 37400 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of molecules. Wave properties of matter; quantum mechanics of translation, rotation, and vibration; atomic structure; molecular orbitals; quantum states; statistical mechanics; chemical kinetics; collision theory; transition state theory. Typically offered Spring.

## **Calculus 1 Selective - Select from (4-5 credits)**

(satisfies Quantitative Reasoning Selective for core)

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## **Calculus 2 Selective - Select from (4-5 credits)**

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.  
CTL:IMA 1603 Calculus - Long II

## **Electives (0-12 credits)**

## **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

## **Program Requirements**

### **Fall 1st Year**

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

#### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

#### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Calculus I Selective - Credit Hours: 4.00 - 5.00
- Language/Culture 1 Selective - Credit Hours: 3.00

## **BIOL 11500 - Biology Resource Seminar**

Credit Hours: 1.00. This course is designed to help integrate new biology students into the Department of Biological Sciences, to help them adjust to university life, and to assist them in developing academic and intellectual survival skills using the medium of introductory Biology courses. The course meets twice a week in groups of 20-25 students. Each section is led by an academic advisor and an undergraduate teaching intern. The class periods have an on-going emphasis on connecting students to one another as resources while learning information, critical thinking skills and problem-solving strategies. Topics include bioethics, time management, available academic resources, biology majors and curricula and career development. Students are exposed to opportunities in undergraduate research, summer internships, the study abroad program, and teaching internships. Throughout the course, students are encouraged to plan their college education rather than merely choose their courses. Permission of department required. Typically offered Fall.

17-18 Credits

Spring 1st Year

## **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

- Organic Chem 1 Selective - Credit Hours: 4.00
- Calculus II Selective - Credit Hours: 4.00 - 5.00
- Language/Culture 2 Selective - Credit Hours: 3.00

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

17-19 Credits

Fall 2nd Year

## **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

## **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

- Organic Chem 2 Selective - Credit Hours: 4.00
- Language/Culture 3 Selective - Credit Hours: 3.00

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

15 Credits

Spring 2nd Year

## **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are

transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

- General Education 1 Selective - Credit Hours: 3.00

14 Credits

Fall 3rd Year

### **BCHM 56100 - General Biochemistry I**

Credit Hours: 3.00. This course provides upper-division undergraduate and graduate students with basic understanding of biochemical and structural properties of amino acids, nucleic acids, lipids, and carbohydrates. This course allows students to connect the relationship between structure and function of biomolecules. In addition, students learn to understand enzyme properties, enzyme mechanism of action, and enzyme regulation. Typically offered Fall.

### **BIOL 39500 - Special Assignments**

Arrange Hours and Credit. Reading, discussions, written reports, seminar presentations, and field or laboratory work provided for enrichment in special areas of the biological sciences. Permission of instructor required. Typically offered Fall Spring Summer.

- Computer Science Selective - Credit Hours: 3.00 - 4.00
- General Education 2 Selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

15-16 Credits

Spring 3rd Year

### **BCHM 56200 - General Biochemistry II**

Credit Hours: 3.00. This course provides upper-division undergraduate and graduate students with an understanding of core metabolic pathways. Anabolic and catabolic processes of metabolic pathways are studied. Biochemical and structural knowledge is used to determine how enzymes and coenzymes are needed to regulate and control metabolic pathways. Typically offered Spring.

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **BIOL 41500 - Introduction To Molecular Biology**

Credit Hours: 3.00. An introduction to modern molecular biology techniques and how they are used to address current topics in gene regulation. Emphasis will be placed on experimental procedures and model systems, such as site-directed mutagenesis of isolated genes and their subsequent introduction into prokaryotic and eukaryotic cells. Topics will address the molecular control mechanisms associated with DNA replication, RNA transcription, RNA processing, and differential gene expression. Typically offered Fall.

- General Education 3 Selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

16 Credits

Fall 4th Year

### **BIOL 42000 - Eukaryotic Cell Biology**

Credit Hours: 3.00. Composition, structure, regulation, and growth of eukaryotic cells. Typically offered Fall.

## **BIOL 59500 - Special Assignments**

Arrange Hours and Credit. Special work, such as directed reading, independent study or research, supervised library, laboratory, or field work, or presentation of material not available in the formal courses of the department. The field in which work is offered will be indicated in the student's record. Permission of instructor required. Typically offered Fall Spring Summer.

- Analytical Chemistry Selective - Credit Hours: 3.00 - 4.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00
- Biology Selective - Credit Hours: 2.00 - 3.00

## 12-15 Credits

### Spring 4th Year

- Physical Chemistry Selective - Credit Hours: 4.00

## **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Great Issues Selective - Credit Hours: 3.00
- Base Lab Requirement- Credit Hours: 2.00 - 4.00
- Free Elective - Credit Hours: 2.00

## 14-16 Credits

### Note

120 semester credits required for Bachelor of Science degree.

3.0 Graduation GPA required for Biochemistry Honors major.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Biology, BS

## About the Program

The Biology major allows a student to pursue a general curriculum with the bachelor of science as a terminal degree or as preparation for graduate work or professional school. This major is designed to give a student maximum flexibility in designing a plan of study suited to individual needs and interests. This curriculum is excellent preparation for a number of careers in both academic and industrial research and professions in medicine, dentistry, and veterinary medicine.

Biology Website

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Biology include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

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BIOLOGY-BS

Code-BIOL

120 Credits

## Departmental/Program Major Courses (34-37 credits)

\*A 2.0 average is required in these courses

### \*Required Major Courses (19 credits)

**BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

### **BIOL 14501 - First Year Biology Laboratory With Neuro Research Project**

Credit Hours: 2.00. This laboratory course has been designed under the goals of the Center for Authentic Science Practice in Education (CASPiE) which aims to expose students to novel research as a means to teach them laboratory science. This course is designed to engage students in authentic research while acquiring necessary skills and concepts to be successful as a biology major. Our topic is Neuroanatomy of Auditory Pathways. We will begin with a series of skills and knowledge building weeks and then transition into independent research projects that culminate in a public presentation of the data in a poster session. In this course, students will learn the fundamentals in neurobiology as well as use sophisticated analysis and instrumentation to answer a research question. Critical thinking in experimental design as well as interpretation and communication of data will be stressed. The goals for this course are to gain a foundation in basic biological measurements and techniques, hone the analytical skills, appreciate the excitement of scientific discovery, and have fun along the way. Permission of department required. Typically offered Fall.

### **IT 22600 - Biotechnology Laboratory I**

Credit Hours: 2.00. Focuses on nucleic acid manipulation. Modules include, making a eukaryotic library, identifying clones, sub-cloning into a bacterial expression vector and verification of the clone's identity by restriction analysis and DNA sequencing. Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures. Typically offered Summer Fall Spring.

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

### **\*Intermediate Biology Selective (3-4 credits)**

Select one; cannot also be used for Major Selectives below

- Intermediate Biology Selective (Req #9) - Credit Hours: 3.00 - 4.00

### **\*Biology Selectives (must total at least 12 credits)**

Can use one course for multiple requirements

- Group A Selective (Req #10) - Credit Hours: 2.00 - 3.00
- Group B Selective (Req #10) - Credit Hours: 2.00 - 3.00
- 500 Level Biology Selective (Req #10) - Credit Hours: 2.00 - 4.00
- Base Lab Requirement (Req #10) - Credit Hours: 2.00 - 4.00

### **Other Departmental /Program Course Requirements (64-76 credits)**

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Organic CHM 1 Selective - Credit Hours: 4.00
- Organic CHM 2 Selective - Credit Hours: 4.00
- Chemistry Selective - Credit Hours: 3.00 - 4.00
- PHYS 1 Selective - Select from PHYS 23300 or 17200 (satisfies Science Selective for core) - Credit Hours: 4.00
- PHYS 2 Selective - Select from PHYS 23400 or 27200 - Credit Hours: 4.00

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Computer Science Selective (may also meet Teambuilding & Collaboration for Science core) - Credit Hours: 3.00 - 4.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language & Culture 1 Selective - Credit Hours: 3.00
- Language & Culture 2 Selective - Credit Hours: 3.00
- Language & Culture 3 Selective - Credit Hours: 3.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- General Education 1 Selective (may satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education 2 Selective (may satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education 3 Selective - Credit Hours: 3.00
- Great Issues Selective (may also meet Teambuilding & Collaboration for Science core) - Credit Hours: 3.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00

## Calculus 1 Selective - Select from (3-5 credits)

(satisfies Quantitative Reasoning Selective for core)

### **MA 16010 - Applied Calculus I**

Credit Hours: 3.00. Topics include trigonometric and exponential functions; limits and differentiation, rules of differentiation, maxima, minima and optimization; curve sketching, integration, anti-derivatives, fundamental theorem of calculus. Properties of definite integrals and numerical methods. Applications to life, managerial and social sciences. Typically offered Fall Spring Summer.

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## Calculus 2 Selective - Select from (3-5 credits)

### **MA 16020 - Applied Calculus II**

Credit Hours: 3.00. This course covers techniques of integration; infinite series, convergence tests; differentiation and integration of functions of several variables; maxima and minima, optimization; differential equations and initial value problems; matrices, determinants, eigenvalues and eigenvectors. Applications. Typically offered Fall Spring Summer.

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

## **MA 17300 - Calculus And Analytic Geometry II**

Credit Hours: 5.00. Calculus of transcendental functions, techniques of integration, conic sections, polar coordinates, parametric equations, infinite series. Admission restricted to those who have established credit in Calculus I. Typically offered Fall.

## **Electives (7-22 credits)**

## **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or click here.

## **Program Requirements**

### **Fall 1st Year**

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

- Fr. Lab - Credit Hours: 2.00

## **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Calculus I Selective - Credit Hours: 3.00 - 5.00
- Language/Culture 1 Selective - Credit Hours: 3.00

## **BIOL 11500 - Biology Resource Seminar**

Credit Hours: 1.00. This course is designed to help integrate new biology students into the Department of Biological Sciences, to help them adjust to university life, and to assist them in developing academic and intellectual survival skills using the medium of introductory Biology courses. The course meets twice a week in groups of 20-25 students. Each section is led by an academic advisor and an undergraduate teaching intern. The class periods have an on-going emphasis on connecting students to one another as resources while learning information, critical thinking skills and problem-solving strategies. Topics include bioethics, time management, available academic resources, biology majors and curricula and career development. Students are exposed to opportunities in undergraduate research, summer internships, the study abroad program, and teaching internships. Throughout the course, students are encouraged to plan their college education rather than merely choose their courses. Permission of department required. Typically offered Fall.

16-18 Credits

Spring 1st Year

## **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

- Organic Chem 1 Selective - Credit Hours: 4.00
- Calculus II Selective - Credit Hours: 3.00 - 5.00
- Language/Culture 2 Selective - Credit Hours: 3.00

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

16-17 Credits

Fall 2nd Year

## **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

## **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

- Organic Chem 2 Selective - Credit Hours: 4.00
- Language/Culture 3 Selective - Credit Hours: 3.00

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

15 Credits

Spring 2nd Year

## **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

## **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

- Chemistry Selective - Credit Hours: 3.00 - 4.00

## **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

## **BIOL 29300 - Sophomore Seminar: Planning Your Future In Biology**

Credit Hours: 1.00. Biology 29300 is a one-credit course designed for sophomores in the Department of Biological Sciences. This course will help students maximize the remainder of their undergraduate career. The course will cover biology career information and suggestions for professional development. Students will learn about the various disciplines that make up modern Biological Sciences. Students will learn about opportunities in undergraduate research and tour a research laboratory. In-depth presentations from biology alumni from a variety of fields are featured. Assignments include a Plan of Study, a resume, and a written paper evaluating the career path of one alumni speaker and describing the student's response to the presentation. Typically offered Spring.

- General Education 1 Selective - Credit Hours: 3.00

## **14-15 Credits**

### **Fall 3rd Year**

- Intermediate Biology Selective (Req #9) - Credit Hours: 3.00
- Group A Selective (Req #10) - Credit Hours: 2.00 - 3.00
- PHYS 1 Selective - Credit Hours: 4.00
- General Education 2 Selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

## 15-16 Credits

### Spring 3rd Year

- Group B Selective (Req #10) - Credit Hours: 3.00
- Computer Science Selective - Credit Hours: 3.00 - 4.00
- PHYS 2 Selective - Credit Hours: 4.00

### **BIOL 39300 - Preparing For Your Future In Biology**

Credit Hours: 1.00. Biology 39300 is a one-credit course for junior and seniors in the Department of Biological Sciences. This course will help students begin to prepare for life after Purdue. Students will learn about interviewing, job searching, graduate and professional school searching, resumes, industrial practices, and how to evaluate job/school offers. Construct a polished image on top of your solid biology foundation! Get the job or get admitted to the school you want. Typically offered Spring.

- General Education 3 Selective - Credit Hours: 3.00

## 14-15 Credits

### Fall 4th Year

- Base Lab Requirement (Req #10) - Credit Hours: 2.00 - 4.00

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00
- Elective - Credit Hours: 3.00
- Elective - Credit Hours: 5.00

## 14-17 Credits

### Spring 4th Year

- 500 Level Biology Selective (Req #10) - Credit Hours: 3.00
- Biology Selective (Req #10) - Credit Hours: 3.00
- Great Issues Selective - Credit Hours: 3.00

- Elective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

## 15 Credits

## Note

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Cell, Molecular, and Developmental Biology, BS

## About the Program

Understanding how eukaryotic cells process information from their environment and initiate programs of gene expression leading to growth, development, and functional specification is the essence of a cell, molecular, and developmental (CMD) biology major. Students enrolled in this curriculum will take courses providing a solid foundation in the molecular biology of cells and gain a full appreciation of how molecular complexes interact to make a cell function. This fundamental knowledge in cell and molecular biology will be applied through further coursework in genetics and developmental biology to examine how eukaryotic organisms function and how specific aspects of that function are perturbed by disease. Within the CMD major, students have the option of focusing their studies on animal systems, plant systems, or both. Graduates with a CMD major are well-prepared to pursue careers in academic or industrial research, biotechnology, genetic engineering, medicine, veterinary medicine, and other health-related professions.

Cell, Molecular, and Developmental Biology Website

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Cell Molecular Developmental Biology include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

BIOLOGY-BS  
Code-CMDB  
120 Credits

## Departmental/Program Major Courses (36-38 credits)

\*A 2.0 average is required in these courses

### \*Required Major Courses (21-23 credits)

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

#### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

#### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

#### **BIOL 14501 - First Year Biology Laboratory With Neuro Research Project**

Credit Hours: 2.00. This laboratory course has been designed under the goals of the Center for Authentic Science Practice in Education (CASPIE) which aims to expose students to novel research as a means to teach them laboratory science. This course is designed to engage students in authentic research while acquiring necessary skills and concepts to be successful as a biology major. Our topic is Neuroanatomy of Auditory Pathways. We will begin with a series of skills and knowledge building weeks and then transition into independent research projects that culminate in a public presentation of the data in a poster session. In this course, students will learn the fundamentals in neurobiology as well as use sophisticated analysis and instrumentation to answer a research question. Critical thinking in experimental design as well as interpretation and communication of data will be stressed. The goals for this course are to gain a foundation in basic biological measurements and techniques, hone the analytical skills, appreciate the excitement of scientific discovery, and have fun along the way. Permission of department required. Typically offered Fall.

## **IT 22600 - Biotechnology Laboratory I**

Credit Hours: 2.00. Focuses on nucleic acid manipulation. Modules include, making a eukaryotic library, identifying clones, sub-cloning into a bacterial expression vector and verification of the clone's identity by restriction analysis and DNA sequencing. Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures. Typically offered Summer Fall Spring.

## **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

## **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

## **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

## **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

## **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

- Base Lab Requirement (Req # 12) - Credit Hours: 2.00 - 4.00

**\*Major Selectives - Select one course for each requirement (15 credits)**

- Intermediate Requirement Selective (Req # 9) - Credit Hours: 3.00
- Cell/Molecular/Development Selective (Req # 10) - Credit Hours: 3.00
- Cell/Molecular/Development Selective (Req # 10) - Credit Hours: 3.00
- 500 Level Biology Selective (Req # 12) - Credit Hours: 3.00
- Biology Selective (Req # 14) - Credit Hours: 3.00

## Other Departmental /Program Course Requirements (64-76 credits)

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Organic CHM 1 Selective - Credit Hours: 4.00
- Organic CHM 2 Selective - Credit Hours: 4.00
- Chemistry Selective - Credit Hours: 3.00 - 4.00
- PHYS 1 Selective - Select from PHYS 23300 or 17200 (satisfies Science Selective for core) - Credit Hours: 4.00
- PHYS 2 Selective - Select from PHYS 23400 or 27200 - Credit Hours: 4.00

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Computer Science Selective - Credit Hours: 3.00 - 4.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language & Culture 1 Selective - Credit Hours: 3.00
- Language & Culture 2 Selective - Credit Hours: 3.00
- Language & Culture 3 Selective - Credit Hours: 3.00

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- General Education 1 Selective (satisfies Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education 2 Selective (satisfies Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education 3 Selective - Credit Hours: 3.00
- Teambuilding & Collaboration Selective - Credit Hours: 0.00 - 3.00
- Great Issues Selective - Credit Hours: 3.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00

## **Calculus 1 Selective - Select from (3-5 credits)**

(satisfies Quantitative Reasoning Selective for core)

### **MA 16010 - Applied Calculus I**

Credit Hours: 3.00. Topics include trigonometric and exponential functions; limits and differentiation, rules of differentiation, maxima, minima and optimization; curve sketching, integration, anti-derivatives, fundamental theorem of calculus. Properties of definite integrals and numerical methods. Applications to life, managerial and social sciences. Typically offered Fall Spring Summer.

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course

MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## Calculus 2 Selective - Select from (3-5 credits)

### **MA 16020 - Applied Calculus II**

Credit Hours: 3.00. This course covers techniques of integration; infinite series, convergence tests; differentiation and integration of functions of several variables; maxima and minima, optimization; differential equations and initial value problems; matrices, determinants, eigenvalues and eigenvectors. Applications. Typically offered Fall Spring Summer.

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.  
CTL:IMA 1603 Calculus - Long II

### **MA 17300 - Calculus And Analytic Geometry II**

Credit Hours: 5.00. Calculus of transcendental functions, techniques of integration, conic sections, polar coordinates, parametric equations, infinite series. Admission restricted to those who have established credit in Calculus I. Typically offered Fall.

## Electives (6-20 credits)

## University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society

- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or click here.

## Program Requirements

### Fall 1st Year

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

#### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

#### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Calculus I Selective - Credit Hours: 3.00 - 5.00
- Language/Culture 1 Selective - Credit Hours: 3.00

#### **BIOL 11500 - Biology Resource Seminar**

Credit Hours: 1.00. This course is designed to help integrate new biology students into the Department of Biological Sciences, to help them adjust to university life, and to assist them in developing academic and intellectual survival skills using the medium of introductory Biology courses. The course meets twice a week in groups of 20-25 students. Each section is led by an academic advisor and an undergraduate teaching intern. The class periods have an on-going emphasis on connecting students to one another as resources while learning information, critical thinking skills and problem-solving strategies. Topics include bioethics, time management, available academic resources, biology majors and curricula and career development. Students are exposed to opportunities in undergraduate research, summer internships, the study abroad program, and teaching internships. Throughout the

course, students are encouraged to plan their college education rather than merely choose their courses. Permission of department required. Typically offered Fall.

16-18 Credits

Spring 1st Year

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

- Organic Chem 1 Selective - Credit Hours: 4.00
- Calculus II Selective - Credit Hours: 3.00 - 5.00
- Language/Culture 2 Selective - Credit Hours: 3.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

16-19 Credits

Fall 2nd Year

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

- Organic Chem 2 Selective - Credit Hours: 4.00
- Language/Culture 3 Selective - Credit Hours: 3.00

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

15 Credits

Spring 2nd Year

## **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

## **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

- Chemistry Selective - Credit Hours: 3.00 - 4.00

## **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

## **BIOL 29300 - Sophomore Seminar: Planning Your Future In Biology**

Credit Hours: 1.00. Biology 29300 is a one-credit course designed for sophomores in the Department of Biological Sciences. This course will help students maximum the remainder of their undergraduate career. The course will cover biology career

information and suggestions for professional development. Students will learn about the various disciplines that make up modern Biological Sciences. Students will learn about opportunities in undergraduate research and tour a research laboratory. In-depth presentations from biology alumni from a variety of fields are featured. Assignments include a Plan of Study, a resume, and a written paper evaluating the career path of one alumni speaker and describing the student's response to the presentation. Typically offered Spring.

- General Education 1 Selective - Credit Hours: 3.00

## 14-15 Credits

### Fall 3rd Year

- Intermediate Requirement Selective (Req # 9) - Credit Hours: 3.00
- PHYS 1 Selective - Credit Hours: 4.00
- General Education 2 Selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

## 16 Credits

### Spring 3rd Year

- Cell/Molecular/Developmental Selective (Req # 10) - Credit Hours: 3.00
- PHYS 2 Selective - Credit Hours: 4.00
- Computer Science Selective - Credit Hours: 3.00 - 4.00

### **BIOL 39300 - Preparing For Your Future In Biology**

Credit Hours: 1.00. Biology 39300 is a one-credit course for junior and seniors in the Department of Biological Sciences. This course will help students begin to prepare for life after Purdue. Students will learn about interviewing, job searching, graduate and professional school searching, resumes, industrial practices, and how to evaluate job/school offers. Construct a polished image on top of your solid biology foundation! Get the job or get admitted to the school you want. Typically offered Spring.

- General Education 3 Selective - Credit Hours: 3.00
- Elective - Credit Hours: 1.00

## 15-16 Credits

### Fall 4th Year

- Cell/Molecular/Developmental Selective (Req # 10) - Credit Hours: 3.00
- Base Lab Requirement (Req # 12) - Credit Hours: 2.00 - 4.00

## STAT 50300 - Statistical Methods For Biology

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00
- Elective - Credit Hours: 3.00

## 12-16 Credits

### Spring 4th Year

- BIOL Selective (Req # 14) - Credit Hours: 3.00
- 500 Level Biology Selective (Req # 13) - Credit Hours: 3.00
- Great Issues Selective - Credit Hours: 3.00
- Elective - Credit Hours: 4.00

## 13 Credits

### Note

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

# Ecology, Evolution, and Environmental Biology, BS

## About the Program

This major investigates how organisms interact with their physical environment and other organisms, from an evolutionary perspective. Ecologists' work includes research and/or teaching involving population genetics and evolution, adaptive strategies for survival, the nature of populations, and community ecology. Ecologists also offer technical services in connection with environmental impact decisions and regional planning, and environmental education at various levels as teacher, naturalist, or journalist. Common career paths for undergraduate students include graduate study leading to academic positions (research and teaching in small colleges and major universities), technical positions in industry (mostly dealing with environmental assessment), and employment in state and federal environmental agencies.

Ecology, Evolution, and Environmental Sciences Website

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Ecology Evolution & Environmental Biology include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

BIOLOGY-BS  
Code-EEEE  
120 Credits

## Departmental/Program Major Courses (35-41 credits)

\*A 2.0 average is required in these courses

### \*Required Major Courses (27-29 credits)

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

#### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

#### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

### **BIOL 14501 - First Year Biology Laboratory With Neuro Research Project**

Credit Hours: 2.00. This laboratory course has been designed under the goals of the Center for Authentic Science Practice in Education (CASPIE) which aims to expose students to novel research as a means to teach them laboratory science. This course is designed to engage students in authentic research while acquiring necessary skills and concepts to be successful as a biology major. Our topic is Neuroanatomy of Auditory Pathways. We will begin with a series of skills and knowledge building weeks and then transition into independent research projects that culminate in a public presentation of the data in a poster session. In this course, students will learn the fundamentals in neurobiology as well as use sophisticated analysis and instrumentation to answer a research question. Critical thinking in experimental design as well as interpretation and communication of data will be stressed. The goals for this course are to gain a foundation in basic biological measurements and techniques, hone the analytical skills, appreciate the excitement of scientific discovery, and have fun along the way. Permission of department required. Typically offered Fall.

### **IT 22600 - Biotechnology Laboratory I**

Credit Hours: 2.00. Focuses on nucleic acid manipulation. Modules include, making a eukaryotic library, identifying clones, sub-cloning into a bacterial expression vector and verification of the clone's identity by restriction analysis and DNA sequencing. Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures. Typically offered Summer Fall Spring.

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

## **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

## **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

## **BIOL 58000 - Evolution**

Credit Hours: 3.00. A study of evolution as a basic concept of the biological sciences; an examination of current methods of experimentation within the area, as well as evidences for the possible mechanisms of evolutionary change. Typically offered Spring.

## **BIOL 58500 - Ecology**

Credit Hours: 3.00. Ecological processes and dynamics of populations, communities, and ecosystems; physical, physiological, behavioral, and population genetic factors regulating population and community structure; case studies; field studies, and simulation models of life history attributes, competition, predation, parasitism, and mutualism. Typically offered Fall.

- Base Lab Requirement - Credit Hours: 2.00 - 4.00

## **\*Intermediate Biology Selective (3-4 credits)**

Select one; cannot also be used for Major Selectives below

- Intermediate Biology Selective (Req #9) - Credit Hours: 3.00 - 4.00

## **\*Major Selectives (5-8 credits)**

Select one unique course for each: one course may satisfy only one selective

- Biology Selective (Req # 13) - Credit Hours: 3.00 - 4.00
- Biology Selective (Req # 14) - Credit Hours: 2.00 - 4.00

## **Other Departmental /Program Course Requirements (64-76 credits)**

## **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Organic CHM 1 Selective - Credit Hours: 4.00
- Organic CHM 2 Selective - Credit Hours: 4.00
- Chemistry Selective - Credit Hours: 4.00
- PHYS 1 Selective - Select from PHYS 23300 or 17200 (satisfies Science Selective for core) - Credit Hours: 4.00
- PHYS 2 Selective - Select from PHYS 23400 or 27200 - Credit Hours: 4.00
- Calculus 1 Selective - Select from MA 16010, MA 16100, or MA 16500 - Credit Hours: 3.00 - 5.00 (*satisfies Quantitative Reasoning Selective for core*)
- Calculus 2 Selective- Select from MA 16020, MA 16200, MA 16600 or MA 17300 - Credit Hours 3.00 - 5.00

## **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Computer Science Selective - Credit Hours: 3.00 - 4.00

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

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Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language & Culture 1 Selective - Credit Hours: 3.00
- Language & Culture 2 Selective - Credit Hours: 3.00
- Language & Culture 3 Selective - Credit Hours: 3.00

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- General Education 1 Selective (satisfies Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education 2 Selective (satisfies Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education 3 Selective - Credit Hours: 3.00
- Teambuilding & Collaboration Selective - Credit Hours: 0.00 - 3.00
- Great Issues Selective - Credit Hours: 3.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00

## **Electives (3-21 credits)**

### **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

## **Program Requirements**

### **Fall 1st Year**

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

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- Calculus I Selective - Credit Hours: 3.00 - 5.00
- Language/Culture 1 Selective - Credit Hours: 3.00

## **BIOL 11500 - Biology Resource Seminar**

Credit Hours: 1.00. This course is designed to help integrate new biology students into the Department of Biological Sciences, to help them adjust to university life, and to assist them in developing academic and intellectual survival skills using the medium of introductory Biology courses. The course meets twice a week in groups of 20-25 students. Each section is led by an academic advisor and an undergraduate teaching intern. The class periods have an on-going emphasis on connecting students to one another as resources while learning information, critical thinking skills and problem-solving strategies. Topics include bioethics, time management, available academic resources, biology majors and curricula and career development. Students are exposed to opportunities in undergraduate research, summer internships, the study abroad program, and teaching internships. Throughout the course, students are encouraged to plan their college education rather than merely choose their courses. Permission of department required. Typically offered Fall.

16-18 Credits

Spring 1st Year

## **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

- Organic Chem 1 Selective - Credit Hours: 4.00
- Calculus II Selective - Credit Hours: 3.00 - 5.00
- Language/Culture 2 Selective - Credit Hours: 3.00

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

16-19 Credits

Fall 2nd Year

## **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

## **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

- Organic Chem 2 Selective - Credit Hours: 4.00
- Language/Culture 3 Selective - Credit Hours: 3.00

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

15 Credits

## Spring 2nd Year

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

- Chemistry Selective - Credit Hours: 3.00 - 4.00

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

- Elective (BIOL 28600 preferred) - Credit Hours: 1.00
- General Education 1 Selective - Credit Hours: 3.00

## 14-15 Credits

## Fall 3rd Year

### **BIOL 58500 - Ecology**

Credit Hours: 3.00. Ecological processes and dynamics of populations, communities, and ecosystems; physical, physiological, behavioral, and population genetic factors regulating population and community structure; case studies; field studies, and simulation models of life history attributes, competition, predation, parasitism, and mutualism. Typically offered Fall.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction

to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- PHYS 1 Selective - Credit Hours: 4.00
- General Education 2 Selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

## 16 Credits

### Spring 3rd Year

- 500 Level Biology Selective (Req # 13) - Credit Hours: 3.00
- PHYS 2 Selective - Credit Hours: 4.00
- Computer Science Selective - Credit Hours: 3.00 - 4.00
- Elective: (BIOL 39300 preferred) - Credit Hours: 1.00
- General Education 3 Selective - Credit Hours: 3.00

## 14-15 Credits

### Fall 4th Year

- Intermediate Biology Selective (Req #9) - Credit Hours: 3.00
- Biology Selective (Req # 14) - Credit Hours: 3.00 -4.00
- Base Lab Requirement - Credit Hours: 2.00 - 4.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00
- Elective - Credit Hours: 4.00

## 13-18 Credits

### Spring 4th Year

- BIOL 58000 Evolution
- Great Issues Selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

## 12-14 Credits

## Note

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Genetics, BS

## About the Program

Genetics is the science of information transfer from one generation to another. We learn the laws of inheritance in all creatures big and small, how they evolve and how they change. On the molecular level we learn about DNA and RNA, on the cellular level we discover what makes a cell cancerous, and on an organismal level we examine the reproductive habits of various organisms. Crucial principles include the structure, function, and transmission of genes. Laboratory techniques explore genetic engineering from the "inside." Genetics is crucial to all of biology, hence a genetics major has great flexibility. This is excellent preparation for advanced study in biological sciences, law, genetic counseling, and many health-related professions.

Genetic Biology Website

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Genetics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

BIOLOGY-BS  
Code-GNTC  
120 Credits

## Departmental/Program Major Courses (34-37 credits)

\*A 2.0 average is required in these courses

## \*Required Major Courses (25-27 credits)

### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

### **BIOL 14501 - First Year Biology Laboratory With Neuro Research Project**

Credit Hours: 2.00. This laboratory course has been designed under the goals of the Center for Authentic Science Practice in Education (CASPiE) which aims to expose students to novel research as a means to teach them laboratory science. This course is designed to engage students in authentic research while acquiring necessary skills and concepts to be successful as a biology major. Our topic is Neuroanatomy of Auditory Pathways. We will begin with a series of skills and knowledge building weeks and then transition into independent research projects that culminate in a public presentation of the data in a poster session. In this course, students will learn the fundamentals in neurobiology as well as use sophisticated analysis and instrumentation to answer a research question. Critical thinking in experimental design as well as interpretation and communication of data will be stressed. The goals for this course are to gain a foundation in basic biological measurements and techniques, hone the analytical skills, appreciate the excitement of scientific discovery, and have fun along the way. Permission of department required. Typically offered Fall.

### **IT 22600 - Biotechnology Laboratory I**

Credit Hours: 2.00. Focuses on nucleic acid manipulation. Modules include, making a eukaryotic library, identifying clones, sub-cloning into a bacterial expression vector and verification of the clone's identity by restriction analysis and DNA sequencing. Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures. Typically offered Summer Fall Spring.

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

### **BIOL 44100 - Biology Senior Seminar In Genetics**

Credit Hours: 1.00. This is a required course for genetics majors. It provides exposure to current research in genetics and molecular biology via invited faculty speakers. Students enrolled in the course who have actively participated in research also give a presentation on their own work. Other students are assigned to review current literature in one aspect of the semester's topic. The topic selected for review is in an area of current research in genetics and may vary from year to year. Typically offered Fall.

### **BIOL 48100 - Eukaryotic Genetics**

Credit Hours: 3.00. This course presents the fundamental concepts of classical and modern molecular genetics in eukaryotic systems, using examples from the model genetic organisms, yeast, *Drosophila*, *Caenorhabditis*, *Arabidopsis*, maize, mice and humans. These concepts are applied to solving problems of genetic analysis. Recent advances in developmental, cancer, and

behavioral genetics and genomics, and applications of genetic technology, are used to demonstrate the impact that modern genetics makes at the cutting edge of biological research. Typically offered Spring.

- **Base Lab Requirement** - Credit Hours: 2.00 - 4.00

### **\*Intermediate Biology Selective (3-4 credits)**

Select one; cannot also be used for Major Selectives below

- Intermediate Biology Selective (Req #9) - Credit Hours: 3.00 - 4.00

### **\*Major Selectives - Select course for each requirement (6 credits)**

- 500 Level Biology Selective (Req # 13) - Credit Hours: 3.00
- Biology Selective (Req # 13) - Credit Hours: 3.00

## **Other Departmental /Program Course Requirements (64-76 credits)**

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Organic CHM 1 Selective - Credit Hours: 4.00
- Organic CHM 2 Selective - Credit Hours: 4.00
- Chemistry Selective - Credit Hours: 3.00 - 4.00
- PHYS 1 Selective - Select from PHYS 23300 or 17200 (satisfies Science Selective for core) - Credit Hours: 4.00
- PHYS 2 Selective - Select from PHYS 23400 or 27200 - Credit Hours: 4.00

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Computer Science Selective - Credit Hours: 3.00 - 4.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language & Culture 1 Selective - Credit Hours: 3.00
- Language & Culture 2 Selective - Credit Hours: 3.00
- Language & Culture 3 Selective - Credit Hours: 3.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- General Education 1 Selective (satisfies Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education 2 Selective (satisfies Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education 3 Selective - Credit Hours: 3.00
- Teambuilding & Collaboration Selective - Credit Hours: 0.00 - 3.00
- Great Issues Selective - Credit Hours: 3.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00

### **Calculus 1 Selective - Select from (3-5 credits)**

(satisfies Quantitative Reasoning Selective for core)

### **MA 16010 - Applied Calculus I**

Credit Hours: 3.00. Topics include trigonometric and exponential functions; limits and differentiation, rules of differentiation, maxima, minima and optimization; curve sketching, integration, anti-derivatives, fundamental theorem of calculus. Properties of definite integrals and numerical methods. Applications to life, managerial and social sciences. Typically offered Fall Spring Summer.

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## **Calculus 2 Selective - Select from (3-5 credits)**

### **MA 16020 - Applied Calculus II**

Credit Hours: 3.00. This course covers techniques of integration; infinite series, convergence tests; differentiation and integration of functions of several variables; maxima and minima, optimization; differential equations and initial value problems; matrices, determinants, eigenvalues and eigenvectors. Applications. Typically offered Fall Spring Summer.

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

### **MA 17300 - Calculus And Analytic Geometry II**

Credit Hours: 5.00. Calculus of transcendental functions, techniques of integration, conic sections, polar coordinates, parametric equations, infinite series. Admission restricted to those who have established credit in Calculus I. Typically offered Fall.

## **Electives (7-22 credits)**

## **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

## Program Requirements

### Fall 1st Year

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

#### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

#### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Calculus I Selective - Credit Hours: 3.00 - 5.00
- Language/Culture 1 Selective - Credit Hours: 3.00

#### **BIOL 11500 - Biology Resource Seminar**

Credit Hours: 1.00. This course is designed to help integrate new biology students into the Department of Biological Sciences, to help them adjust to university life, and to assist them in developing academic and intellectual survival skills using the medium of introductory Biology courses. The course meets twice a week in groups of 20-25 students. Each section is led by an academic advisor and an undergraduate teaching intern. The class periods have an on-going emphasis on connecting students to one another as resources while learning information, critical thinking skills and problem-solving strategies. Topics include bioethics, time management, available academic resources, biology majors and curricula and career development. Students are exposed to opportunities in undergraduate research, summer internships, the study abroad program, and teaching internships. Throughout the course, students are encouraged to plan their college education rather than merely choose their courses. Permission of department required. Typically offered Fall.

16-18 Credits

Spring 1st Year

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

- Organic Chem 1 Selective - Credit Hours: 4.00
- Calculus II Selective - Credit Hours: 3.00 - 5.00
- Language/Culture 2 Selective - Credit Hours: 3.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

16-19 Credits

Fall 2nd Year

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

- Organic Chem 2 Selective - Credit Hours: 4.00
- Language/Culture 3 Selective - Credit Hours: 3.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

15 Credits

Spring 2nd Year

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

- Chemistry Selective - Credit Hours: 3.00 - 4.00

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

### **BIOL 29300 - Sophomore Seminar: Planning Your Future In Biology**

Credit Hours: 1.00. Biology 29300 is a one-credit course designed for sophomores in the Department of Biological Sciences. This course will help students maximize the remainder of their undergraduate career. The course will cover biology career information and suggestions for professional development. Students will learn about the various disciplines that make up modern Biological Sciences. Students will learn about opportunities in undergraduate research and tour a research laboratory. In-depth presentations from biology alumni from a variety of fields are featured. Assignments include a Plan of Study, a resume, and a written paper evaluating the career path of one alumni speaker and describing the student's response to the presentation. Typically offered Spring.

- General Education 1 Selective - Credit Hours: 3.00

### **14-15 Credits**

#### **Fall 3rd Year**

- Biology Selective (Req # 13) - Credit Hours: 3.00
- PHYS 1 Selective - Credit Hours: 4.00
- General Education 2 Selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

### **16 Credits**

#### **Spring 3rd Year**

### **BIOL 48100 - Eukaryotic Genetics**

Credit Hours: 3.00. This course presents the fundamental concepts of classical and modern molecular genetics in eukaryotic systems, using examples from the model genetic organisms, yeast, *Drosophila*, *Caenorhabditis*, *Arabidopsis*, maize, mice and humans. These concepts are applied to solving problems of genetic analysis. Recent advances in developmental, cancer, and behavioral genetics and genomics, and applications of genetic technology, are used to demonstrate the impact that modern genetics makes at the cutting edge of biological research. Typically offered Spring.

- PHYS 2 Selective - Credit Hours: 4.00
- Computer Science Selective - Credit Hours: 3.00 - 4.00

### **BIOL 39300 - Preparing For Your Future In Biology**

Credit Hours: 1.00. Biology 39300 is a one-credit course for junior and seniors in the Department of Biological Sciences. This course will help students begin to prepare for life after Purdue. Students will learn about interviewing, job searching, graduate and professional school searching, resumes, industrial practices, and how to evaluate job/school offers. Construct a polished image on top of your solid biology foundation! Get the job or get admitted to the school you want. Typically offered Spring.

- General Education 3 Selective - Credit Hours: 3.00

## 14-15 Credits

### Fall 4th Year

- Intermediate Biology Selective (Req #9) - Credit Hours: 3.00

### **BIOL 44100 - Biology Senior Seminar In Genetics**

Credit Hours: 1.00. This is a required course for genetics majors. It provides exposure to current research in genetics and molecular biology via invited faculty speakers. Students enrolled in the course who have actively participated in research also give a presentation on their own work. Other students are assigned to review current literature in one aspect of the semester's topic. The topic selected for review is in an area of current research in genetics and may vary from year to year. Typically offered Fall.

- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Elective - Credit Hours: 4.00
- Elective - Credit Hours: 1.00

## 13-17 Credits

### Spring 4th Year

- 500 Level Biology Selective (Req # 13) - Credit Hours: 3.00
- Base Lab Requirement - Credit Hours: 2.00 - 4.00
- Great Issues Selective - Credit Hours: 3.00
- Elective - Credit Hours: 5.00

## 13-15 Credits

## Note

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Health and Disease, BS

## About the Program

Health and disease is a biology program of study with an emphasis on disease-related upper-level biology courses and general education electives that relate to health. The major provides a rigorous curriculum for students interested in health careers, thus giving the student many career options after graduation.

Health and Disease Website

### **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Health and Disease include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

BIOLOGY-BS  
Code-HLDS  
120 Credits

## Departmental/Program Major Courses (39 credits)

\*A 2.0 average is required in these courses

## \*Required Major Courses (30 credits)

### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

### **BIOL 14501 - First Year Biology Laboratory With Neuro Research Project**

Credit Hours: 2.00. This laboratory course has been designed under the goals of the Center for Authentic Science Practice in Education (CASPIE) which aims to expose students to novel research as a means to teach them laboratory science. This course is designed to engage students in authentic research while acquiring necessary skills and concepts to be successful as a biology major. Our topic is Neuroanatomy of Auditory Pathways. We will begin with a series of skills and knowledge building weeks and then transition into independent research projects that culminate in a public presentation of the data in a poster session. In this course, students will learn the fundamentals in neurobiology as well as use sophisticated analysis and instrumentation to answer a research question. Critical thinking in experimental design as well as interpretation and communication of data will be stressed. The goals for this course are to gain a foundation in basic biological measurements and techniques, hone the analytical skills, appreciate the excitement of scientific discovery, and have fun along the way. Permission of department required. Typically offered Fall.

### **IT 22600 - Biotechnology Laboratory I**

Credit Hours: 2.00. Focuses on nucleic acid manipulation. Modules include, making a eukaryotic library, identifying clones, sub-cloning into a bacterial expression vector and verification of the clone's identity by restriction analysis and DNA sequencing. Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures. Typically offered Summer Fall Spring.

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

### **BIOL 30100 - Human Design: Anatomy And Physiology**

Credit Hours: 3.00. A study of human function, emphasizing physiology of body tissues and systems. Relevant aspects of anatomy and histology are also included. Use of examples from current medical practice encourages application of knowledge to predict symptoms of disease and rationale for treatment. Topics covered include histophysiology of cells and tissues, nerve and muscle physiology, the nervous system, and cardiovascular dynamics. Typically offered Fall.

### **BIOL 30200 - Human Design: Anatomy And Physiology**

Credit Hours: 3.00. A continuation of BIOL 30100. (It is helpful but not essential for this course to be preceded by BIOL 30100.) Topics covered include body fluids and renal function, respiration, endocrine systems, the gastro-intestinal system, exercise physiology, reproduction, and immunity. Typically offered Spring.

## **BIOL 43800 - General Microbiology**

Credit Hours: 3.00. An examination of microbial diversity that emphasizes the interrelationship of bacteria and their environments. This includes aspects of cell composition, metabolism, and growth of microorganisms. Typically offered Fall.

## **BIOL 43900 - Laboratory In General Microbiology**

Credit Hours: 2.00. Includes enrichment cultures to isolate microorganisms, studies of cell composition, measurements of cell growth, and examination of enzyme regulation. Typically offered Fall.

**\*Major Selectives - Select course for each requirement (must total at least 9 credits)**

- Health & Disease Selective (Req # 13) - Credit Hours: 3.00
- Biology Selective (Req # 14) - Credit Hours: 2.00 - 3.00
- 500 Level Biology Selective (Req # 14) - Credit Hours: 2.00 - 3.00
- Biology Selective (Req # 14) - Credit Hours: 0.00 - 2.00

## **Other Departmental /Program Course Requirements (70-79 credits)**

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Organic CHM 1 Selective - Credit Hours: 4.00
- Organic CHM 2 Selective - Credit Hours: 4.00
- Chemistry Selective - Credit Hours: 3.00 - 4.00
- PHYS 1 Selective - Select from PHYS 23300 or 17200 (satisfies Science Selective for core) - Credit Hours: 4.00
- PHYS 2 Selective - Select from PHYS 23400 or 27200 - Credit Hours: 4.00

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction

to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Computer Science Selective - Credit Hours: 3.00 - 4.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language & Culture 1 Selective - Credit Hours: 3.00
- Language & Culture 2 Selective - Credit Hours: 3.00
- Language & Culture 3 Selective - Credit Hours: 3.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- General Education 1 Selective (satisfies Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education 2 Selective (satisfies Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education 3 Selective - Credit Hours: 3.00
- Teambuilding & Collaboration Selective - Credit Hours: 3.00
- Great Issues Selective - Credit Hours: 3.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00
- Pre-professional Selective - Credit Hours: 3.00

### **Calculus 1 Selective - Select from (3-5 credits)**

(satisfies Quantitative Reasoning Selective for core)

### **MA 16010 - Applied Calculus I**

Credit Hours: 3.00. Topics include trigonometric and exponential functions; limits and differentiation, rules of differentiation, maxima, minima and optimization; curve sketching, integration, anti-derivatives, fundamental theorem of calculus. Properties of definite integrals and numerical methods. Applications to life, managerial and social sciences. Typically offered Fall Spring Summer.

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## **Calculus 2 Selective - Select from (3-5 credits)**

## **MA 16020 - Applied Calculus II**

Credit Hours: 3.00. This course covers techniques of integration; infinite series, convergence tests; differentiation and integration of functions of several variables; maxima and minima, optimization; differential equations and initial value problems; matrices, determinants, eigenvalues and eigenvectors. Applications. Typically offered Fall Spring Summer.

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

## **MA 17300 - Calculus And Analytic Geometry II**

Credit Hours: 5.00. Calculus of transcendental functions, techniques of integration, conic sections, polar coordinates, parametric equations, infinite series. Admission restricted to those who have established credit in Calculus I. Typically offered Fall.

## Electives (2-11 credits)

## University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or click here.

## Program Requirements

### Fall 1st Year

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

#### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

#### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures;

molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required.

Typically offered Fall.

- Calculus I Selective - Credit Hours: 3.00 - 5.00
- Language/Culture 1 Selective - Credit Hours: 3.00

## **BIOL 11500 - Biology Resource Seminar**

Credit Hours: 1.00. This course is designed to help integrate new biology students into the Department of Biological Sciences, to help them adjust to university life, and to assist them in developing academic and intellectual survival skills using the medium of introductory Biology courses. The course meets twice a week in groups of 20-25 students. Each section is led by an academic advisor and an undergraduate teaching intern. The class periods have an on-going emphasis on connecting students to one another as resources while learning information, critical thinking skills and problem-solving strategies. Topics include bioethics, time management, available academic resources, biology majors and curricula and career development. Students are exposed to opportunities in undergraduate research, summer internships, the study abroad program, and teaching internships. Throughout the course, students are encouraged to plan their college education rather than merely choose their courses. Permission of department required. Typically offered Fall.

16-18 Credits

Spring 1st Year

## **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

- Organic Chem 1 Selective - Credit Hours: 4.00
- Calculus II Selective - Credit Hours: 3.00 - 5.00
- Language/Culture 2 Selective - Credit Hours: 3.00

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

16-19 Credits

Fall 2nd Year

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

- Organic Chem 2 Selective - Credit Hours: 4.00
- Language/Culture 3 Selective - Credit Hours: 3.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

15 Credits

Spring 2nd Year

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

## **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

- Chemistry Selective - Credit Hours: 3.00 - 4.00

## **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

## **BIOL 29300 - Sophomore Seminar: Planning Your Future In Biology**

Credit Hours: 1.00. Biology 29300 is a one-credit course designed for sophomores in the Department of Biological Sciences. This course will help students maximize the remainder of their undergraduate career. The course will cover biology career information and suggestions for professional development. Students will learn about the various disciplines that make up modern Biological Sciences. Students will learn about opportunities in undergraduate research and tour a research laboratory. In-depth presentations from biology alumni from a variety of fields are featured. Assignments include a Plan of Study, a resume, and a written paper evaluating the career path of one alumni speaker and describing the student's response to the presentation. Typically offered Spring.

- General Education 1 Selective - Credit Hours: 3.00

14-15 Credits

Fall 3rd Year

## **BIOL 30100 - Human Design: Anatomy And Physiology**

Credit Hours: 3.00. A study of human function, emphasizing physiology of body tissues and systems. Relevant aspects of anatomy and histology are also included. Use of examples from current medical practice encourages application of knowledge to predict symptoms of disease and rationale for treatment. Topics covered include histophysiology of cells and tissues, nerve and muscle physiology, the nervous system, and cardiovascular dynamics. Typically offered Fall.

- Biology Selective (Req # 14) - Credit Hours: 2.00 - 3.00
- PHYS 1 Selective - Credit Hours: 4.00
- General Education 2 Selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

14-15 Credits

## Spring 3rd Year

### **BIOL 30200 - Human Design: Anatomy And Physiology**

Credit Hours: 3.00. A continuation of BIOL 30100. (It is helpful but not essential for this course to be preceded by BIOL 30100.) Topics covered include body fluids and renal function, respiration, endocrine systems, the gastro-intestinal system, exercise physiology, reproduction, and immunity. Typically offered Spring.

- PHYS 2 Selective - Credit Hours: 4.00
- Computer Science Selective - Credit Hours: 3.00 - 4.00

### **BIOL 39300 - Preparing For Your Future In Biology**

Credit Hours: 1.00. Biology 39300 is a one-credit course for junior and seniors in the Department of Biological Sciences. This course will help students begin to prepare for life after Purdue. Students will learn about interviewing, job searching, graduate and professional school searching, resumes, industrial practices, and how to evaluate job/school offers. Construct a polished image on top of your solid biology foundation! Get the job or get admitted to the school you want. Typically offered Spring.

- General Education 3 Selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

## 17-18 Credits

## Fall 4th Year

### **BIOL 43800 - General Microbiology**

Credit Hours: 3.00. An examination of microbial diversity that emphasizes the interrelationship of bacteria and their environments. This includes aspects of cell composition, metabolism, and growth of microorganisms. Typically offered Fall.

### **BIOL 43900 - Laboratory In General Microbiology**

Credit Hours: 2.00. Includes enrichment cultures to isolate microorganisms, studies of cell composition, measurements of cell growth, and examination of enzyme regulation. Typically offered Fall.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive

statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00
- Elective - Credit Hours: 4.00

## 13-15 Credits

## Spring 4th Year

- 500 Level Biology Selective (Req # 14) - Credit Hours: 2.00 - 3.00
- Health & Disease Selective (Req # 13) - Credit Hours: 3.00
- Great Issues Selective - Credit Hours: 3.00
- Pre-professional selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

## 14-15 Credits

## Note

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Microbiology Honors, BS

# About the Program

Microbiology includes the study of viruses, bacteria, and fungi. A student can expect to study topics such as microbial growth, nutrition, metabolism, pathogenesis, morphogenesis, and production of antibiotics. Career opportunities are found in public health, medical laboratories, quality assurance, environmental toxicology, and related areas. A microbiology major provides excellent preparation for advanced study (or direct employment) in biological sciences, education, and many health-related professions.

Microbiology Website

## Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Microbiology Honors include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

BIOLOGY-BS  
Code-MICH  
120 Credits

## Departmental/Program Major Courses (47-51 credits)

\*A 2.0 average is required in these courses

### \*Required Major Courses (34 credits)

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

#### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

#### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

## **BIOL 14501 - First Year Biology Laboratory With Neuro Research Project**

Credit Hours: 2.00. This laboratory course has been designed under the goals of the Center for Authentic Science Practice in Education (CASPiE) which aims to expose students to novel research as a means to teach them laboratory science. This course is designed to engage students in authentic research while acquiring necessary skills and concepts to be successful as a biology major. Our topic is Neuroanatomy of Auditory Pathways. We will begin with a series of skills and knowledge building weeks and then transition into independent research projects that culminate in a public presentation of the data in a poster session. In this course, students will learn the fundamentals in neurobiology as well as use sophisticated analysis and instrumentation to answer a research question. Critical thinking in experimental design as well as interpretation and communication of data will be stressed. The goals for this course are to gain a foundation in basic biological measurements and techniques, hone the analytical skills, appreciate the excitement of scientific discovery, and have fun along the way. Permission of department required. Typically offered Fall.

## **IT 22600 - Biotechnology Laboratory I**

Credit Hours: 2.00. Focuses on nucleic acid manipulation. Modules include, making a eukaryotic library, identifying clones, sub-cloning into a bacterial expression vector and verification of the clone's identity by restriction analysis and DNA sequencing. Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures. Typically offered Summer Fall Spring.

## **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

## **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

## **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

## **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

### **BIOL 41600 - Viruses And Viral Disease**

Credit Hours: 3.00. The objective of this course is to provide students with an introductory understanding of viruses and their impact on human health. The course will be divided into two sections. During the first section, we will discuss the cellular and organismal events that occur following virus infection, including viral entry, replication, modulation of cell biology by viral proteins, the host immune response to infection, evasion of the immune response by viruses, and resulting virus-induced disease. The emphasis of this first section will be on the general strategies used by viruses to establish and maintain infection in a population. In the second section, we will discuss in relative detail our current understanding of select important human viruses including influenza, HIV, smallpox, the herpesviruses, and tumor-causing viruses. The objective of this section will be to understand how the unique aspects of each virus's biology affect the outcome of infection with these pathogens. In addition to virus-associated diseases, we will discuss potential ways that viruses may provide symbiotic benefits to their hosts and thereby shape the course of human evolution. Throughout the course, we will emphasize societal and political aspects of virology and virus-derived technologies, including vaccine development, the use of viruses as gene therapy vectors, and the threat of viral bioterror or bio-error. Typically offered Spring.

### **BIOL 43800 - General Microbiology**

Credit Hours: 3.00. An examination of microbial diversity that emphasizes the interrelationship of bacteria and their environments. This includes aspects of cell composition, metabolism, and growth of microorganisms. Typically offered Fall.

### **BIOL 43900 - Laboratory In General Microbiology**

Credit Hours: 2.00. Includes enrichment cultures to isolate microorganisms, studies of cell composition, measurements of cell growth, and examination of enzyme regulation. Typically offered Fall.

### **BIOL 52900 - Bacterial Physiology**

Credit Hours: 3.00. A detailed consideration of the central metabolic routes, their role in generation of energy and key intermediates, and the conversion of those intermediates to small molecule building blocks. Regulatory mechanisms will be stressed. Typically offered Fall.

## **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **\*Major Selectives - Select one course for each requirement (13-17 credits)**

- Microbiology Selective I - Credit Hours: 3.00
- Microbiology Selective II - Credit Hours: 3.00
- Chemistry Selective - Credit Hours: 3.00
- Microbiology Honors Selective - Credit Hours: 0.00 - 4.00
- Microbiology Honors Selective - Credit Hours: 4.00

### **Other Departmental /Program Course Requirements (63-72 credits)**

#### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Organic CHM I Selective - Credit Hours: 4.00
- Organic CHM II Selective - Credit Hours: 4.00

#### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Computer Science Selective - Credit Hours: 3.00 - 4.00

#### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language & Culture I Selective - Credit Hours: 3.00
- Language & Culture II Selective - Credit Hours: 3.00
- Language & Culture III Selective - Credit Hours: 3.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- General Education I Selective (satisfies Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Selective (satisfies Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education III Selective - Credit Hours: 3.00
- Teambuilding & Collaboration Selective - Credit Hours: 0.00 - 3.00
- Great Issues Selective - Credit Hours: 3.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00

### **PHYS I Selective - Select from (4 credits)**

(satisfies Science Selective for core)

### **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena

extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

## PHYS II Selective - Select from (4 credits)

### **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## Calculus I Selective - Select from (4-5 credits)

(satisfies Quantitative Reasoning Selective for core)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## Calculus II Selective - Select from (4-5 credits)

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.  
CTL:IMA 1603 Calculus - Long II

## **MA 17300 - Calculus And Analytic Geometry II**

Credit Hours: 5.00. Calculus of transcendental functions, techniques of integration, conic sections, polar coordinates, parametric equations, infinite series. Admission restricted to those who have established credit in Calculus I. Typically offered Fall.

## **Electives (0-10 credits)**

## **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or click here.

## **Program Requirements**

### **Fall 1st Year**

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Calculus I Selective - Credit Hours: 4.00 - 5.00
- Language/Culture I Selective - Credit Hours: 3.00

### **BIOL 11500 - Biology Resource Seminar**

Credit Hours: 1.00. This course is designed to help integrate new biology students into the Department of Biological Sciences, to help them adjust to university life, and to assist them in developing academic and intellectual survival skills using the medium of introductory Biology courses. The course meets twice a week in groups of 20-25 students. Each section is led by an academic advisor and an undergraduate teaching intern. The class periods have an on-going emphasis on connecting students to one another as resources while learning information, critical thinking skills and problem-solving strategies. Topics include bioethics, time management, available academic resources, biology majors and curricula and career development. Students are exposed to opportunities in undergraduate research, summer internships, the study abroad program, and teaching internships. Throughout the course, students are encouraged to plan their college education rather than merely choose their courses. Permission of department required. Typically offered Fall.

17-18 Credits

Spring 1st Year

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

- Organic Chem I Selective - Credit Hours: 4.00
- Calculus II Selective - Credit Hours: 4.00 - 5.00
- Language/Culture II Selective - Credit Hours: 3.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

17-19 Credits

Fall 2nd Year

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

- Organic Chem II Selective - Credit Hours: 4.00

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals.

Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

- Language/Culture III Selective - Credit Hours: 3.00

16 Credits

Spring 2nd Year

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

- Chemistry Selective - Credit Hours: 3.00 - 4.00

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

- General Education I Selective - Credit Hours: 3.00

13-14 Credits

Fall 3rd Year

### **BIOL 43800 - General Microbiology**

Credit Hours: 3.00. An examination of microbial diversity that emphasizes the interrelationship of bacteria and their environments. This includes aspects of cell composition, metabolism, and growth of microorganisms. Typically offered Fall.

## **BIOL 43900 - Laboratory In General Microbiology**

Credit Hours: 2.00. Includes enrichment cultures to isolate microorganisms, studies of cell composition, measurements of cell growth, and examination of enzyme regulation. Typically offered Fall.

- PHYS I Selective - Credit Hours: 4.00
- General Education II Selective - Credit Hours: 3.00

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

15 Credits

Spring 3rd Year

## **BIOL 52900 - Bacterial Physiology**

Credit Hours: 3.00. A detailed consideration of the central metabolic routes, their role in generation of energy and key intermediates, and the conversion of those intermediates to small molecule building blocks. Regulatory mechanisms will be stressed. Typically offered Fall.

## **BIOL 41600 - Viruses And Viral Disease**

Credit Hours: 3.00. The objective of this course is to provide students with an introductory understanding of viruses and their impact on human health. The course will be divided into two sections. During the first section, we will discuss the cellular and organismal events that occur following virus infection, including viral entry, replication, modulation of cell biology by viral proteins, the host immune response to infection, evasion of the immune response by viruses, and resulting virus-induced disease. The emphasis of this first section will be on the general strategies used by viruses to establish and maintain infection in a population. In the second section, we will discuss in relative detail our current understanding of select important human viruses including influenza, HIV, smallpox, the herpesviruses, and tumor-causing viruses. The objective of this section will be to understand how the unique aspects of each virus's biology affect the outcome of infection with these pathogens. In addition to virus-associated diseases, we will discuss potential ways that viruses may provide symbiotic benefits to their hosts and thereby shape the course of human evolution. Throughout the course, we will emphasize societal and political aspects of virology and virus-derived technologies, including vaccine development, the use of viruses as gene therapy vectors, and the threat of viral bioterror or bio-error. Typically offered Spring.

- PHYS II Selective - Credit Hours: 4.00

## **BIOL 39300 - Preparing For Your Future In Biology**

Credit Hours: 1.00. Biology 39300 is a one-credit course for junior and seniors in the Department of Biological Sciences. This course will help students begin to prepare for life after Purdue. Students will learn about interviewing, job searching, graduate and professional school searching, resumes, industrial practices, and how to evaluate job/school offers. Construct a polished image on top of your solid biology foundation! Get the job or get admitted to the school you want. Typically offered Spring.

- General Education III Selective - Credit Hours: 3.00

## 14 Credits

### Fall 4th Year

- Microbiology Selective I - Credit Hours: 3.00
- Computer Science Selective - Credit Hours: 3.00 - 4.00
- Microbiology Honors Selective - Credit Hours: 4.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00
- Elective - Credit Hours: 3.00

## 14-17 Credits

### Spring 4th Year

- Microbiology Selective II - Credit Hours: 3.00

## **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Microbiology Honors Selective - Credit Hours: 4.00
- Great Issues Selective - Credit Hours: 3.00

## 13 Credits

## Note

120 semester credits required for Bachelor of Science degree.

3.0 Graduation GPA required for Microbiology Honors major.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Microbiology, BS

## About the Program

Microbiology includes the study of viruses, bacteria, and fungi. A student can expect to study topics such as microbial growth, nutrition, metabolism, pathogenesis, morphogenesis, and production of antibiotics. Career opportunities are found in public health, medical laboratories, quality assurance, environmental toxicology, and related areas. A microbiology major provides excellent preparation for advanced study (or direct employment) in biological sciences, education, and many health-related professions.

Microbiology Website

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Microbiology include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

BIOLOGY-BS  
Code-MICR  
120 Credits

### Departmental/Program Major Courses (36 credits)

\*A 2.0 average is required in these courses

### \*Required Major Courses (30 credits)

## **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

## **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

## **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

## **BIOL 14501 - First Year Biology Laboratory With Neuro Research Project**

Credit Hours: 2.00. This laboratory course has been designed under the goals of the Center for Authentic Science Practice in Education (CASPiE) which aims to expose students to novel research as a means to teach them laboratory science. This course is designed to engage students in authentic research while acquiring necessary skills and concepts to be successful as a biology major. Our topic is Neuroanatomy of Auditory Pathways. We will begin with a series of skills and knowledge building weeks and then transition into independent research projects that culminate in a public presentation of the data in a poster session. In this course, students will learn the fundamentals in neurobiology as well as use sophisticated analysis and instrumentation to answer a research question. Critical thinking in experimental design as well as interpretation and communication of data will be stressed. The goals for this course are to gain a foundation in basic biological measurements and techniques, hone the analytical skills, appreciate the excitement of scientific discovery, and have fun along the way. Permission of department required. Typically offered Fall.

## **IT 22600 - Biotechnology Laboratory I**

Credit Hours: 2.00. Focuses on nucleic acid manipulation. Modules include, making a eukaryotic library, identifying clones, sub-cloning into a bacterial expression vector and verification of the clone's identity by restriction analysis and DNA sequencing. Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures. Typically offered Summer Fall Spring.

## **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

## **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

## **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

## **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

## **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

## **BIOL 41600 - Viruses And Viral Disease**

Credit Hours: 3.00. The objective of this course is to provide students with an introductory understanding of viruses and their impact on human health. The course will be divided into two sections. During the first section, we will discuss the cellular and organismal events that occur following virus infection, including viral entry, replication, modulation of cell biology by viral proteins, the host immune response to infection, evasion of the immune response by viruses, and resulting virus-induced disease. The emphasis of this first section will be on the general strategies used by viruses to establish and maintain infection in a population. In the second section, we will discuss in relative detail our current understanding of select important human viruses including influenza, HIV, smallpox, the herpesviruses, and tumor-causing viruses. The objective of this section will be to understand how the unique aspects of each virus's biology affect the outcome of infection with these pathogens. In addition to virus-associated diseases, we will discuss potential ways that viruses may provide symbiotic benefits to their hosts and thereby shape the course of human evolution. Throughout the course, we will emphasize societal and political aspects of virology and virus-derived technologies, including vaccine development, the use of viruses as gene therapy vectors, and the threat of viral bioterror or bio-error. Typically offered Spring.

## **BIOL 43800 - General Microbiology**

Credit Hours: 3.00. An examination of microbial diversity that emphasizes the interrelationship of bacteria and their environments. This includes aspects of cell composition, metabolism, and growth of microorganisms. Typically offered Fall.

### **BIOL 43900 - Laboratory In General Microbiology**

Credit Hours: 2.00. Includes enrichment cultures to isolate microorganisms, studies of cell composition, measurements of cell growth, and examination of enzyme regulation. Typically offered Fall.

### **BIOL 52900 - Bacterial Physiology**

Credit Hours: 3.00. A detailed consideration of the central metabolic routes, their role in generation of energy and key intermediates, and the conversion of those intermediates to small molecule building blocks. Regulatory mechanisms will be stressed. Typically offered Fall.

### **\*Major Selectives - Select one course for each requirement (6 credits)**

- Microbiology Selective I (Req # 13) - Credit Hours: 3.00
- Microbiology Selective II (Req # 15) - Credit Hours: 3.00

### **Other Departmental /Program Course Requirements (64-76 credits)**

#### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Organic CHM I Selective - Credit Hours: 4.00
- Organic CHM II Selective - Credit Hours: 4.00
- Chemistry Selective - Credit Hours: 3.00 - 4.00

#### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors

related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Computer Science Selective - Credit Hours: 3.00 - 4.00

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language & Culture I Selective - Credit Hours: 3.00
- Language & Culture II Selective - Credit Hours: 3.00
- Language & Culture III Selective - Credit Hours: 3.00

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- General Education I Selective (satisfies Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Selective (satisfies Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education III Selective - Credit Hours: 3.00
- Teambuilding & Collaboration Selective - Credit Hours: 0.00 - 3.00
- Great Issues Selective - Credit Hours: 3.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00

## **PHYS I Selective - Select from (4 credits)**

(satisfies Science Selective for core)

## **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

## **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

## **PHYS II Selective - Select from (4 credits)**

## **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

## **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **Calculus I Selective - Select from (3-5 credits)**

(satisfies Quantitative Reasoning Selective for core)

## **MA 16010 - Applied Calculus I**

Credit Hours: 3.00. Topics include trigonometric and exponential functions; limits and differentiation, rules of differentiation, maxima, minima and optimization; curve sketching, integration, anti-derivatives, fundamental theorem of calculus. Properties of definite integrals and numerical methods. Applications to life, managerial and social sciences. Typically offered Fall Spring Summer.

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or

departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602 Calculus - Long I

### **Calculus II Selective - Select from (3-5 credits)**

### **MA 16020 - Applied Calculus II**

Credit Hours: 3.00. This course covers techniques of integration; infinite series, convergence tests; differentiation and integration of functions of several variables; maxima and minima, optimization; differential equations and initial value problems; matrices, determinants, eigenvalues and eigenvectors. Applications. Typically offered Fall Spring Summer.

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

### **MA 17300 - Calculus And Analytic Geometry II**

Credit Hours: 5.00. Calculus of transcendental functions, techniques of integration, conic sections, polar coordinates, parametric equations, infinite series. Admission restricted to those who have established credit in Calculus I. Typically offered Fall.

### **Electives (8-20 credits)**

## University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

## Program Requirements

### Fall 1st Year

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

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Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

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- Calculus I Selective - Credit Hours: 3.00 - 5.00
- Language/Culture I Selective - Credit Hours: 3.00

## **BIOL 11500 - Biology Resource Seminar**

Credit Hours: 1.00. This course is designed to help integrate new biology students into the Department of Biological Sciences, to help them adjust to university life, and to assist them in developing academic and intellectual survival skills using the medium of introductory Biology courses. The course meets twice a week in groups of 20-25 students. Each section is led by an academic advisor and an undergraduate teaching intern. The class periods have an on-going emphasis on connecting students to one another as resources while learning information, critical thinking skills and problem-solving strategies. Topics include bioethics, time management, available academic resources, biology majors and curricula and career development. Students are exposed to opportunities in undergraduate research, summer internships, the study abroad program, and teaching internships. Throughout the course, students are encouraged to plan their college education rather than merely choose their courses. Permission of department required. Typically offered Fall.

16-18 Credits

Spring 1st Year

## **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

- Organic Chem I Selective - Credit Hours: 4.00
- Calculus II Selective - Credit Hours: 3.00 - 5.00
- Language/Culture II Selective - Credit Hours: 3.00

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

16-19 Credits

## Fall 2nd Year

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

- Organic Chem II Selective - Credit Hours: 4.00
- Language/Culture III Selective - Credit Hours: 3.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

15 Credits

## Spring 2nd Year

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

- Chemistry Selective - Credit Hours: 3.00 - 4.00

## **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

## **BIOL 29300 - Sophomore Seminar: Planning Your Future In Biology**

Credit Hours: 1.00. Biology 29300 is a one-credit course designed for sophomores in the Department of Biological Sciences. This course will help students maximize the remainder of their undergraduate career. The course will cover biology career information and suggestions for professional development. Students will learn about the various disciplines that make up modern Biological Sciences. Students will learn about opportunities in undergraduate research and tour a research laboratory. In-depth presentations from biology alumni from a variety of fields are featured. Assignments include a Plan of Study, a resume, and a written paper evaluating the career path of one alumni speaker and describing the student's response to the presentation. Typically offered Spring.

- General Education I Selective - Credit Hours: 3.00

14-15 Credits

Fall 3rd Year

## **BIOL 43800 - General Microbiology**

Credit Hours: 3.00. An examination of microbial diversity that emphasizes the interrelationship of bacteria and their environments. This includes aspects of cell composition, metabolism, and growth of microorganisms. Typically offered Fall.

## **BIOL 43900 - Laboratory In General Microbiology**

Credit Hours: 2.00. Includes enrichment cultures to isolate microorganisms, studies of cell composition, measurements of cell growth, and examination of enzyme regulation. Typically offered Fall.

- PHYS I Selective - Credit Hours: 4.00
- General Education II Selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

15 Credits

Spring 3rd Year

## **BIOL 41600 - Viruses And Viral Disease**

Credit Hours: 3.00. The objective of this course is to provide students with an introductory understanding of viruses and their impact on human health. The course will be divided into two sections. During the first section, we will discuss the cellular and organismal events that occur following virus infection, including viral entry, replication, modulation of cell biology by viral proteins, the host immune response to infection, evasion of the immune response by viruses, and resulting virus-induced disease. The emphasis of this first section will be on the general strategies used by viruses to establish and maintain infection in a population. In the second section, we will discuss in relative detail our current understanding of select important human viruses including influenza, HIV, smallpox, the herpesviruses, and tumor-causing viruses. The objective of this section will be to understand how the unique aspects of each virus's biology affect the outcome of infection with these pathogens. In addition to virus-associated diseases, we will discuss potential ways that viruses may provide symbiotic benefits to their hosts and thereby shape the course of human evolution. Throughout the course, we will emphasize societal and political aspects of virology and virus-derived technologies, including vaccine development, the use of viruses as gene therapy vectors, and the threat of viral bioterror or bio-error. Typically offered Spring.

## **BIOL 52900 - Bacterial Physiology**

Credit Hours: 3.00. A detailed consideration of the central metabolic routes, their role in generation of energy and key intermediates, and the conversion of those intermediates to small molecule building blocks. Regulatory mechanisms will be stressed. Typically offered Fall.

- PHYS II Selective - Credit Hours: 4.00

## **BIOL 39300 - Preparing For Your Future In Biology**

Credit Hours: 1.00. Biology 39300 is a one-credit course for junior and seniors in the Department of Biological Sciences. This course will help students begin to prepare for life after Purdue. Students will learn about interviewing, job searching, graduate and professional school searching, resumes, industrial practices, and how to evaluate job/school offers. Construct a polished image on top of your solid biology foundation! Get the job or get admitted to the school you want. Typically offered Spring.

- General Education III Selective - Credit Hours: 3.00

## **14 Credits**

### **Fall 4th Year**

- Microbiology Selective I - Credit Hours 3.00
- Computer Science Selective - Credit Hours: 3.00 - 4.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00
- Elective - Credit Hours: 4.00
- Elective - Credit Hours: 3.00

## **14-17 Credits**

Spring 4th Year

## **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Microbiology Selective II (Req # 15) - Credit Hours: 3.00
- Great Issues Selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

15 Credits

## **Note**

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## **Degree Requirements**

The student is ultimately responsible for knowing and completing all degree requirements.

## **Foreign Language Courses**

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## **Critical Course**

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## **Neurobiology and Physiology, BS**

# About the Program

Physiology is the study of the functions of living organisms and of the organ and tissue systems of which they are composed. The goal of physiology is to understand, in terms of physical and chemical principles, the mechanisms that operate in living organisms from the subcellular level to the level of the whole animal, with an emphasis on how these mechanisms are integrated to produce a viable organism.

Neurobiology is the study of the structure, function, and development of the nervous system, and originated, in part, as a subdiscipline of physiology. In recent years, neurobiology has become one of the most rapidly changing and exciting areas of biology. A neurobiology and physiology major is excellent preparation for careers in education, research, industry, medicine, veterinary medicine, and other professions.

Neurobiology and Physiology Website

## Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Neurobiology and Physiology include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

BIOLOGY-BS

Code-NRPH

120 Credits

## Departmental/Program Major Courses (34-36 credits)

\*A 2.0 average is required in these courses

### \*Required Major Courses (23 credits)

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

#### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

#### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

### **BIOL 14501 - First Year Biology Laboratory With Neuro Research Project**

Credit Hours: 2.00. This laboratory course has been designed under the goals of the Center for Authentic Science Practice in Education (CASPIE) which aims to expose students to novel research as a means to teach them laboratory science. This course is designed to engage students in authentic research while acquiring necessary skills and concepts to be successful as a biology major. Our topic is Neuroanatomy of Auditory Pathways. We will begin with a series of skills and knowledge building weeks and then transition into independent research projects that culminate in a public presentation of the data in a poster session. In this course, students will learn the fundamentals in neurobiology as well as use sophisticated analysis and instrumentation to answer a research question. Critical thinking in experimental design as well as interpretation and communication of data will be stressed. The goals for this course are to gain a foundation in basic biological measurements and techniques, hone the analytical skills, appreciate the excitement of scientific discovery, and have fun along the way. Permission of department required. Typically offered Fall.

### **IT 22600 - Biotechnology Laboratory I**

Credit Hours: 2.00. Focuses on nucleic acid manipulation. Modules include, making a eukaryotic library, identifying clones, sub-cloning into a bacterial expression vector and verification of the clone's identity by restriction analysis and DNA sequencing. Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures. Typically offered Summer Fall Spring.

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

## **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

## **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

## **BIOL 32800 - Principles Of Physiology**

Credit Hours: 4.00. This course is designed to provide students with an introduction to physiology with an emphasis on cellular mechanisms that underlie anatomical and physiological adaptations used by animals to survive in their habitat. Topics covered will range from cellular respiration to the physical limits of animal performance as we deconstruct and then reconstruct the body to examine how animals can live in extreme environments. Goals for this course are for students to gain a foundation in basic physiological principles, to learn about the integrative nature of the systems of animals, and to appreciate how and why animals have evolved and strategies to help them survive in their unique environment. Typically offered Spring.

### **\*Major Selectives - Select one course for each requirement (11-13 credits)**

- Neurobiology & Physiology Selective (Req # 10) - Credit Hours: 3.00
- 500 Level Neurobiology & Physiology Selective (Req # 10) - Credit Hours: 3.00
- Biology Selective (Req # 13) - Credit Hours: 3.00
- Base Lab Requirements (Req # 11) - Credit Hours: 2.00 - 4.00

### **Other Departmental /Program Course Requirements (64-76 credits)**

#### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

- Organic CHM I Selective - Credit Hours: 4.00
- Organic CHM II Selective - Credit Hours: 4.00

- Chemistry Selective - Credit Hours: 3.00 - 4.00

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

- Computer Science Selective - Credit Hours: 3.00 - 4.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language & Culture I Selective - Credit Hours: 3.00
- Language & Culture II Selective - Credit Hours: 3.00
- Language & Culture III Selective - Credit Hours: 3.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- General Education I Selective (satisfies Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Selective (satisfies Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education III Selective - Credit Hours: 3.00
- Teambuilding & Collaboration Selective - Credit Hours: 0.00 - 3.00
- Great Issues Selective - Credit Hours: 3.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00

### **PHYS I Selective - Select from (4 credits)**

(satisfies Science Selective for core)

### **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS II Selective - Select from (4 credits)**

### **PHYS 23400 - Physics For Life Sciences II**

Credit hours: 4.00. Physics For Life Sciences II builds upon prerequisite knowledge in college level biology, chemistry, and mathematics, as well as on Physics of Life Sciences I, to develop an understanding of how energy, entropy, enthalpy, and Boltzmann distributions affect the dynamics of living systems, of how electric fields and potentials are applied to fluids and membranes, and how the physics of harmonic oscillators, waves, sound, optics, photons, and quantized states are relevant to biological systems and the tools used for their study. Typically offered Fall Spring Summer.

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **Calculus I Selective - Select from (3-5 credits)**

(satisfies Quantitative Reasoning Selective for core)

### **MA 16010 - Applied Calculus I**

Credit Hours: 3.00. Topics include trigonometric and exponential functions; limits and differentiation, rules of differentiation, maxima, minima and optimization; curve sketching, integration, anti-derivatives, fundamental theorem of calculus. Properties of definite integrals and numerical methods. Applications to life, managerial and social sciences. Typically offered Fall Spring Summer.

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## **Calculus II Selective - Select from (3-5 credits)**

### **MA 16020 - Applied Calculus II**

Credit Hours: 3.00. This course covers techniques of integration; infinite series, convergence tests; differentiation and integration of functions of several variables; maxima and minima, optimization; differential equations and initial value problems; matrices, determinants, eigenvalues and eigenvectors. Applications. Typically offered Fall Spring Summer.

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

### **MA 17300 - Calculus And Analytic Geometry II**

Credit Hours: 5.00. Calculus of transcendental functions, techniques of integration, conic sections, polar coordinates, parametric equations, infinite series. Admission restricted to those who have established credit in Calculus I. Typically offered Fall.

## Electives (8-22 credits)

## University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or click here.

## Program Requirements

### Fall 1st Year

#### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

#### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

#### **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures;

molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required.

Typically offered Fall.

- Calculus I Selective - Credit Hours: 3.00 - 5.00
- Language/Culture I Selective - Credit Hours: 3.00

## **BIOL 11500 - Biology Resource Seminar**

Credit Hours: 1.00. This course is designed to help integrate new biology students into the Department of Biological Sciences, to help them adjust to university life, and to assist them in developing academic and intellectual survival skills using the medium of introductory Biology courses. The course meets twice a week in groups of 20-25 students. Each section is led by an academic advisor and an undergraduate teaching intern. The class periods have an on-going emphasis on connecting students to one another as resources while learning information, critical thinking skills and problem-solving strategies. Topics include bioethics, time management, available academic resources, biology majors and curricula and career development. Students are exposed to opportunities in undergraduate research, summer internships, the study abroad program, and teaching internships. Throughout the course, students are encouraged to plan their college education rather than merely choose their courses. Permission of department required. Typically offered Fall.

16-18 Credits

Spring 1st Year

## **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

- Organic Chem I Selective - Credit Hours: 4.00
- Calculus II Selective - Credit Hours: 3.00 - 5.00
- Language/Culture II Selective - Credit Hours: 3.00

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

16-19 Credits

Fall 2nd Year

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

- Organic Chem II Selective - Credit Hours: 4.00
- Language/Culture III Selective - Credit Hours: 3.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

15 Credits

Spring 2nd Year

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

## **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

- Chemistry Selective - Credit Hours: 3.00 - 4.00

## **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

## **BIOL 29300 - Sophomore Seminar: Planning Your Future In Biology**

Credit Hours: 1.00. Biology 29300 is a one-credit course designed for sophomores in the Department of Biological Sciences. This course will help students maximize the remainder of their undergraduate career. The course will cover biology career information and suggestions for professional development. Students will learn about the various disciplines that make up modern Biological Sciences. Students will learn about opportunities in undergraduate research and tour a research laboratory. In-depth presentations from biology alumni from a variety of fields are featured. Assignments include a Plan of Study, a resume, and a written paper evaluating the career path of one alumni speaker and describing the student's response to the presentation. Typically offered Spring.

- General Education I Selective - Credit Hours: 3.00

## **14-15 Credits**

### **Fall 3rd Year**

- Neurobiology & Physiology Selective (Req # 10) - Credit Hours: 3.00
- PHYS I Selective - Credit Hours: 4.00
- General Education II Selective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

## **16 Credits**

### **Spring 3rd Year**

## **BIOL 32800 - Principles Of Physiology**

Credit Hours: 4.00. This course is designed to provide students with an introduction to physiology with an emphasis on cellular mechanisms that underlie anatomical and physiological adaptations used by animals to survive in their habitat. Topics covered will range from cellular respiration to the physical limits of animal performance as we deconstruct and then reconstruct the body to examine how animals can live in extreme environments. Goals for this course are for students to gain a foundation in basic physiological principles, to learn about the integrative nature of the systems of animals, and to appreciate how and why animals have evolved and strategies to help them survive in their unique environment. Typically offered Spring.

- PHYS II Selective - Credit Hours: 4.00

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

### **BIOL 39300 - Preparing For Your Future In Biology**

Credit Hours: 1.00. Biology 39300 is a one-credit course for junior and seniors in the Department of Biological Sciences. This course will help students begin to prepare for life after Purdue. Students will learn about interviewing, job searching, graduate and professional school searching, resumes, industrial practices, and how to evaluate job/school offers. Construct a polished image on top of your solid biology foundation! Get the job or get admitted to the school you want. Typically offered Spring.

- General Education III Selective - Credit Hours: 3.00

## 14-15 Credits

### Fall 4th Year

- Biology Selective (Req # 13) - Credit Hours: 3.00
- Base Lab Requirement (Req # 11) - Credit Hours: 2.00 - 4.00
- Multidisciplinary Selective - Credit Hours: 1.00 - 3.00
- Elective - Credit Hours: 3.00
- Elective - Credit Hours: 4.00

## 13-15 Credits

### Spring 4th Year

- 500 Level Neurobiology & Physiology Selective (Req # 10) - Credit Hours: 3.00
- Computer Science Selective - Credit Hours: 3.00 - 4.00
- Great Issues Selective - Credit Hours: 3.00

- Elective - Credit Hours: 3.00
- Elective - Credit Hours: 3.00

## 15-16 Credits

## Note

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Biological Sciences Minor

The following courses describe the minimum coursework necessary to earn a minor in Biology.

ALL COURSES FOR THIS MINOR MUST BE TAKEN AT PURDUE UNIVERSITY.

At least one-half of these courses must be taken on the West Lafayette Campus.

A 2.0 or higher average is required in courses used to complete the minor.

## Part I - Complete the following courses (7-8 credits)

Complete the following courses<sup>1</sup>:

**BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

### **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

or

### **BIOL 11000 - Fundamentals Of Biology I**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Principles of biology, focusing on diversity, ecology, evolution, and the development, structure, and function of organisms. Typically offered Summer Fall Spring.

### **BIOL 11100 - Fundamentals Of Biology II**

Credit Hours: 4.00. This course is designed primarily to provide an introduction to the principles of biology for students in agriculture and health sciences. Continuation of BIOL 11000. Principles of biology, focusing on cell structure and function, molecular biology, and genetics. Typically offered Fall Spring.

## **Part II - Complete the following courses (6 credits)**

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23000 - Biology Of The Living Cell**

Credit Hours: 3.00. An introduction to modern cell biology for students who may not have taken a previous college course in biology. All students with the appropriate prerequisites are welcome, and this course will be of special interest to students from

engineering, chemistry, physics and computer science. This course will provide a solid foundation in modern cell biology concepts for engineers and students from other disciplines. Typically offered Fall.

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **AGRY 32000 - Genetics**

Credit Hours: 3.00. The transmission of heritable traits; probability; genotypic-environmental interactions; chromosomal aberrations; polyploidy; gene mutations; genes in populations; the structure and function of nucleic acids; biochemical genetics; molecular genetics; coding. Typically offered Fall Spring.

## **Part III - Complete one of the following courses (2-4 credits)**

### **BIOL 28600 - Introduction To Ecology And Evolution**

Credit Hours: 2.00. Evolutionary processes and ecological principles associated with individuals, populations, communities, and ecosystems. Topics include genetic drift, natural selection, adaptation, life tables, population dynamics, competition, predation, biodiversity, and ecological stability, with emphasis on natural systems. Typically offered Spring.

### **BIOL 30100 - Human Design: Anatomy And Physiology**

Credit Hours: 3.00. A study of human function, emphasizing physiology of body tissues and systems. Relevant aspects of anatomy and histology are also included. Use of examples from current medical practice encourages application of knowledge to predict symptoms of disease and rationale for treatment. Topics covered include histophysiology of cells and tissues, nerve and muscle physiology, the nervous system, and cardiovascular dynamics. Typically offered Fall.

### **BIOL 30200 - Human Design: Anatomy And Physiology**

Credit Hours: 3.00. A continuation of BIOL 30100. (It is helpful but not essential for this course to be preceded by BIOL 30100.) Topics covered include body fluids and renal function, respiration, endocrine systems, the gastro-intestinal system, exercise physiology, reproduction, and immunity. Typically offered Spring.

### **BIOL 32800 - Principles Of Physiology**

Credit Hours: 4.00. This course is designed to provide students with an introduction to physiology with an emphasis on cellular mechanisms that underlie anatomical and physiological adaptations used by animals to survive in their habitat. Topics covered will range from cellular respiration to the physical limits of animal performance as we deconstruct and then reconstruct the body to examine how animals can live in extreme environments. Goals for this course are for students to gain a foundation in basic physiological principles, to learn about the integrative nature of the systems of animals, and to appreciate how and why animals have evolved and strategies to help them survive in their unique environment. Typically offered Spring.

## **BIOL 36700 - Principles Of Development**

Credit Hours: 2.00. This course deals with the process by which genes in a fertilized egg control cell behavior in the embryo and so determine the nature of the animal or plant. The emphasis is on early development and the laying down of body plan and organ systems in various model systems (*Drosophila*, nematode, *Arabidopsis*, zebrafish, mouse, chick, and frog). Typically offered Fall Spring.

## **BIOL 39500 - Special Assignments**

Arrange Hours and Credit. Reading, discussions, written reports, seminar presentations, and field or laboratory work provided for enrichment in special areas of the biological sciences. Permission of instructor required. Typically offered Fall Spring Summer.

## **BIOL 41500 - Introduction To Molecular Biology**

Credit Hours: 3.00. An introduction to modern molecular biology techniques and how they are used to address current topics in gene regulation. Emphasis will be placed on experimental procedures and model systems, such as site-directed mutagenesis of isolated genes and their subsequent introduction into prokaryotic and eukaryotic cells. Topics will address the molecular control mechanisms associated with DNA replication, RNA transcription, RNA processing, and differential gene expression. Typically offered Fall.

## **BIOL 41600 - Viruses And Viral Disease**

Credit Hours: 3.00. The objective of this course is to provide students with an introductory understanding of viruses and their impact on human health. The course will be divided into two sections. During the first section, we will discuss the cellular and organismal events that occur following virus infection, including viral entry, replication, modulation of cell biology by viral proteins, the host immune response to infection, evasion of the immune response by viruses, and resulting virus-induced disease. The emphasis of this first section will be on the general strategies used by viruses to establish and maintain infection in a population. In the second section, we will discuss in relative detail our current understanding of select important human viruses including influenza, HIV, smallpox, the herpesviruses, and tumor-causing viruses. The objective of this section will be to understand how the unique aspects of each virus's biology affect the outcome of infection with these pathogens. In addition to virus-associated diseases, we will discuss potential ways that viruses may provide symbiotic benefits to their hosts and thereby shape the course of human evolution. Throughout the course, we will emphasize societal and political aspects of virology and virus-derived technologies, including vaccine development, the use of viruses as gene therapy vectors, and the threat of viral bioterror or bio-error. Typically offered Spring.

## **BIOL 42000 - Eukaryotic Cell Biology**

Credit Hours: 3.00. Composition, structure, regulation, and growth of eukaryotic cells. Typically offered Fall.

## **BIOL 43200 - Reproductive Physiology**

Credit Hours: 3.00. This course provides an integrated approach to examining how tissues interact to regulate reproductive processes. Each section begins by describing fundamental commonalities of a reproductive event in a variety of species. This is followed by an emphasis on the difference in the details of that event among species. Students will be strongly encouraged to initiate and participate in discussions related to course topics during class. To gain a deeper understanding of physiological processes, students are asked to select a current research article related to reproductive physiology. Students are then required to present an analysis of article to the class in a formal presentation. Some of the topics to be covered in lecture include ovarian and testicular function, the hypothalamic-pituitary-gonadal axis, fertilization, establishment of the placenta, maternal support of pregnancy, parturition, and lactation. Typically offered Fall.

## **BIOL 43600 - Neurobiology**

Credit Hours: 3.00. This course will cover key aspects in molecular, cellular, and developmental neurobiology. Topics include: Cell biology of neurons and glia, electrophysiological properties of neurons, electrical and chemical signaling between neurons, synaptic integration and plasticity, development and regeneration of the nervous system, nervous system diseases. Up-to-date research findings and techniques will be included. A basic knowledge of cell biology and protein structure and function is strongly recommended. Typically offered Fall.

## **BIOL 43800 - General Microbiology**

Credit Hours: 3.00. An examination of microbial diversity that emphasizes the interrelationship of bacteria and their environments. This includes aspects of cell composition, metabolism, and growth of microorganisms. Typically offered Fall.

## **BIOL 44400 - Human Genetics**

Credit Hours: 3.00. An intermediate-level survey course of human genetics with a balanced review of both Mendelian and molecular aspects. Review of current development and application of DNA technology emphasized. Typically offered Fall.

## **BIOL 44600 - Molecular Bacterial Pathogenesis**

Credit Hours: 3.00. This course will focus on the interface of classical cell biology and microbiology, with emphasis on the exploitation of mammalian host cell by medically relevant pathogens, such as Yersinia, Salmonella, and Listeria. This course will cover the molecular mechanisms of infectious diseases. It will introduce modern cellular microbial strategies for studying the

complex interaction between pathogens and their host cells. Topics and readings will be prepared from the most current literature. Typically offered Spring.

### **BIOL 47800 - Introduction to Bioinformatics**

Credit Hours: 3.00. (CS 47800) Bioinformatics is broadly defined as the study of molecular biological information, targeting particularly the enormous volume of DNA sequence and functional complexity embedded in entire genomes. Topics will include understanding the evolutionary organization of genes (genomics), the structure and function of gene products (proteomics), and the dynamics of gene expression in biological processes (transcriptomics). Inherently, bioinformatics is interdisciplinary, melding various applications of computational science with biology. This jointly taught course introduces analytical methods from biology, statistics and computer science that are necessary for bioinformatics investigations. The course is intended for junior and senior undergraduates from various science backgrounds. Our objective is to develop the skills of both tool users and tool designers in this important new field of research. Typically offered Fall.

### **BIOL 48100 - Eukaryotic Genetics**

Credit Hours: 3.00. This course presents the fundamental concepts of classical and modern molecular genetics in eukaryotic systems, using examples from the model genetic organisms, yeast, *Drosophila*, *Caenorhabditis*, *Arabidopsis*, maize, mice and humans. These concepts are applied to solving problems of genetic analysis. Recent advances in developmental, cancer, and behavioral genetics and genomics, and applications of genetic technology, are used to demonstrate the impact that modern genetics makes at the cutting edge of biological research. Typically offered Spring.

### **BIOL 48300 - Great Issues: Environmental And Conservation Biology**

Credit Hours: 3.00. Concerned with the application of ecological principles to environmental issues, the course introduces fundamental ecology, emphasizing the interplay of theoretical models, natural history, and experimentation. New research developments are stressed, with the outlook for application to environmental management and restoration. Whole-biosphere issues, such as the loss of biological diversity, frame a focus at the population level to understand local and global extinction and community stability. In-depth case studies of endangered ecosystems (both temperate and tropical), with computer modeling, field trips, and discussions of policy formulation, demonstrate the range of tools and information necessary to accomplish coexistence of humans with the rest of nature. Typically offered Fall.

### **BIOL 49500 - Special Assignments**

Arrange Hours and Credit. Readings, discussions, written reports, seminar presentations, and field or laboratory work provided for enrichment in special areas of the biological sciences. Permission of instructor required. Typically offered Fall Spring Summer.

### **BIOL 51100 - Introduction To X-Ray Crystallography**

Credit Hours: 3.00. (EAPS 51100) Analysis of two- and three-dimensionally ordered structures by optical, electron, and X-ray diffraction methods. Geometry of diffraction. Detection of diffraction. Intensity of diffracted waves. Symmetry of crystals. The

phase problem. The heavy atom method. Isomorphous replacement. Direct methods. Molecular replacement. Helical diffraction. Typically offered Fall.

### **BIOL 51600 - Molecular Biology Of Cancer**

Credit Hours: 3.00. A detailed course examining the molecular mechanisms controlling the growth of animal cells. Emphasis will be placed on current experimental approaches to defining the molecular basis of growth regulation in developing systems and the uncontrolled proliferation of cells in metabolic disorders, such as cancer. Typically offered Spring.

### **BIOL 51700 - Molecular Biology: Proteins**

Credit Hours: 2.00. Principles of protein three-dimensional architecture. The molecular and structural basis of protein folding, function, and evolution. Typically offered Spring.

### **BIOL 53300 - Medical Microbiology**

Credit Hours: 3.00. Host-parasite relationships. Immunology. Bacteria and viruses associated with infectious diseases. Typically offered Fall.

### **BIOL 53700 - Immunobiology**

Credit Hours: 3.00. Readings and discussion in the structural, cellular, and genetic basis of the immune response. BIOL 42000 recommended as a pre-requisite. Typically offered Spring.

### **BIOL 53800 - Molecular, Cellular, And Developmental Neurobiology**

Credit Hours: 3.00. Molecular mechanisms of neural cell biology and development are considered. Topics and readings are drawn from the current primary literature. BIOL 42000 recommended as a pre-requisite. Typically offered Spring.

### **BIOL 55900 - Endocrinology**

Credit Hours: 3.00. The study of hormone function. Consideration will be given to the role of hormones in growth, development, metabolism, homeostasis, and reproduction. Typically offered Fall.

### **BIOL 56200 - Neural Systems**

Credit Hours: 3.00. (SLHS 50700, PSY 51200) Overview of the structure and function of neural systems including those

involved with motor, somatosensory, visual, auditory, learning, memory, and higher cortical processes. Molecular and cellular aspects of neural function are integrated with discussion of relevant neuroanatomy. Background in cell biology, psychobiology, physiology or anatomy is recommended. Typically offered Spring.

### **BIOL 56310 - Protein Bioinformatics**

Credit Hours: 3.00. Accumulation of biological data, such as genome sequences, protein structures and sequences, metabolic pathways, opened up a new way of research in biology-bioinformatics. Through the survey of the various active research topics in bioinformatics, in this course we will learn bioinformatics databases, tools, and algorithms behind these tools. Special emphasis is placed on protein sequence and structure analyses. Covered topics will include methods for protein sequence comparison, protein structure comparison, protein structure prediction/modeling, protein docking prediction, protein function prediction, and protein network analysis. Typically offered Spring.

### **BIOL 58000 - Evolution**

Credit Hours: 3.00. A study of evolution as a basic concept of the biological sciences; an examination of current methods of experimentation within the area, as well as evidences for the possible mechanisms of evolutionary change. Typically offered Spring.

### **BIOL 58210 - Ecological Statistics**

Credit Hours: 3.00. This course covers topics that are useful for successfully designing and analyzing statistically observational and experimental studies in ecology, animal behavior, evolutionary biology, forestry, wildlife sciences, fisheries, etc. Some topics are: differences between hypotheses and predictions, design of an ecological study, general linear models, assumptions, different types of designs (factorial, nested, repeated measures, blocks, split-plots, etc.). fitting models to data, etc. The course will focus on the conceptual understanding of these topics (e.g., interpreting the results of statistical tests) and practice with statistical programs and real datasets. Typically offered Fall.

### **BIOL 58705 - Animal Communication**

Credit Hours: 3.00. This course will be a broad-scaled analysis of animal communication. Topics will include the physics of sound- and light-signal production, propagation and reception of signals, the use of communication as a means of information transfer, and the evolution of signaling systems. Mathematical principles are covered (e.g. in the evolution of signals), so some background in mathematics (e.g. calculus or algebra and introductory physics) is helpful. Typically offered Fall.

### **BIOL 59200 - The Evolution Of Behavior**

Credit Hours: 3.00. An investigation of behaviors as adaptations: specializations of sensory and motor mechanisms involved in behavior; animal communication systems; behavioral ecology; patterns of social behavior as solutions to ecological problems, such as predator avoidance and resource exploitation. Emphasis will be on theoretical principles; examples will be broadly comparative, ranging from microorganisms to mammals. Offered in alternate years. Typically offered Spring.

## **BIOL 59500 - Special Assignments**

Arrange Hours and Credit. Special work, such as directed reading, independent study or research, supervised library, laboratory, or field work, or presentation of material not available in the formal courses of the department. The field in which work is offered will be indicated in the student's record. Permission of instructor required. Typically offered Fall Spring Summer.

- BIOL 59500 - Special Assignments - Epigenetics of Health & Disease (fall)
- BIOL 59500 - Special Assignments - Neurobiology in Learning & Memory (fall)
- BIOL 59500 - Special Assignments - Methods & Measurement in Physical Biochemistry (fall)
- BIOL 59500 - Special Assignments - Practical Biocomputing (spring)
- BIOL 59500 - Special Assignments - Neural Mechanisms in Health & Disease (spring)

## **Part IV - Complete at least one of the following laboratory courses**

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

### **BIOL 30100 - Human Design: Anatomy And Physiology**

Credit Hours: 3.00. A study of human function, emphasizing physiology of body tissues and systems. Relevant aspects of anatomy and histology are also included. Use of examples from current medical practice encourages application of knowledge to predict symptoms of disease and rationale for treatment. Topics covered include histophysiology of cells and tissues, nerve and muscle physiology, the nervous system, and cardiovascular dynamics. Typically offered Fall.

### **BIOL 30200 - Human Design: Anatomy And Physiology**

Credit Hours: 3.00. A continuation of BIOL 30100. (It is helpful but not essential for this course to be preceded by BIOL 30100.) Topics covered include body fluids and renal function, respiration, endocrine systems, the gastro-intestinal system, exercise physiology, reproduction, and immunity. Typically offered Spring.

### **BIOL 32800 - Principles Of Physiology**

Credit Hours: 4.00. This course is designed to provide students with an introduction to physiology with an emphasis on cellular mechanisms that underlie anatomical and physiological adaptations used by animals to survive in their habitat. Topics covered will range from cellular respiration to the physical limits of animal performance as we deconstruct and then reconstruct the body to examine how animals can live in extreme environments. Goals for this course are for students to gain a foundation in basic physiological principles, to learn about the integrative nature of the systems of animals, and to appreciate how and why animals have evolved and strategies to help them survive in their unique environment. Typically offered Spring.

### **BIOL 36701 - Principles Of Development Lab**

Credit Hours: 1.00. This laboratory will offer students the experience working with different model systems to observe developmental processes, examine key regulatory gene expression, and manipulate gene functions used in different biochemical, molecular and genetic approaches. Typically offered Fall Spring.

### **BIOL 39500 - Special Assignments**

Arrange Hours and Credit. Reading, discussions, written reports, seminar presentations, and field or laboratory work provided for enrichment in special areas of the biological sciences. Permission of instructor required. Typically offered Fall Spring Summer.

### **AGRY 32100 - Genetics Laboratory**

Credit Hours: 1.00. Experiments with plants and microorganisms to elucidate the basic concepts of molecular and classical genetics as applied to genome analysis. Typically offered Fall Spring.

## **Note**

<sup>1</sup> For acceptable regional campus options see below.

<sup>2</sup> For alternative choices to BIOL 13500, see below.

<sup>3</sup> If both BIOL 30100 and 30200 are completed, they will meet the requirements for Parts III and IV of the minor. BIOL 30100 or 30200 alone will not meet any requirement for the minor.

<sup>4</sup> Either BIOL 32800 (Principles of Physiology) or BIOL 39500 (Macromolecules) alone will meet the requirements for Parts III and IV of the minor.

**1 - These complete sequences are also acceptable for Part I of the Biological Sciences Minor**

West Lafayette

## **BIOL 19500 - Special Assignments**

Arrange Hours and Credit. Reading, discussions, written reports, seminar presentations, and field or laboratory work provided for enrichment in special areas of the biological sciences. Permission of instructor required. Typically offered Fall Spring Summer.

- BIOL 19500 Organismal Dev & Physiology

## **BIOL 13500 - First year Biology Laboratory**

Credit Hours: 2.00. Laboratory exercises emphasizing student mastery of basic laboratory skills needed to succeed in the biological sciences; intended for beginning (first-year) biology majors. Typically offered Fall Spring.

## **IUPUI**

- BIOL K1010 Concepts of Biology I
- BIOL K1030 Concepts of Biology II

## **Calumet**

- BIOL 10100 Introductory Biology
- BIOL 10200 Introductory Biology

## **North Central (PNC)**

### **BIOL 12100 - Biology I: Diversity, Ecology, And Behavior**

Credit Hours: 2.00. Creates a framework for ordering biology by examining the unity and diversity of life on earth with an emphasis on ecology, genetics, population biology, evolution, and behavior. Typically offered Fall.

### **BIOL 13100 - Biology II: Development, Structure, And Function Of Organisms**

Credit Hours: 3.00. Principles of development of plants and animals and the relationship between the structure and function of selected systems of these organisms. Typically offered Spring.

- BIOL 11600 Laboratory in Biology I: Diversity, Ecology and Behavior
- BIOL 11800 Laboratory in Biology II: Structure, Function and Development

## **Ft. Wayne (IPFW)**

- BIOL 11700 Principles of Ecology and Evolution

- BIOL 11900 Principles of Structure and Function

## Ft. Wayne (IPFW)

- BIOL 10800 Biology of Plants
- BIOL 10900 Biology of Animals

## 2 - These courses are acceptable alternatives to BIOL 13500

### **BIOL 14501 - First Year Biology Laboratory With Neuro Research Project**

Credit Hours: 2.00. This laboratory course has been designed under the goals of the Center for Authentic Science Practice in Education (CASPIE) which aims to expose students to novel research as a means to teach them laboratory science. This course is designed to engage students in authentic research while acquiring necessary skills and concepts to be successful as a biology major. Our topic is Neuroanatomy of Auditory Pathways. We will begin with a series of skills and knowledge building weeks and then transition into independent research projects that culminate in a public presentation of the data in a poster session. In this course, students will learn the fundamentals in neurobiology as well as use sophisticated analysis and instrumentation to answer a research question. Critical thinking in experimental design as well as interpretation and communication of data will be stressed. The goals for this course are to gain a foundation in basic biological measurements and techniques, hone the analytical skills, appreciate the excitement of scientific discovery, and have fun along the way. Permission of department required. Typically offered Fall.

### **BIOL 14502 - First Year Biology Laboratory With Micro Research Project**

Credit Hours: 2.00. This laboratory course has been designed under the goals of the Center for Authentic Science Practice in Education (CASPIE) which aims to expose students to novel research as a means to teach them laboratory science. The course is designed to engage students in authentic research while acquiring the necessary skills and concepts to be successful as a biology major. Our topic is Bacterial Adaptations to Osmotic Stress. In this course, students will learn the fundamentals in bacterial genetics as well as use sophisticated analysis and instrumentation to answer a research question. Critical thinking in experimental design as well as interpretation and communication of data will be stressed. The goal for this course is to gain a foundation in basic biological measurements and techniques, hone the analytical skills, appreciate the excitement of scientific discovery, and have fun along the way. Permission of department required. Typically offered Spring.

### **BIOL 19500 - Special Assignments**

Arrange Hours and Credit. Reading, discussions, written reports, seminar presentations, and field or laboratory work provided for enrichment in special areas of the biological sciences. Permission of instructor required. Typically offered Fall Spring Summer.

### **IT 22600 - Biotechnology Laboratory I**

Credit Hours: 2.00. Focuses on nucleic acid manipulation. Modules include, making a eukaryotic library, identifying clones, sub-cloning into a bacterial expression vector and verification of the clone's identity by restriction analysis and DNA sequencing.

Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures. Typically offered Summer Fall Spring.

# Department of Chemistry

## Overview

The Department of Chemistry is located centrally on the Purdue campus and is housed in the *Richard B. Wetherill Laboratories(WTHR)* and the *Herbert C. Brown Laboratory of Chemistry(BRWN)*. Students, faculty, and staff have access to world class facilities both for teaching and research.

Our Mission | Our Vision

The Department is home to:

- 52 faculty members
- 350 undergraduate students
- 310 graduate students
- 90 support personnel

In the 2013 Academic Ranking of World Universities (Shanghai Rankings), our departments ranked 20th world-wide and 13th nationally.

The Department of Chemistry offers a Bachelor of Science in Chemistry (ACS accredited), a Bachelor of Science and a minor in Chemistry. The department also offers an Honors program and the opportunity to participate in Cooperative Education Program.

### Honors Program

The Department of Chemistry has an honors program for superior students. Participation can begin during the sophomore year, and a student will be assigned to advanced sections in chemistry courses. During the junior and senior years, a student engages in undergraduate research, participates in research seminars and completes honor courses. The undergraduate research experience (CHM 49900 or equivalent) is to be a minimum of six credits. In addition, the student must write an honor's thesis based on the CHM 49900 work. The faculty advisor will read the thesis and the student will give a presentation of the research.

Admission to the chemistry honors program must be made by the end of the junior year. The honors student is expected to achieve and maintain a scholastic graduation index of at least 3.40. Students fulfilling requirements of the chemistry honors program will be graduated "with honors in chemistry". The honors program has been approved by the Royal Society of Chemistry.

### Cooperative Education Program

The Department of Chemistry participates in the Cooperative Education Program. This program requires five years and involves the option of 3 or 5 work period sessions, either semester or summer modules, with a cooperating company in the chemical industry. As a student gains experience, she or he is given increasingly responsible industrial assignments and receives more compensation. A student can enter the program meeting the following requirements: has completed two semesters of chemistry and has a chemistry index of 2.80. Information is available from the Coordinator of Cooperative Education in the Department of Chemistry. Check with your advisor for further information.

## Faculty

<https://www.chem.purdue.edu/people/directory/faculty/>

## Contact Information

*Head:* Professor Timothy Zwiier

*Graduate Admissions:* Ms. Candice Kissinger, Assistant Head

*Undergraduate Information:* Dr. Beatriz Cisneros

*Webmaster:* webmaster@chem.purdue.edu

### **Mailing address:**

Department of Chemistry

560 Oval Drive

West Lafayette, Indiana 47907-2084

**Telephone** (765) 494-5200 **FAX** (765) 494-0239

## Graduate Information

For Graduate Information please see Chemistry Graduate Program Information.

## Biochemistry, BSCH

## About the Program

Biochemists study the chemical basis of life. Some of the major problems include the transfer of genetic information to biological structures, the conversion of nutrients into cell constituents and their utilization as sources of energy, the storage of memory, and the chemical nature of neural processes. Furthermore, biochemists are interested in the chemical details of important processes such as photosynthesis, blood clotting, fertilization, and other functions that may be unique to certain organisms. This program includes six credits of undergraduate research in a wide range of fields, including drug discovery, nano-medicine, protein structure determination, development and application of novel chemical tools to dissect different biological processes.

By concentrating advanced elective credit hours in biochemistry and by taking biology courses, this degree provides an excellent preparation for medical, dental, or veterinary schools. This program would particularly benefit those planning careers in medical research.

Biochemistry (Chemistry) Website

### **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Biochemistry (ACS) include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

CHEM-BSCHM

BICH

120 Credits

2.0 GPA in CHM courses and 2.0 GPA overall

## Departmental/Program Major Courses (107-120 credits)

### Required Major Courses (86 credits)

#### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

#### **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

#### **CHM 26505 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemistry. Typically offered Fall.

#### **CHM 26500 - Organic Chemistry Laboratory**

Credit Hours: 2.00. Similar to CHM 26300 except that a larger number and more sophisticated organic syntheses are required. The preparations are designed not only to illustrate the classical reactions discussed in CHM 26100, but to allow for an extrapolation of the principles involved to other systems. Typically offered Fall.

#### **CHM 26605 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26505, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

#### **CHM 26600 - Organic Chemistry Laboratory**

Credit Hours: 2.00. A continuation of CHM 26500. All experiments are designed to illustrate the principles discussed in CHM 26200. A major portion of the course is devoted to the methods employed in organic qualitative analysis. The student is expected to identify unknowns and mixtures and is introduced to some modern instrumental techniques. Typically offered Spring.

### **CHM 32100 - Analytical Chemistry I**

Credit Hours: 4.00. Quantitative measurements on complex chemical systems that show matrix effects or require isolation of a component prior to its determination; general approaches to quantitative problems at the trace level; critical comparisons of competitive procedures with emphasis on principles of separation processes, including chromatography; recognition and evaluation of possible sources of error; approaches for optimizing conditions so as to minimize time and/or effort required to attain prescribed levels of accuracy and precision. Required of students majoring in chemistry. Typically offered Fall.

### **CHM 24100 - Introductory Inorganic Chemistry**

Credit Hours: 4.00. Descriptive inorganic chemistry dealing in a systematic way with the elements and the structures, properties, and reactions of their compounds. Required of students majoring in chemistry. Typically offered Fall.

### **CHM 34200 - Inorganic Chemistry**

Credit Hours: 3.00. Interpretation and correlation of the reactions and properties of inorganic compounds in terms of their electronic and molecular structures. A survey of the preparations and reactivities of important compounds of the representative elements, with an emphasis on group trends. The elementary chemistry of the transition metals, including magnetic and spectral properties of coordination compounds. Typically offered Spring.

### **CHM 37300 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of matter. Properties of gases, liquids, and solids; equations of state; thermodynamics; energy, heat, and work; entropy; spontaneity and equilibrium; chemical potential; chemical equilibrium; phase diagrams; colligative properties. Typically offered Summer Fall.

### **CHM 37301 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37300. Typically offered Fall.

### **CHM 37401 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37400. Typically offered Spring.

### **CHM 37400 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of molecules. Wave properties of matter; quantum mechanics of translation, rotation, and vibration; atomic structure; molecular orbitals; quantum states; statistical mechanics; chemical kinetics; collision theory; transition state theory. Typically offered Spring.

### **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

### **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

### **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

### **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

### **CHM 53300 - Introductory Biochemistry**

Credit Hours: 3.00. A rigorous one-semester introduction to biochemistry. Typically offered Fall.

### **CHM 53800 - Molecular Biotechnology**

Credit Hours: 3.00. An examination of modern tools for the characterization, manipulation, and design of nucleic acids and proteins. Typically offered Spring.

### **CHM 49900 - Special Assignments**

Credit Hours: 1.00 to 5.00. Undergraduate research. Individual research projects undertaken under faculty direction. Permission of instructor required. Typically offered Fall Spring.

### **CHM 19400 - Freshman Chemistry Orientation**

Credit Hours: 1.00. Designed to provide incoming chemistry majors with the academic, survival, and computational skills to make a successful transition from high school to college. Discussion of opportunities within the chemistry department including degree options, co-op program, undergraduate research, careers in chemistry, use of spreadsheet software, graphing packages, and drawing programs for chemical structures. Attendance and performance on assigned projects are the basis of the assigned grades. Typically offered Fall Spring.

### **CHM 29400 - Sophomore Chemistry Seminar**

Credit Hours: 1.00. Discussion of undergraduate research opportunities, upper-division courses, career opportunities, laboratory safety, use of the library and chemical information, and topics of current interest in chemistry. Required of sophomores majoring in any chemistry curriculum. Typically offered Fall.

### **CHM 49400 - Junior-Senior Chemistry Seminar**

Credit Hours: 1.00. Major emphasis on developing skills in oral and written presentations by students. The subject matter can be library material and/or accomplishments in undergraduate or co-op research. Typically offered Spring.

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **Other Departmental /Program Course Requirements (25-38 credits)**

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Language I Selective - Credit Hours: 0.00 - 3.00
- Language II Selective - Credit Hours: 0.00 - 3.00
- Language and Culture III Selective (select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 3.00
- General Education I Selective (select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education II Selective (select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education III Selective (select courses could satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- Great Issues Selective - Credit Hours: 3.00

- Multidisciplinary Selective (can be satisfied with a minor) - Credit Hours: 3.00

## **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

## **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

## **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

## **Electives (1-9 credits)**

## **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

## Program Requirements

### Fall 1st Year

#### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

#### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

#### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

#### **CHM 19400 - Freshman Chemistry Orientation**

Credit Hours: 1.00. Designed to provide incoming chemistry majors with the academic, survival, and computational skills to make a successful transition from high school to college. Discussion of opportunities within the chemistry department including degree options, co-op program, undergraduate research, careers in chemistry, use of spreadsheet software, graphing packages,

and drawing programs for chemical structures. Attendance and performance on assigned projects are the basis of the assigned grades. Typically offered Fall Spring.

- Language I - Credit Hours: 3.00 \*\*

18 Credits

Spring 1st Year

### **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

- Language II - Credit Hours: 3.00 \*\*
- STS Elective\*/Multidisciplinary - Credit Hours: 3.00

16 Credits

Fall 2nd Year

### **CHM 26505 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemistry. Typically offered Fall.

### **CHM 26500 - Organic Chemistry Laboratory**

Credit Hours: 2.00. Similar to CHM 26300 except that a larger number and more sophisticated organic syntheses are required.

The preparations are designed not only to illustrate the classical reactions discussed in CHM 26100, but to allow for an extrapolation of the principles involved to other systems. Typically offered Fall.

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **CHM 29400 - Sophomore Chemistry Seminar**

Credit Hours: 1.00. Discussion of undergraduate research opportunities, upper-division courses, career opportunities, laboratory safety, use of the library and chemical information, and topics of current interest in chemistry. Required of sophomores majoring in any chemistry curriculum. Typically offered Fall.

14 Credits

Spring 2nd Year

### **CHM 26605 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26505, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

### **CHM 26600 - Organic Chemistry Laboratory**

Credit Hours: 2.00. A continuation of CHM 26500. All experiments are designed to illustrate the principles discussed in CHM 26200. A major portion of the course is devoted to the methods employed in organic qualitative analysis. The student is expected to identify unknowns and mixtures and is introduced to some modern instrumental techniques. Typically offered Spring.

## **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

- General Education - Credit Hours: 3.00 \*\*
- Language and Culture - Credit Hours: 3.00 \*\*

15 Credits

Fall 3rd Year

## **BIOL 23100 - Biology III: Cell Structure And Function**

Credit Hours: 3.00. An introduction to modern cell biology through an examination of the physical and chemical properties that lead to an understanding of the molecular basis for cell function. Typically offered Fall.

## **BIOL 23200 - Laboratory In Biology III: Cell Structure And Function**

Credit Hours: 2.00. Laboratory exercises designed to illustrate the properties, functions, and growth of prokaryotic and eukaryotic cells and to introduce the student to modern experimental methods used to study cells and their separated components. Typically offered Fall.

## **CHM 53300 - Introductory Biochemistry**

Credit Hours: 3.00. A rigorous one-semester introduction to biochemistry. Typically offered Fall.

## **CHM 49900 - Special Assignments**

Credit Hours: 1.00 to 5.00. Undergraduate research. Individual research projects undertaken under faculty direction. Permission of instructor required. Typically offered Fall Spring.

## **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations,

basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

## **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

- General Education - Credit Hours: 3.00

16-17 Credits

Spring 3rd Year

## **BIOL 24100 - Biology IV: Genetics And Molecular Biology**

Credit Hours: 3.00. An introduction to the principles of classical genetics and to molecular genetics. Topics covered are transmission of the genetic material (both in eukaryotes and prokaryotes); changes in the genetic material, structure, and function of the genetic material; and the manipulation of genetic material (recombinant DNA technology). Typically offered Spring.

## **BIOL 24200 - Laboratory In Biology IV: Genetics And Molecular Biology**

Credit Hours: 2.00. Experiments in classical and modern genetics and exercises to acquaint the students with basic techniques in molecular biology. Typically offered Spring.

## **CHM 53800 - Molecular Biotechnology**

Credit Hours: 3.00. An examination of modern tools for the characterization, manipulation, and design of nucleic acids and proteins. Typically offered Spring.

## **CHM 49900 - Special Assignments**

Credit Hours: 1.00 to 5.00. Undergraduate research. Individual research projects undertaken under faculty direction. Permission of instructor required. Typically offered Fall Spring.

### **CHM 24100 - Introductory Inorganic Chemistry**

Credit Hours: 4.00. Descriptive inorganic chemistry dealing in a systematic way with the elements and the structures, properties, and reactions of their compounds. Required of students majoring in chemistry. Typically offered Fall.

### **CHM 49400 - Junior-Senior Chemistry Seminar**

Credit Hours: 1.00. Major emphasis on developing skills in oral and written presentations by students. The subject matter can be library material and/or accomplishments in undergraduate or co-op research. Typically offered Spring.

15 Credits

Fall 4th Year

### **CHM 37300 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of matter. Properties of gases, liquids, and solids; equations of state; thermodynamics; energy, heat, and work; entropy; spontaneity and equilibrium; chemical potential; chemical equilibrium; phase diagrams; colligative properties. Typically offered Summer Fall.

### **CHM 37301 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37300. Typically offered Fall.

### **CHM 32100 - Analytical Chemistry I**

Credit Hours: 4.00. Quantitative measurements on complex chemical systems that show matrix effects or require isolation of a component prior to its determination; general approaches to quantitative problems at the trace level; critical comparisons of competitive procedures with emphasis on principles of separation processes, including chromatography; recognition and evaluation of possible sources of error; approaches for optimizing conditions so as to minimize time and/or effort required to attain prescribed levels of accuracy and precision. Required of students majoring in chemistry. Typically offered Fall.

## **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

## **CHM 49900 - Special Assignments**

Credit Hours: 1.00 to 5.00. Undergraduate research. Individual research projects undertaken under faculty direction. Permission of instructor required. Typically offered Fall Spring.

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

16 Credits

Spring 4th Year

## **CHM 37400 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of molecules. Wave properties of matter; quantum mechanics of translation, rotation, and vibration; atomic structure; molecular orbitals; quantum states; statistical mechanics; chemical kinetics; collision theory; transition state theory. Typically offered Spring.

## **CHM 37401 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37400. Typically offered Spring.

## **CHM 34200 - Inorganic Chemistry**

Credit Hours: 3.00. Interpretation and correlation of the reactions and properties of inorganic compounds in terms of their electronic and molecular structures. A survey of the preparations and reactivities of important compounds of the representative elements, with an emphasis on group trends. The elementary chemistry of the transition metals, including magnetic and spectral properties of coordination compounds. Typically offered Spring.

- General Education - Credit Hours: 3.00 \*\*
- Great Issues - Credit Hours: 3.00 \*\*

## 13 Credits

## Note

\*Satisfies a University Core Requirement

\*\*Satisfies a Non-departmental Major Course Requirement

Students must earn a cumulative GPA of 2.0 in all CHM courses.

Students must have 32 credits at the 30000 level or above taken at Purdue.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Chemistry (ACS), BSCH

## About the Program

Chemistry at Purdue University has a ratio of 1 faculty member for every 8 undergraduates, which allows students to enjoy a great deal of individualized attention. It also offers opportunities for mentoring programs and cutting-edge undergraduate research in a wide range of fields from drug discovery to climate change. Chemistry majors can pursue one of two degrees: B.S. in chemistry, accredited by the American Chemical Society (ACS); or the more flexible B.S. with chemistry as a field of study.

Chemistry (ACS accredited) is designed primarily for students planning professional careers as chemists in industry, universities, or research institutes. This degree program fulfills the recommendations of the Committee of Professional Training of the ACS and graduates will be certified by the ACS as having fulfilled its recommended requirements.

This degree provides an excellent preparation for students pursuing graduate school in Chemistry.

There is also the opportunity to complete in five years a dual degree with chemical engineering if the student has been accepted into the College of Engineering.

Chemistry - American Chemical Society Website

### **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Chemistry (ACS) include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

CHEM-BSCHM

CHMA

120 Credits

2.0 GPA in CHM courses and 2.0 GPA overall

## **Departmental/Program Major Courses (97-118 credits)**

### **Required Major Courses (80 credits)**

#### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

#### **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

#### **CHM 26505 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemistry. Typically offered Fall.

### **CHM 26500 - Organic Chemistry Laboratory**

Credit Hours: 2.00. Similar to CHM 26300 except that a larger number and more sophisticated organic syntheses are required. The preparations are designed not only to illustrate the classical reactions discussed in CHM 26100, but to allow for an extrapolation of the principles involved to other systems. Typically offered Fall.

### **CHM 26605 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26505, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

### **CHM 26600 - Organic Chemistry Laboratory**

Credit Hours: 2.00. A continuation of CHM 26500. All experiments are designed to illustrate the principles discussed in CHM 26200. A major portion of the course is devoted to the methods employed in organic qualitative analysis. The student is expected to identify unknowns and mixtures and is introduced to some modern instrumental techniques. Typically offered Spring.

### **CHM 32100 - Analytical Chemistry I**

Credit Hours: 4.00. Quantitative measurements on complex chemical systems that show matrix effects or require isolation of a component prior to its determination; general approaches to quantitative problems at the trace level; critical comparisons of competitive procedures with emphasis on principles of separation processes, including chromatography; recognition and evaluation of possible sources of error; approaches for optimizing conditions so as to minimize time and/or effort required to attain prescribed levels of accuracy and precision. Required of students majoring in chemistry. Typically offered Fall.

### **CHM 24100 - Introductory Inorganic Chemistry**

Credit Hours: 4.00. Descriptive inorganic chemistry dealing in a systematic way with the elements and the structures, properties, and reactions of their compounds. Required of students majoring in chemistry. Typically offered Fall.

### **CHM 34200 - Inorganic Chemistry**

Credit Hours: 3.00. Interpretation and correlation of the reactions and properties of inorganic compounds in terms of their

electronic and molecular structures. A survey of the preparations and reactivities of important compounds of the representative elements, with an emphasis on group trends. The elementary chemistry of the transition metals, including magnetic and spectral properties of coordination compounds. Typically offered Spring.

### **CHM 34201 - Inorganic Chemistry Laboratory**

Credit Hours: 1.00. Laboratory work to accompany CHM 34200. Typically offered Spring.

### **CHM 37300 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of matter. Properties of gases, liquids, and solids; equations of state; thermodynamics; energy, heat, and work; entropy; spontaneity and equilibrium; chemical potential; chemical equilibrium; phase diagrams; colligative properties. Typically offered Summer Fall.

### **CHM 37400 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of molecules. Wave properties of matter; quantum mechanics of translation, rotation, and vibration; atomic structure; molecular orbitals; quantum states; statistical mechanics; chemical kinetics; collision theory; transition state theory. Typically offered Spring.

### **CHM 37301 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37300. Typically offered Fall.

### **CHM 37401 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37400. Typically offered Spring.

### **CHM 42400 - Analytical Chemistry II**

Credit Hours: 4.00. Principles and application of optical and electrical methods of chemical analysis, including topics in instrumentation. Typically offered Fall.

### **CHM 51300 - Chemical Literature**

Credit Hours: 1.00. Types of information in technical publications; exercises in finding, assembling, and using such data. Typically offered Spring.

### **CHM 53300 - Introductory Biochemistry**

Credit Hours: 3.00. A rigorous one-semester introduction to biochemistry. Typically offered Fall.

### **CHM 19400 - Freshman Chemistry Orientation**

Credit Hours: 1.00. Designed to provide incoming chemistry majors with the academic, survival, and computational skills to make a successful transition from high school to college. Discussion of opportunities within the chemistry department including degree options, co-op program, undergraduate research, careers in chemistry, use of spreadsheet software, graphing packages, and drawing programs for chemical structures. Attendance and performance on assigned projects are the basis of the assigned grades. Typically offered Fall Spring.

### **CHM 29400 - Sophomore Chemistry Seminar**

Credit Hours: 1.00. Discussion of undergraduate research opportunities, upper-division courses, career opportunities, laboratory safety, use of the library and chemical information, and topics of current interest in chemistry. Required of sophomores majoring in any chemistry curriculum. Typically offered Fall.

### **CHM 49400 - Junior-Senior Chemistry Seminar**

Credit Hours: 1.00. Major emphasis on developing skills in oral and written presentations by students. The subject matter can be library material and/or accomplishments in undergraduate or co-op research. Typically offered Spring.

- CHM Elective - CHM 46200 or CHM 49900 or CHM 56000 or CHM 57900 or CHM 58100 or CHM 53800

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series,

conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **MA 26200 - Linear Algebra And Differential Equations**

Credit Hours: 4.00. Linear algebra, elements of differential equations. Not open to students with credit in MA 26500 or MA 26600. Typically offered Fall Spring Summer.

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **Other Departmental /Program Course Requirements (27-38 credits)**

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Language I Selective - Credit Hours: 0.00 - 3.00
- Language II Selective - Credit Hours: 0.00 - 3.00
- Language and Culture III Selective (select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 3.00
- General Education I Selective (select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education II Selective (select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education III Selective (select courses could satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- Great Issues Selective - Credit Hours: 3.00
- Multidisciplinary Selective (can be satisfied with a minor) - Credit Hours: 3.00

## **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

## **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of

searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

## **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

## **Electives (2-13 credits)**

### **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

## **Program Requirements**

### **Fall 1st Year**

#### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

#### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **CHM 19400 - Freshman Chemistry Orientation**

Credit Hours: 1.00. Designed to provide incoming chemistry majors with the academic, survival, and computational skills to make a successful transition from high school to college. Discussion of opportunities within the chemistry department including degree options, co-op program, undergraduate research, careers in chemistry, use of spreadsheet software, graphing packages, and drawing programs for chemical structures. Attendance and performance on assigned projects are the basis of the assigned grades. Typically offered Fall Spring.

- Language I (may be test out) - Credit Hours: 3.00 \*\*

18 Credits

Spring 1st Year

## **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

## **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

- Language II - Credit Hours: 3.00 \*\*

## **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

17 Credits

Fall 2nd Year

## **CHM 26505 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemistry. Typically offered Fall.

## **CHM 26500 - Organic Chemistry Laboratory**

Credit Hours: 2.00. Similar to CHM 26300 except that a larger number and more sophisticated organic syntheses are required. The preparations are designed not only to illustrate the classical reactions discussed in CHM 26100, but to allow for an extrapolation of the principles involved to other systems. Typically offered Fall.

## **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

## **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **CHM 29400 - Sophomore Chemistry Seminar**

Credit Hours: 1.00. Discussion of undergraduate research opportunities, upper-division courses, career opportunities, laboratory safety, use of the library and chemical information, and topics of current interest in chemistry. Required of sophomores majoring in any chemistry curriculum. Typically offered Fall.

14 Credits

Spring 2nd Year

## **CHM 26605 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26505, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

### **CHM 26600 - Organic Chemistry Laboratory**

Credit Hours: 2.00. A continuation of CHM 26500. All experiments are designed to illustrate the principles discussed in CHM 26200. A major portion of the course is devoted to the methods employed in organic qualitative analysis. The student is expected to identify unknowns and mixtures and is introduced to some modern instrumental techniques. Typically offered Spring.

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

### **MA 26200 - Linear Algebra And Differential Equations**

Credit Hours: 4.00. Linear algebra, elements of differential equations. Not open to students with credit in MA 26500 or MA 26600. Typically offered Fall Spring Summer.

- General Education - Credit Hours: 3.00 \*\*

15 Credits

Fall 3rd Year

### **CHM 32100 - Analytical Chemistry I**

Credit Hours: 4.00. Quantitative measurements on complex chemical systems that show matrix effects or require isolation of a component prior to its determination; general approaches to quantitative problems at the trace level; critical comparisons of competitive procedures with emphasis on principles of separation processes, including chromatography; recognition and evaluation of possible sources of error; approaches for optimizing conditions so as to minimize time and/or effort required to attain prescribed levels of accuracy and precision. Required of students majoring in chemistry. Typically offered Fall.

### **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic

probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

### **CHM 37300 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of matter. Properties of gases, liquids, and solids; equations of state; thermodynamics; energy, heat, and work; entropy; spontaneity and equilibrium; chemical potential; chemical equilibrium; phase diagrams; colligative properties. Typically offered Summer Fall.

### **CHM 37301 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37300. Typically offered Fall.

### **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

### **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

14-15 Credits

Spring 3rd Year

### **CHM 24100 - Introductory Inorganic Chemistry**

Credit Hours: 4.00. Descriptive inorganic chemistry dealing in a systematic way with the elements and the structures, properties, and reactions of their compounds. Required of students majoring in chemistry. Typically offered Fall.

### **CHM 37400 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of molecules. Wave properties of matter; quantum mechanics of translation, rotation, and vibration; atomic structure; molecular orbitals; quantum states; statistical mechanics; chemical kinetics; collision theory; transition state theory. Typically offered Spring.

### **CHM 37401 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37400. Typically offered Spring.

- General Education - Credit Hours: 3.00 \*\*

### **CHM 51300 - Chemical Literature**

Credit Hours: 1.00. Types of information in technical publications; exercises in finding, assembling, and using such data. Typically offered Spring.

- Language and Culture - Credit Hours: 3.00 \*\*

15 Credits

Fall 4th Year

### **CHM 53300 - Introductory Biochemistry**

Credit Hours: 3.00. A rigorous one-semester introduction to biochemistry. Typically offered Fall.

### **CHM 42400 - Analytical Chemistry II**

Credit Hours: 4.00. Principles and application of optical and electrical methods of chemical analysis, including topics in instrumentation. Typically offered Fall.

- Multidisc.\*\*/STS Selective\* - Credit Hours: 3.00
- General Education - Credit Hours: 3.00 \*\*

## **CHM 49400 - Junior-Senior Chemistry Seminar**

Credit Hours: 1.00. Major emphasis on developing skills in oral and written presentations by students. The subject matter can be library material and/or accomplishments in undergraduate or co-op research. Typically offered Spring.

14 Credits

Spring 4th Year

## **CHM 34200 - Inorganic Chemistry**

Credit Hours: 3.00. Interpretation and correlation of the reactions and properties of inorganic compounds in terms of their electronic and molecular structures. A survey of the preparations and reactivities of important compounds of the representative elements, with an emphasis on group trends. The elementary chemistry of the transition metals, including magnetic and spectral properties of coordination compounds. Typically offered Spring.

## **CHM 34201 - Inorganic Chemistry Laboratory**

Credit Hours: 1.00. Laboratory work to accompany CHM 34200. Typically offered Spring.

- CHM Elective - Credit Hours: 3.00
- Great Issues - Credit Hours: 3.00 \*\*
- Free elective - Credit Hours: 2.00

12 Credits

## **Note**

\*Satisfies a University Core Requirement

\*\*Satisfies a Non-departmental Major Course Requirement

Students must earn a cumulative GPA of 2.0 in all CHM courses.

Students must have 32 credits at the 30000 level or above taken at Purdue.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Chemistry, BS

## About the Program

Chemistry at Purdue University has a ratio of 1 faculty member for every 8 undergraduates, which allows students to enjoy a great deal of individualized attention. It also offers opportunities for mentoring programs and cutting-edge undergraduate research in a wide range of fields from drug discovery to climate change.

The B.S. program with chemistry as a field of study is designed for those who want training in chemistry and freedom to pursue minors or second majors in other areas. Common areas of interest have been Forensic Sciences, Biology, Foreign Languages, Management, Psychology, and other Liberal Arts areas. The flexibility in this program adapts easily to Study Abroad semesters.

Chemistry Website

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Chemistry include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

CHEM-BS

CHEM

120 Credits

2.0 GPA in CHM courses and 2.0 GPA overall

## Departmental/Program Major Courses (86-102 credits)

## Required Major Courses (64 credits)

### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

### **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

### **CHM 26505 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemistry. Typically offered Fall.

### **CHM 26500 - Organic Chemistry Laboratory**

Credit Hours: 2.00. Similar to CHM 26300 except that a larger number and more sophisticated organic syntheses are required. The preparations are designed not only to illustrate the classical reactions discussed in CHM 26100, but to allow for an extrapolation of the principles involved to other systems. Typically offered Fall.

### **CHM 26605 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26505, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

### **CHM 26600 - Organic Chemistry Laboratory**

Credit Hours: 2.00. A continuation of CHM 26500. All experiments are designed to illustrate the principles discussed in CHM 26200. A major portion of the course is devoted to the methods employed in organic qualitative analysis. The student is expected to identify unknowns and mixtures and is introduced to some modern instrumental techniques. Typically offered Spring.

## **CHM 32100 - Analytical Chemistry I**

Credit Hours: 4.00. Quantitative measurements on complex chemical systems that show matrix effects or require isolation of a component prior to its determination; general approaches to quantitative problems at the trace level; critical comparisons of competitive procedures with emphasis on principles of separation processes, including chromatography; recognition and evaluation of possible sources of error; approaches for optimizing conditions so as to minimize time and/or effort required to attain prescribed levels of accuracy and precision. Required of students majoring in chemistry. Typically offered Fall.

## **CHM 24100 - Introductory Inorganic Chemistry**

Credit Hours: 4.00. Descriptive inorganic chemistry dealing in a systematic way with the elements and the structures, properties, and reactions of their compounds. Required of students majoring in chemistry. Typically offered Fall.

## **CHM 34200 - Inorganic Chemistry**

Credit Hours: 3.00. Interpretation and correlation of the reactions and properties of inorganic compounds in terms of their electronic and molecular structures. A survey of the preparations and reactivities of important compounds of the representative elements, with an emphasis on group trends. The elementary chemistry of the transition metals, including magnetic and spectral properties of coordination compounds. Typically offered Spring.

## **CHM 37300 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of matter. Properties of gases, liquids, and solids; equations of state; thermodynamics; energy, heat, and work; entropy; spontaneity and equilibrium; chemical potential; chemical equilibrium; phase diagrams; colligative properties. Typically offered Summer Fall.

## **CHM 37400 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of molecules. Wave properties of matter; quantum mechanics of translation, rotation, and vibration; atomic structure; molecular orbitals; quantum states; statistical mechanics; chemical kinetics; collision theory; transition state theory. Typically offered Spring.

## **CHM 37301 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37300. Typically offered Fall.

## **CHM 37401 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37400. Typically offered Spring.

### **CHM 19400 - Freshman Chemistry Orientation**

Credit Hours: 1.00. Designed to provide incoming chemistry majors with the academic, survival, and computational skills to make a successful transition from high school to college. Discussion of opportunities within the chemistry department including degree options, co-op program, undergraduate research, careers in chemistry, use of spreadsheet software, graphing packages, and drawing programs for chemical structures. Attendance and performance on assigned projects are the basis of the assigned grades. Typically offered Fall Spring.

### **CHM 29400 - Sophomore Chemistry Seminar**

Credit Hours: 1.00. Discussion of undergraduate research opportunities, upper-division courses, career opportunities, laboratory safety, use of the library and chemical information, and topics of current interest in chemistry. Required of sophomores majoring in any chemistry curriculum. Typically offered Fall.

### **CHM 49400 - Junior-Senior Chemistry Seminar**

Credit Hours: 1.00. Major emphasis on developing skills in oral and written presentations by students. The subject matter can be library material and/or accomplishments in undergraduate or co-op research. Typically offered Spring.

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals.

Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **Other Departmental /Program Course Requirements (28-38 credits)**

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Language I Selective - Credit Hours: 0.00 - 3.00
- Language II Selective - Credit Hours: 0.00 - 3.00
- Language and Culture III Selective (select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 3.00
- General Education I Selective (select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education II Selective (select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education III Selective (select courses could satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- Great Issues Selective - Credit Hours: 3.00
- Multidisciplinary Selective (can be satisfied with a minor) - Credit Hours: 3.00

## **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

## **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

## **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

## **Electives (18-28 credits)**

## **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

## Program Requirements

### Fall 1st Year

#### **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

#### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

#### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

#### **CHM 19400 - Freshman Chemistry Orientation**

Credit Hours: 1.00. Designed to provide incoming chemistry majors with the academic, survival, and computational skills to make a successful transition from high school to college. Discussion of opportunities within the chemistry department including degree options, co-op program, undergraduate research, careers in chemistry, use of spreadsheet software, graphing packages,

and drawing programs for chemical structures. Attendance and performance on assigned projects are the basis of the assigned grades. Typically offered Fall Spring.

- Language I (may be test out) - Credit Hours: 3.00 \*\*

18 Credits

Spring 1st Year

### **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

- Language II - Credit Hours: 3.00 \*\*
- Science, Technology and Society - Credit Hours: 3.00

16 Credits

Fall 2nd Year

### **CHM 26505 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemistry. Typically offered Fall.

### **CHM 26500 - Organic Chemistry Laboratory**

Credit Hours: 2.00. Similar to CHM 26300 except that a larger number and more sophisticated organic syntheses are required.

The preparations are designed not only to illustrate the classical reactions discussed in CHM 26100, but to allow for an extrapolation of the principles involved to other systems. Typically offered Fall.

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **CHM 29400 - Sophomore Chemistry Seminar**

Credit Hours: 1.00. Discussion of undergraduate research opportunities, upper-division courses, career opportunities, laboratory safety, use of the library and chemical information, and topics of current interest in chemistry. Required of sophomores majoring in any chemistry curriculum. Typically offered Fall.

14 Credits

Spring 2nd Year

### **CHM 26605 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26505, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

### **CHM 26600 - Organic Chemistry Laboratory**

Credit Hours: 2.00. A continuation of CHM 26500. All experiments are designed to illustrate the principles discussed in CHM 26200. A major portion of the course is devoted to the methods employed in organic qualitative analysis. The student is expected to identify unknowns and mixtures and is introduced to some modern instrumental techniques. Typically offered Spring.

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

## **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

- General Education - Credit Hours: 3.00

15 Credits

Fall 3rd Year

## **CHM 32100 - Analytical Chemistry I**

Credit Hours: 4.00. Quantitative measurements on complex chemical systems that show matrix effects or require isolation of a component prior to its determination; general approaches to quantitative problems at the trace level; critical comparisons of competitive procedures with emphasis on principles of separation processes, including chromatography; recognition and evaluation of possible sources of error; approaches for optimizing conditions so as to minimize time and/or effort required to attain prescribed levels of accuracy and precision. Required of students majoring in chemistry. Typically offered Fall.

## **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

- General Education - Credit Hours: 3.00
- Free elective - Credit Hours: 3.00
- Free elective - Credit Hours: 2.00

15 Credits

## Spring 3rd Year

### **CHM 24100 - Introductory Inorganic Chemistry**

Credit Hours: 4.00. Descriptive inorganic chemistry dealing in a systematic way with the elements and the structures, properties, and reactions of their compounds. Required of students majoring in chemistry. Typically offered Fall.

### **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

### **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

- General Education - Credit Hours: 3.00 \*\*
- Great Issues - Credit Hours: 3.00

13 or 14 Credits

## Fall 4th Year

### **CHM 37300 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of matter. Properties of gases, liquids, and solids; equations of state; thermodynamics; energy, heat, and work; entropy; spontaneity and equilibrium; chemical potential; chemical equilibrium; phase diagrams; colligative properties. Typically offered Summer Fall.

### **CHM 37301 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37300. Typically offered Fall.

- Multidisciplinary/Free elective - Credit Hours: 3.00 \*\*
- Language and Culture - Credit Hours: 3.00
- Free elective - Credit Hours: 3.00

### **CHM 49400 - Junior-Senior Chemistry Seminar**

Credit Hours: 1.00. Major emphasis on developing skills in oral and written presentations by students. The subject matter can be library material and/or accomplishments in undergraduate or co-op research. Typically offered Spring.

14 Credits

Spring 4th Year

### **CHM 37400 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of molecules. Wave properties of matter; quantum mechanics of translation, rotation, and vibration; atomic structure; molecular orbitals; quantum states; statistical mechanics; chemical kinetics; collision theory; transition state theory. Typically offered Spring.

### **CHM 37401 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37400. Typically offered Spring.

### **CHM 34200 - Inorganic Chemistry**

Credit Hours: 3.00. Interpretation and correlation of the reactions and properties of inorganic compounds in terms of their electronic and molecular structures. A survey of the preparations and reactivities of important compounds of the representative elements, with an emphasis on group trends. The elementary chemistry of the transition metals, including magnetic and spectral properties of coordination compounds. Typically offered Spring.

- Free elective - Credit Hours: 3.00
- Free elective - Credit Hours: 4.00 or 5.00

14/15 Credits

## Note

\*Satisfies a University Core Requirement

\*\*Satisfies a Non-departmental Major Course Requirement

Students must earn a cumulative GPA of 2.0 in all CHM courses.

Students must have 32 credits at the 30000 level or above taken at Purdue.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Chemistry Minor

### Pre-Requisite Courses for Chem Minor (CHEM)

To complete the required courses for the Chemistry minor, you will need to first complete the following pre-requisite courses [by completing the course or establishing credit]. These courses are not part of the Chemistry minor.

#### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## **MA 16020 - Applied Calculus II**

Credit Hours: 3.00. This course covers techniques of integration; infinite series, convergence tests; differentiation and integration of functions of several variables; maxima and minima, optimization; differential equations and initial value problems; matrices, determinants, eigenvalues and eigenvectors. Applications. Typically offered Fall Spring Summer.

## **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

## **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab  
or

## **CHM 12500 - Introduction To Chemistry I**

Credit Hours: 5.00. Principles of chemistry including stoichiometry; atomic structure and chemical bonding; properties of gases, liquids, and solids; thermochemistry; descriptive inorganic chemistry. Recommended for entering students intending to major in chemistry. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall.

## **CHM 12600 - Introduction To Chemistry II**

Credit Hours: 5.00. A continuation of CHM 12500. Properties of solutions; chemical equilibrium calculations; elementary thermodynamics; oxidation-reduction reactions and electrochemical cells; rates of reaction; qualitative analysis; descriptive chemistry. Typically offered Spring.

or

## **CHM 12901 - General Chemistry With A Biological Focus**

Credit Hours: 5.00. An accelerated and comprehensive one-semester general chemistry course that emphasizes principles that are important in biological systems. This course is designed to cover the essential elements of general chemistry traditionally covered in a two semester series. Topics to be covered include: Stoichiometry and chemical equations; atomic theory and structure; periodic properties; electronegativity; ionic and covalent bonding; non-covalent forces; bond energies; Lewis structures; molecular geometry; gases, liquids, and solids; solutions, quantitative equilibria in aqueous solution; acid/base chemistry and buffers; introductory thermodynamics; oxidation-reduction; electrochemical and membrane potential; colligative properties; chemical and enzyme kinetics; nuclear chemistry; coordination chemistry. One year of high school chemistry is required. Typically offered Fall.

## **Requirements for the Minor**

The Chemistry Minor provides a strong background in Chemistry for students majoring in some other discipline

To qualify for the minor, the following classes must be completed with a cumulative GPA of 2.0 or better.

ALL COURSES FOR THIS MINOR LISTED BELOW MUST BE TAKEN AT PURDUE UNIVERSITY WEST LAFAYETTE.

To obtain a minor in Chemistry you can choose 16 credits from the following courses.

The 16 credits can come from Area 1 and/or Area 2 and/or Area 3 and/or Area 4 and any of the courses listed in the last block.

AREA 1: Organic Chemistry only one first semester and one second semester organic course, as described below.

AREA 2 and AREA 3: the OR which means one course or the other, both will not count.

TOTAL CREDITS OF AREA 1 + AREA 2 + AREA 3 + AREA 4 = 16 credits

### **Area 1 Organic Chemistry (0-10 credits)**

#### **CHM 25500 - Organic Chemistry**

Credit Hours: 3.00. A study of aliphatic and aromatic hydrocarbons and their simple derivatives in terms of (a) structure, bonding, etc.; (b) general syntheses and reactions; and (c) a logical modern rationale for fundamental phenomena as supported by reactivity orders, orientation effects, stereochemistry, and relative rates. Recommended for biology majors. Typically offered Fall Spring.

#### **CHM 26100 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students

majoring in chemical engineering. If not a chemical engineering major, see CHM 26505 - Organic Chemistry. Typically offered Fall.

### **CHM 26505 - Organic Chemistry**

Credit Hours: 3.00. A comprehensive study of the chemical principles underlying aliphatic and aromatic compounds. The syntheses and reactions of these materials are discussed. Modern theory and stereochemistry are stressed to illustrate the logic inherent in the subject matter and to demonstrate the predictability of many chemical transformations. Recommended for students majoring in chemistry. Typically offered Fall.

### **MCMP 20400 - Organic Chemistry I**

Credit Hours: 4.00. Organic chemistry; a study of the compounds of carbon on a functional group basis, with particular emphasis on those organic compounds of pharmaceutical and physiological importance; microlaboratory experiments involving the methods of purification, reactions, and synthesis of organic compounds. Typically offered Spring.

### **CHM 25600 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 25500 with various functional groups such as the carboxyl, amino, etc., and including such polyfunctional natural products as carbohydrates and peptides. Typically offered Fall Spring.

### **CHM 26200 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26100, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

### **CHM 26605 - Organic Chemistry**

Credit Hours: 3.00. A continuation of CHM 26505, but a broader scope. The chemistry of a variety of functional groups is discussed. Theory is employed extensively to demonstrate the coherence underlying seemingly diverse transformations. Qualitative organic analysis is introduced, with particular emphasis on spectroscopic methods. Typically offered Spring.

### **MCMP 20500 - Organic Chemistry II**

Credit Hours: 4.00. Continuation of MCMP 20400. Typically offered Fall.

### **CHM 25501 - Organic Chemistry Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany CHM 25500, illustrating methods of separation, instrumental methods of analysis, and the more common techniques and methods for preparing various types of organic compounds. Typically offered Fall Spring.

### **CHM 26300 - Organic Chemistry Laboratory**

Credit Hours: 1.00. Laboratory experiments designed to illustrate the lecture material of CHM 26100. Elementary laboratory techniques essential to organic chemistry are introduced, followed by the actual syntheses and purification of compounds discussed in CHM 26100. Typically offered Fall.

### **CHM 26500 - Organic Chemistry Laboratory**

Credit Hours: 2.00. Similar to CHM 26300 except that a larger number and more sophisticated organic syntheses are required. The preparations are designed not only to illustrate the classical reactions discussed in CHM 26100, but to allow for an extrapolation of the principles involved to other systems. Typically offered Fall.

### **CHM 26700 - Organic Chemistry Laboratory Honors**

Credit Hours: 2.00. Laboratory experiments designed to accompany the lecture material of CHM 26100, but at an advanced level. Modern instrumentation is introduced to supplement the usual elementary laboratory techniques of organic chemistry. Multistep syntheses are employed to illustrate and supplement the reactions discussed in CHM 26100. Typically offered Fall.

### **CHM 25601 - Organic Chemistry Laboratory**

Credit Hours: 1.00. A continuation of CHM 25501. Experiments are designed to illustrate principles discussed in CHM 25600. Typically offered Fall Spring.

### **CHM 26400 - Organic Chemistry Laboratory**

Credit Hours: 1.00. A continuation of CHM 26300 in that the experiments are designed to illustrate principles discussed in CHM 26200. A major portion of the course is devoted to methods employed in organic qualitative analysis. The student is expected to identify several unknown compounds and mixtures. Typically offered Spring.

### **CHM 26600 - Organic Chemistry Laboratory**

Credit Hours: 2.00. A continuation of CHM 26500. All experiments are designed to illustrate the principles discussed in CHM 26200. A major portion of the course is devoted to the methods employed in organic qualitative analysis. The student is expected to identify unknowns and mixtures and is introduced to some modern instrumental techniques. Typically offered Spring.

## **CHM 26800 - Organic Chemistry Laboratory Honors**

Credit Hours: 2.00. A continuation of CHM 26700. Experiments, more sophisticated than those in CHM 26600, are designed to illustrate and extend the concepts presented in CHM 26200. A major portion of the course is devoted to organic qualitative analysis. The student is expected to identify unknown compounds by classical methods as well as by the use of modern instrumentation like infrared gas chromatography and nuclear magnetic resonance. Typically offered Spring.

## Area 2 Physical Chemistry (0-7 credits)

### **CHM 37200 - Physical Chemistry**

Credit Hours: 4.00. Principles of physical chemistry with emphasis on chemical thermodynamics and kinetics, illustrated examples from the biological sciences. Intended primarily for students in the life sciences. Typically offered Spring.

### **CHM 37300 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of matter. Properties of gases, liquids, and solids; equations of state; thermodynamics; energy, heat, and work; entropy; spontaneity and equilibrium; chemical potential; chemical equilibrium; phase diagrams; colligative properties. Typically offered Summer Fall.

### **CHM 37000 - Topics In Physical Chemistry**

Credit Hours: 3.00. Kinetic theory of gases; statistical thermodynamics; quantum mechanics; atomic and molecular structure and spectroscopy; properties of ionic phases. May not be used to satisfy requirements for graduation in chemistry. Typically offered Fall Spring.

### **CHM 37400 - Physical Chemistry**

Credit Hours: 3.00. Physical chemistry of molecules. Wave properties of matter; quantum mechanics of translation, rotation, and vibration; atomic structure; molecular orbitals; quantum states; statistical mechanics; chemical kinetics; collision theory; transition state theory. Typically offered Spring.

## Area 3 Biochemistry (0-3 credits)

### **CHM 53300 - Introductory Biochemistry**

Credit Hours: 3.00. A rigorous one-semester introduction to biochemistry. Typically offered Fall.

### **BCHM 56100 - General Biochemistry I**

Credit Hours: 3.00. This course provides upper-division undergraduate and graduate students with basic understanding of biochemical and structural properties of amino acids, nucleic acids, lipids, and carbohydrates. This course allows students to connect the relationship between structure and function of biomolecules. In addition, students learn to understand enzyme properties, enzyme mechanism of action, and enzyme regulation. Typically offered Fall.

### **CHM 33900 - Biochemistry: A Molecular Approach**

Credit Hours: 3.00. CHM 33900 is a comprehensive one-semester biochemistry course that emphasizes molecules and molecular reaction mechanisms, building upon the principles conveyed in general chemistry and organic chemistry. This course is designed to cover the essential elements of biochemistry traditionally covered in a two semester series. Topics to be covered include: Amino acids, peptides and proteins, molecular models and structure-function relationships, enzymes, enzyme kinetics and enzyme mechanisms, carbohydrates and carbohydrate metabolism, aerobic metabolism, lipids and membranes, lipid metabolism, nitrogen metabolism and integration and regulation of metabolism. Special emphasis will be placed on connections between biochemical principles and the fields of medicine, human health and disease, nutrition and biotechnology. This course should serve as excellent preparation for higher-level biochemistry courses as well as standardized pre-health professional exams. CHM 33900 was designed as the 4th semester of the 1-2-1 competency-based curriculum transformation in chemistry as it applies to pre-health professional and life science students at Purdue. However, this course is open to other students who meet the prerequisites. Typically offered Spring.

### **Area 4 Others (0-16 credits)**

Course Choices in addition to Area 1, Area 2 and Area 3 options:

### **CHM 32100 - Analytical Chemistry I**

Credit Hours: 4.00. Quantitative measurements on complex chemical systems that show matrix effects or require isolation of a component prior to its determination; general approaches to quantitative problems at the trace level; critical comparisons of competitive procedures with emphasis on principles of separation processes, including chromatography; recognition and evaluation of possible sources of error; approaches for optimizing conditions so as to minimize time and/or effort required to attain prescribed levels of accuracy and precision. Required of students majoring in chemistry. Typically offered Fall.

### **CHM 32300 - Analytical Chemistry I Honors**

Credit Hours: 4.00. Open to students in the chemistry honors program. Topical coverage similar to CHM 32100. Laboratory will include a group of core experiments plus special experiments designed by students and staff to study original problems related to analytical chemistry. Typically offered Fall.

## **CHM 42400 - Analytical Chemistry II**

Credit Hours: 4.00. Principles and application of optical and electrical methods of chemical analysis, including topics in instrumentation. Typically offered Fall.

## **CHM 24100 - Introductory Inorganic Chemistry**

Credit Hours: 4.00. Descriptive inorganic chemistry dealing in a systematic way with the elements and the structures, properties, and reactions of their compounds. Required of students majoring in chemistry. Typically offered Fall.

## **CHM 34200 - Inorganic Chemistry**

Credit Hours: 3.00. Interpretation and correlation of the reactions and properties of inorganic compounds in terms of their electronic and molecular structures. A survey of the preparations and reactivities of important compounds of the representative elements, with an emphasis on group trends. The elementary chemistry of the transition metals, including magnetic and spectral properties of coordination compounds. Typically offered Spring.

## **CHM 34201 - Inorganic Chemistry Laboratory**

Credit Hours: 1.00. Laboratory work to accompany CHM 34200. Typically offered Spring.

## **CHM 37301 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37300. Typically offered Fall.

## **CHM 37401 - Physical Chemistry Laboratory**

Credit Hours: 1.00. A physical chemistry laboratory course that will provide students with hands-on experience that illustrates the core concepts presented in the associated physical chemistry lecture course CHM 37400. Typically offered Spring.

## **CHM 57900 - Computational Chemistry**

Credit Hours: 3.00. Theoretical basis and practical applications of computational methods relevant to chemical and biochemical research problems. Typically offered Spring.

## **CHM 33901 - Biochemistry Laboratory**

Credit Hours: 1.00. CHM 33901 is a laboratory course based on two modules from the Undergraduate Research Inspired Experimental Chemistry Alternatives (URIECA) developed at MIT that are designed to introduce students to cutting-edge research topics in biochemistry. The course provides students with a research-inspired laboratory experience that introduces standard biochemical techniques in the context of investigating a current research topic, for example, acquired resistance to cancer drugs. Techniques include protein expression, purification, and gel analysis, PCR, site-directed mutagenesis, kinase activity assays, and protein structure viewing. CHM 33901 was designed as the 4th semester of the 1-2-1 competency-based curriculum transformation in chemistry as it applies to pre-health professional and life science students at Purdue. However, the course is open to other students who meet the pre-requisites. Typically offered Spring.

## **CHM 46200 - Intermediate Organic Chemistry**

Credit Hours: 3.00. Theory and application of organic chemistry and reaction mechanisms to organic synthesis and contemporary research topics in closely related areas. Topics include stereochemistry, reactive organic intermediates, molecular orbital theory, photochemistry, organic materials chemistry, and chemical biology. Typically offered Spring.

## **CHM 56000 - Organic Spectroscopic Analysis**

Credit Hours: 3.00. Identification of organic compounds and characteristic groups by the use of mass spectrometry, infrared, nuclear magnetic resonance, and ultraviolet spectroscopy. Typically offered Spring.

## **CHM 53800 - Molecular Biotechnology**

Credit Hours: 3.00. An examination of modern tools for the characterization, manipulation, and design of nucleic acids and proteins. Typically offered Spring.

## **CHM 58100 - Atmospheric Chemistry**

Credit Hours: 3.00. (EAPS 52100) An introduction to the chemistry of the earth's atmosphere. Covers evolution of the earth's atmosphere, its physical and chemical structure, its natural chemical composition and oxidative properties, and human impacts, including increasing tropospheric ozone, decreasing stratospheric ozone, climate change, and acidic deposition. Typically offered Fall.

## **CHM 51300 - Chemical Literature**

Credit Hours: 1.00. Types of information in technical publications; exercises in finding, assembling, and using such data. Typically offered Spring.

## **CHM 49900 - Special Assignments**

Credit Hours: 1.00 to 5.00. Undergraduate research. Individual research projects undertaken under faculty direction. Permission of instructor required. Typically offered Fall Spring.

## **CHM 29000 - Selected Topics In Chemistry For Lower-Division Students**

Credit Hours: 1.00 to 4.00. Topics vary. Permission of instructor required. Typically offered Fall Spring Summer.

## **CHM 49000 - Selected Topics In Chemistry For Upper-Division Students**

Credit Hours: 1.00 to 4.00. Topics vary. Typically offered Fall Spring Summer.

Total: 16.00 credits or above

\*Please note that CHM 20000, CHM 22400, CHM 25700 and CHM 33300 cannot be used to complete the minor.

# **Department of Computer Science**

## **Department of Computer Science**

Purdue Computer Science is one of the country's top-ranked programs. Faculty members are shaping the future of information technology through cutting-edge research. Students can take courses that include such topics as graphics and animation, competitive programming, cryptography and security, networks, software engineering, distributed systems, information systems, artificial intelligence, and bioinformatics. Computer Science graduates pursue careers in animation and visualization, biotechnology, computational finance, computer graphics, consulting, information security, wireless systems, and software engineering. Many also go on to graduate or professional school in areas such as business, law, or medicine.

The department is located in the Lawson Computer Science Building, which opened in 2006. In addition to offering an inviting and comfortable environment, the building is equipped with cutting-edge networking and computing technologies, including 10-gigabit Ethernet cabling and wireless access throughout the building. There are four classrooms, four instructional labs, five research labs, and a student activity center. The building also offers students a variety of interaction areas, and a deli-style café and espresso bar. A 16-by-9 foot tiled video wall donated by the Harris Corporation is used for a variety of purposes, including notices of campus events, workshop and colloquium speakers, news and information, research demonstrations, and class projects.

The Purdue Computer Science Department offers a Bachelor of Science (BS), a minor in computer science, or a 5-year combined BS/MS degree. The department also offers an Honors Program, and the opportunity to participate in the Cooperative Education Program.

Computer Science Website

# Faculty

<https://www.cs.purdue.edu/people/faculty/index.html>

## Contact Information

### General Department Contact

Purdue University  
Department of Computer Science  
305 N. University Street  
West Lafayette, IN 47907-2107  
Phone: (765) 494-6010  
Fax: (765) 494-0739

## Graduate Information

For Graduate Information please see Computer Science Graduate Program Information.

## Computer Science Honors, BS

## About the Program

Students in the Computer Science Honors major, in addition to fulfilling all the requirements for a BS in Computer Science, will complete additional coursework and a research project. Honors students must maintain an overall GPA of 3.25 plus at least a 3.6 in Computer Science and required CSHO courses. The program requirements include additional math coursework, an Electrical Engineering course, a research seminar and project, and a graduate level course. It is especially suitable for students planning on graduate level coursework, though it also offers advantages to students seeking employment.

Students are invited to declare the major if they meet the qualifications after their first semester or after completion of the six core courses. Students who have been admitted to the Honors College may also join the major. Students may also request to declare the major if they meet qualifications no later than their seventh semester (student must have at least 2 academic semesters remaining to accommodate both the research seminar and the research project).

Computer Science Website

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Computer Science Honors include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

Code - BS

Code - CSHO

120 cr for graduation

"C" or better in all major courses

## Computer Science Honors Major Courses (59-63 credits)

### Required CS Honors Major Math Courses (7-8 credits)

(must have C or better to meet prerequisite for certain upper level CS courses)

#### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

#### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

#### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### Required CS Major Core Courses (21 credits)

(must have C or better in all courses)

#### **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

#### **CS 18200 - Foundations Of Computer Science**

Credit Hours: 3.00. Logic and proofs; sets, functions, relations, sequences and summations; number representations; counting;

fundamentals of the analysis of algorithms; graphs and trees; proof techniques; recursion; Boolean logic; finite state machines; pushdown automata; computability and undecidability. Typically offered Spring Fall.

## **CS 24000 - Programming In C**

Credit Hours: 3.00. The UNIX environment, C development cycle, data representation, operators, program structure, recursion, macros, C preprocessor, pointers and addresses, dynamic memory allocation, structures, unions, typedef, bit-fields, pointer/structure applications, UNIX file abstraction, file access, low-level I/O, concurrency. Typically offered Fall Spring.

## **CS 25000 - Computer Architecture**

Credit Hours: 4.00. Digital logic: transistors, gates, and combinatorial circuits; clocks; registers and register banks; arithmetic-logic units; data representation: big-endian and little-endian integers; ones and twos complement arithmetic; signed and unsigned values; Von-Neumann architecture and bottleneck; instruction sets; RISC and CISC designs; instruction pipelines and stalls; rearranging code; memory and address spaces; physical and virtual memory; interleaving; page tables; memory caches; bus architecture; polling and interrupts; DMA; device programming; assembly language; optimizations; parallelism; data pipelining. Typically offered Fall Spring.

## **CS 25100 - Data Structures And Algorithms**

Credit Hours: 3.00. Running time analysis of algorithms and their implementations, one-dimensional data structures, trees, heaps, additional sorting algorithms, binary search trees, hash tables, graphs, directed graphs, weighted graph algorithms, additional topics. Typically offered Fall Spring.

## **CS 25200 - Systems Programming**

Credit Hours: 4.00. Low-level programming; review of addresses, pointers, memory layout, and data representation; text, data, and bss segments; debugging and hex dumps; concurrent execution with threads and processes; address spaces; file names; descriptors and file pointers; inheritance; system calls and library functions; standard I/O and string libraries; simplified socket programming; building tools to help programmers; make and make files; shell scripts and quoting; unix tools including sed, echo, test, and find; scripting languages such as awk; version control; object and executable files (.o and a.out); symbol tables; pointers to functions; hierarchical directories; and DNS hierarchy; programming embedded systems. Typically offered Fall Spring.

## **Required CS Major Track Selectives - (18-21 credits)**

**(must have C or better in all courses)** select from list [LINK](#)

- CS Track Required course - Credit Hours: 3.00
- CS Track Required course - Credit Hours: 3.00
- CS Track Required/Elective course - Credit Hours: 3.00
- CS Track Required/Elective course - Credit Hours: 3.00
- CS Track Elective course - Credit Hours: 3.00

- CS Track Elective course - Credit Hours: 3.00
- CS Track Elective course (if Computational Science & Engineering track or Database & Information Systems track) - Credit Hours: 3.00

## Required CS Honors - (13 credits)

select from list (need CS GPA of 3.60 or better & cum GPA of 3.25 and **must have a C or better in all**) [LINK](#)

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **ECE 27000 - Introduction To Digital System Design**

Credit Hours: 4.00. An introduction to digital system design and hardware engineering, with an emphasis on practical design techniques and circuit implementation. Typically offered Fall Spring.

### **CS 39700 - Honors Seminar**

Credit Hours: 0.00. A seminar for all sophomores, juniors, and seniors in the Computer Sciences Honors Program. Meets eight times each semester under the supervision of the Honors coordinator. The meetings focus on honors research projects, helping students to identify appropriate projects and form groups, and providing a forum for juniors and seniors to report on their projects as required in the honors program. Typically offered Fall.

### **CS 49700 - Honors Research Project**

Credit Hours: 3.00. One semester of the project may be counted as one of the seven computer science courses at or above the 300 level required for the bachelor's degree. One more semester, if approved by the honors coordinator, can be used as a free elective. A group research project directed by Computer Sciences faculty members. Each group must submit a technical report describing its work and the results obtained. Typically offered Fall Spring.

- CS 500 level course (may use for Track Elective - see Track chairperson for approval) - Credit Hours: 3.00

## Other Departmental/Program Course Requirements (35-62 credits)

\* Requirement may be met with a zero credit experiential learning option. See your advisor for more information.

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and

research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **HONR 19903 - Interdisciplinary Approaches In Writing**

Credit Hours: 3.00. This course is a writing-intensive course in which students learn how to find, evaluate, and use credible information, how to express themselves well in a variety of different written genres, and how to write for different audiences. Typically offered Fall Spring.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Te
- Technical Writing Option and Technical Presenting Option (COM 21700 recommended) (select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Language I \* - select from three options; select from list - Credit Hours: 0.00 - 4.00
- Language II \* - select from three options; select from list - Credit Hours: 0.00 - 4.00
- Language and Culture III \* - (may satisfy Human Cultures Humanities) select from three options; select from list - Credit Hours: 0.00 - 4.00
- General Education I - (may satisfy Human Culture Humanities and Behavioral/Social Science) select from list - Credit Hours: 3.00
- General Education II - (may satisfy Human Culture Humanities and Behavioral/Social Science) select from list - Credit Hours: 3.00
- General Education III - select from list - Credit Hours: 3.00
- Great Issues -select from list - Credit Hours: 3.00
- Multidisciplinary Experience \* (may satisfy Science, Technology and Society) - select from list - Credit Hours: 0.00 - 3.00
- Teambuilding and Collaboration Experience \* (CS 18000 meets requirement) - select from list - Credit Hours: 0.00 - 4.00
- Lab Science I selective - (satisfies Science) select from list - Credit Hours: 3.00 - 4.00
- Lab Science II selective - (may satisfy Science) select from list - Credit Hours: 3.00 - 4.00

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed

for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

### **Electives (1-26 credits)**

\* Required freshman seminar courses; co-requisites with CS 17700 or CS 18000. They are not degree requirements. CS 19700 Freshman Honors Seminar, CS 29100 Sophomore Seminar, and CS 39100 Junior Seminar are optional but recommended.

### **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

[http://www.cs.purdue.edu/academic\\_programs/undergraduate/curriculum/bachelor/index.shtml](http://www.cs.purdue.edu/academic_programs/undergraduate/curriculum/bachelor/index.shtml)

### Fall 1st Year

#### **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

- Free elective - CS 19000 - Topics In Computer Sciences recommended
- Free elective - CS 19100 - Freshman Resources Seminar recommended
- Free elective - Credit Hours: 1.00

#### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

#### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

#### **HONR 19903 - Interdisciplinary Approaches In Writing**

Credit Hours: 3.00. This course is a writing-intensive course in which students learn how to find, evaluate, and use credible information, how to express themselves well in a variety of different written genres, and how to write for different audiences. Typically offered Fall Spring.

- Language 10100 - Credit Hours: 3.00 - 4.00

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

15-16 Credits

Spring 1st Year

## **CS 18200 - Foundations Of Computer Science**

Credit Hours: 3.00. Logic and proofs; sets, functions, relations, sequences and summations; number representations; counting; fundamentals of the analysis of algorithms; graphs and trees; proof techniques; recursion; Boolean logic; finite state machines; pushdown automata; computability and undecidability. Typically offered Spring Fall.

## **CS 24000 - Programming In C**

Credit Hours: 3.00. The UNIX environment, C development cycle, data representation, operators, program structure, recursion, macros, C preprocessor, pointers and addresses, dynamic memory allocation, structures, unions, typedef, bit-fields, pointer/structure applications, UNIX file abstraction, file access, low-level I/O, concurrency. Typically offered Fall Spring.

- General Education I - Credit Hours: 3.00
- RECOMMENDED: CS 19700 - Freshman Honors Seminar (Free elective - Credit Hours: 1.00)

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

## **HONR 19903 - Interdisciplinary Approaches In Writing**

Credit Hours: 3.00. This course is a writing-intensive course in which students learn how to find, evaluate, and use credible information, how to express themselves well in a variety of different written genres, and how to write for different audiences. Typically offered Fall Spring.

- Language 10100 - Credit Hours: 3.00 - 4.00

15-16 Credits

Fall 2nd Year

**CS 25000 - Computer Architecture**

Credit Hours: 4.00. Digital logic: transistors, gates, and combinatorial circuits; clocks; registers and register banks; arithmetic-logic units; data representation: big-endian and little-endian integers; ones and twos complement arithmetic; signed and unsigned values; Von-Neumann architecture and bottleneck; instruction sets; RISC and CISC designs; instruction pipelines and stalls; rearranging code; memory and address spaces; physical and virtual memory; interleaving; page tables; memory caches; bus architecture; polling and interrupts; DMA; device programming; assembly language; optimizations; parallelism; data pipelining. Typically offered Fall Spring.

## **CS 25100 - Data Structures And Algorithms**

Credit Hours: 3.00. Running time analysis of algorithms and their implementations, one-dimensional data structures, trees, heaps, additional sorting algorithms, binary search trees, hash tables, graphs, directed graphs, weighted graph algorithms, additional topics. Typically offered Fall Spring.

- RECOMMENDED: CS 29100 - Sophomore Development Seminar (Free elective: Credit Hours: 1.00)
- Language 10200 - Credit Hours: 3.00 - 4.00

## **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

## **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

15-17 Credits

Spring 2nd Year

## **CS 25200 - Systems Programming**

Credit Hours: 4.00. Low-level programming; review of addresses, pointers, memory layout, and data representation; text, data, and bss segments; debugging and hex dumps; concurrent execution with threads and processes; address spaces; file names; descriptors and file pointers; inheritance; system calls and library functions; standard I/O and string libraries; simplified socket programming; building tools to help programmers; make and make files; shell scripts and quoting; unix tools including sed, echo, test, and find; scripting languages such as awk; version control; object and executable files (.o and a.out); symbol tables; pointers to functions; hierarchical directories; and DNS hierarchy; programming embedded systems. Typically offered Fall Spring.

## **ECE 27000 - Introduction To Digital System Design**

Credit Hours: 4.00. An introduction to digital system design and hardware engineering, with an emphasis on practical design techniques and circuit implementation. Typically offered Fall Spring.

## **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

- Language 20100/Culture or Diversity course - Credit Hours: 3.00
- Free elective/minor - Credit Hours: 1.00

15 Credits

## **Fall 3rd Year**

- CS track requirement - Credit Hours: 3.00 \*\*\*
- CS track requirement - Credit Hours: 3.00 \*\*\*

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

## **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

## **CS 39700 - Honors Seminar**

Credit Hours: 0.00. A seminar for all sophomores, juniors, and seniors in the Computer Sciences Honors Program. Meets eight times each semester under the supervision of the Honors coordinator. The meetings focus on honors research projects, helping students to identify appropriate projects and form groups, and providing a forum for juniors and seniors to report on their projects as required in the honors program. Typically offered Fall.

- RECOMMENDED: COM 21700 - Science Writing And Presentation
- Free elective/minor - Credit Hours: 3.00

## 15 Credits

### Spring 3rd Year

- CS track requirement/elective - Credit Hours: 3.00 \*\*\*
- CS track requirement/elective - Credit Hours: 3.00 \*\*\*
- Great Issues - Credit Hours: 3.00
- General Education II - Credit Hours: 3.00
- MA > 35100 - Credit Hours: 3.00

## 15 Credits

### Fall 4th Year

- CS track elective - Credit Hours: 3.00 \*\*\*
- Lab Science I - Credit Hours: 3.00 - 4.00
- Multidisciplinary Experience/Free Elective/Minor - Credit Hours: 3.00
- General Education III - Credit Hours: 3.00

### **CS 49700 - Honors Research Project**

Credit Hours: 3.00. One semester of the project may be counted as one of the seven computer science courses at or above the 300 level required for the bachelor's degree. One more semester, if approved by the honors coordinator, can be used as a free elective. A group research project directed by Computer Sciences faculty members. Each group must submit a technical report describing its work and the results obtained. Typically offered Fall Spring.

## 15-16 Credits

### Spring 4th Year

- CS track elective - Credit Hours: 3.00 \*\*\*
- Lab Science II - Credit Hours: 3.00 - 4.00
- Free elective/minor - Credit Hours: 3.00

- CS 50000 level - Credit Hours: 3.00
- Free elective - Credit Hours: 3.00

## 15-16 Credits

## Note

120 semester credits required for Bachelor of Science degree.

2.0 Major and Graduation GPA required for Bachelor of Science degree.

\*\*\*All CS core courses and all track requirements, regardless of department, must be completed with a grade of "C" or higher (effective fall 2011). All prerequisites to CS core courses and track requirements, regardless of department, must be completed with a grade of C or higher (effective Fall 2015).

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

MyPurdue Plan is a knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Computer Science, BS

## About the Program

Purdue Computer Science is one of the country's top-ranked programs. Faculty members are shaping the future of information technology through cutting-edge research. Students can take courses that include such topics as graphics and animation, robotics, web programming, competitive programming, cryptography and security, networks, software engineering, distributed systems, information systems, artificial intelligence, and bioinformatics.

The Purdue University Department of Computer Science has a comprehensive and exciting curriculum for its undergraduate students. The flexible curriculum offers adventurous young women and men an excellent opportunity to be involved in a dynamic discipline that will continue to grow and to contribute significantly to progress in many other disciplines and ultimately to

changes in human society that are nothing short of profound. Students learn communication skills, teamwork, and problem-solving skills and acquire the necessary technical skills for positions in computing in nearly any industry.

Computer Science students begin by taking six core courses that teach them the fundamentals of computer science. Students can then select one or more tracks, which allow them to deepen their understanding in a specific area (or areas) of Computer Science. These academic tracks include:

- Computational Science and Engineering Track (CSE)
- Computer Graphics and Visualization Track (CGV)
- Database and Information Systems Track (DBIS)
- Foundations of Computer Science Track (FCS)
- Machine Intelligence Track (MI)
- Programming Language Track (PL)
- Security Track (Security)
- Software Engineering Track (SofEngr)
- Systems Programming Track (Systems)

This curriculum offers adventurous young women and men an excellent opportunity to be involved in a dynamic discipline that will continue to grow and to contribute significantly to progress in many other disciplines and ultimately to changes in human society that are nothing short of profound.

Computer Science Website

### **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Computer Science include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

Code - BS

Code - CS

120 cr for graduation

"C" or better in all major courses

## **Computer Science Major Courses (46-50 credits)**

### **Required CS Major Math Courses (7-8 credits)**

(must have C or better to meet prerequisite for certain upper level CS courses)

#### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

### **MA 26500 - Linear Algebra**

Credit Hours: 3.00. Introduction to linear algebra. Systems of linear equations, matrix algebra, vector spaces, determinants, eigenvalues and eigenvectors, diagonalization of matrices, applications. Not open to students with credit in MA 26200, 27200, 35000 or MA 35100. Typically offered Fall Spring Summer.

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

## **Required CS Major Core Courses (21 credits)**

(must have C or better in all courses)

### **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.  
(satisfies CoS Computing and Teambuilding requirements)

### **CS 18200 - Foundations Of Computer Science**

Credit Hours: 3.00. Logic and proofs; sets, functions, relations, sequences and summations; number representations; counting; fundamentals of the analysis of algorithms; graphs and trees; proof techniques; recursion; Boolean logic; finite state machines; pushdown automata; computability and undecidability. Typically offered Spring Fall.

## **CS 24000 - Programming In C**

Credit Hours: 3.00. The UNIX environment, C development cycle, data representation, operators, program structure, recursion, macros, C preprocessor, pointers and addresses, dynamic memory allocation, structures, unions, typedef, bit-fields, pointer/structure applications, UNIX file abstraction, file access, low-level I/O, concurrency. Typically offered Fall Spring.

## **CS 25000 - Computer Architecture**

Credit Hours: 4.00. Digital logic: transistors, gates, and combinatorial circuits; clocks; registers and register banks; arithmetic-logic units; data representation: big-endian and little-endian integers; ones and twos complement arithmetic; signed and unsigned values; Von-Neumann architecture and bottleneck; instruction sets; RISC and CISC designs; instruction pipelines and stalls; rearranging code; memory and address spaces; physical and virtual memory; interleaving; page tables; memory caches; bus architecture; polling and interrupts; DMA; device programming; assembly language; optimizations; parallelism; data pipelining. Typically offered Fall Spring.

## **CS 25100 - Data Structures And Algorithms**

Credit Hours: 3.00. Running time analysis of algorithms and their implementations, one-dimensional data structures, trees, heaps, additional sorting algorithms, binary search trees, hash tables, graphs, directed graphs, weighted graph algorithms, additional topics. Typically offered Fall Spring.

## **CS 25200 - Systems Programming**

Credit Hours: 4.00. Low-level programming; review of addresses, pointers, memory layout, and data representation; text, data, and bss segments; debugging and hex dumps; concurrent execution with threads and processes; address spaces; file names; descriptors and file pointers; inheritance; system calls and library functions; standard I/O and string libraries; simplified socket programming; building tools to help programmers; make and make files; shell scripts and quoting; unix tools including sed, echo, test, and find; scripting languages such as awk; version control; object and executable files (.o and a.out); symbol tables; pointers to functions; hierarchical directories; and DNS hierarchy; programming embedded systems. Typically offered Fall Spring.

## **Required CS Major Track Selectives - (18-21 credits)**

**Please see links to all track requirements above.**

**(must have C or better in all courses)** select from list [LINK](#)

- CS Track Required course - Credit Hours: 3.00
- CS Track Required Course - Credit Hours: 3.00
- CS Track Required/Elective course - Credit Hours: 3.00
- CS Track Required/Elective course - Credit Hours: 3.00
- CS Track Elective course - Credit Hours: 3.00
- CS Track Elective course - Credit Hours: 3.00

- CS Track Elective course (if Computational Science & Engineering track or Database & Information Systems track) - Credit Hours: 3.00

## Other Departmental/Program Course Requirements (35-62 credits)

\* Requirement may be met with a zero credit experiential learning option. See your advisor for more information.

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

### **HONR 19903 - Interdisciplinary Approaches In Writing**

Credit Hours: 3.00. This course is a writing-intensive course in which students learn how to find, evaluate, and use credible information, how to express themselves well in a variety of different written genres, and how to write for different audiences. Typically offered Fall Spring.

- Technical Writing Option and Technical Presenting Option - (COM 21700 recommended) (may satisfy Oral Communication) select from list - Credit Hours: 3.00 - 6.00
- Language I \* - select from three options; select from list - Credit Hours: 0.00 - 4.00
- Language II \* - select from three options; select from list - Credit Hours: 0.00 - 4.00
- Language and Culture III \* - (may satisfy Human Cultures Humanities) select from three options; select from list - Credit Hours: 0.00 - 4.00
- General Education I - (may satisfy Human Culture Humanities and Behavioral/Social Science) select from list - Credit Hours: 3.00
- General Education II - (may satisfy Human Culture Humanities and Behavioral/Social Science) select from list - Credit Hours: 3.00
- General Education III - select from list - Credit Hours: 3.00
- Great Issues -select from list - Credit Hours: 3.00
- Multidisciplinary Experience \* - (may satisfy Science, Technology & Society) select from list - Credit Hours: 0.00 - 3.00
- Teambuilding and Collaboration Experience \* (CS 18000 meets requirement) - select from list - Credit Hours: 0.00 - 4.00
- Lab Science I selective - (satisfies Science) select from list - Credit Hours: 3.00 - 4.00
- Lab Science II selective - (may satisfy Science) select from list - Credit Hours: 3.00 - 4.00

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT

50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

## Electives (8-39 credits)

\* Required freshman seminar courses; corequisites with CS 39100 or CS 18000. They are not degree requirements. CS 29100 - Sophomore Development Seminar and CS 39100 - Junior Resources Seminar are optional but recommended.

## University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

#### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

#### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

#### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

### **HONR 19903 - Interdisciplinary Approaches In Writing**

Credit Hours: 3.00. This course is a writing-intensive course in which students learn how to find, evaluate, and use credible information, how to express themselves well in a variety of different written genres, and how to write for different audiences. Typically offered Fall Spring.

- Language 10100 - Credit Hours: 3.00 - 4.00

### **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

- Free elective (CS 19100 recommended) - Credit Hours: 1.00
- Free elective - Credit Hours: 1.00

14-16 Credits

Spring 1st Year

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.  
CTL:IMA 1603 Calculus - Long II

- Free elective/minor - Credit Hours: 1.00 - 3.00

## **CS 18200 - Foundations Of Computer Science**

Credit Hours: 3.00. Logic and proofs; sets, functions, relations, sequences and summations; number representations; counting; fundamentals of the analysis of algorithms; graphs and trees; proof techniques; recursion; Boolean logic; finite state machines; pushdown automata; computability and undecidability. Typically offered Spring Fall.

## **CS 24000 - Programming In C**

Credit Hours: 3.00. The UNIX environment, C development cycle, data representation, operators, program structure, recursion, macros, C preprocessor, pointers and addresses, dynamic memory allocation, structures, unions, typedef, bit-fields, pointer/structure applications, UNIX file abstraction, file access, low-level I/O, concurrency. Typically offered Fall Spring.

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

## **HONR 19903 - Interdisciplinary Approaches In Writing**

Credit Hours: 3.00. This course is a writing-intensive course in which students learn how to find, evaluate, and use credible information, how to express themselves well in a variety of different written genres, and how to write for different audiences. Typically offered Fall Spring.

- Language 10100 - Credit Hours: 3.00 - 4.00

14-16 Credits

Fall 2nd Year

## **CS 25000 - Computer Architecture**

Credit Hours: 4.00. Digital logic: transistors, gates, and combinatorial circuits; clocks; registers and register banks; arithmetic-logic units; data representation: big-endian and little-endian integers; ones and twos complement arithmetic; signed and unsigned values; Von-Neumann architecture and bottleneck; instruction sets; RISC and CISC designs; instruction pipelines and stalls; rearranging code; memory and address spaces; physical and virtual memory; interleaving; page tables; memory caches; bus architecture; polling and interrupts; DMA; device programming; assembly language; optimizations; parallelism; data pipelining. Typically offered Fall Spring.

## **CS 25100 - Data Structures And Algorithms**

Credit Hours: 3.00. Running time analysis of algorithms and their implementations, one-dimensional data structures, trees, heaps, additional sorting algorithms, binary search trees, hash tables, graphs, directed graphs, weighted graph algorithms, additional topics. Typically offered Fall Spring.

- Language 10200 - Credit Hours: 3.00 - 4.00
- Free elective (CS 29100 recommended) - Credit Hours: 1.00

## **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

## **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

15-17 Credits

Spring 2nd Year

## **MA 26500 - Linear Algebra**

Credit Hours: 3.00. Introduction to linear algebra. Systems of linear equations, matrix algebra, vector spaces, determinants, eigenvalues and eigenvectors, diagonalization of matrices, applications. Not open to students with credit in MA 26200, 27200, 35000 or MA 35100. Typically offered Fall Spring Summer.

## **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

## **CS 25200 - Systems Programming**

Credit Hours: 4.00. Low-level programming; review of addresses, pointers, memory layout, and data representation; text, data, and bss segments; debugging and hex dumps; concurrent execution with threads and processes; address spaces; file names; descriptors and file pointers; inheritance; system calls and library functions; standard I/O and string libraries; simplified socket programming; building tools to help programmers; make and make files; shell scripts and quoting; unix tools including sed, echo, test, and find; scripting languages such as awk; version control; object and executable files (.o and a.out); symbol tables; pointers to functions; hierarchical directories; and DNS hierarchy; programming embedded systems. Typically offered Fall Spring.

- RECOMMENDED: COM 21700 - Credit Hours: 3.00
- Language 201/Culture or Diversity course - Credit Hours: 3.00
- Free elective/minor - Credit Hours: 3.00

16 Credits

## **Fall 3rd Year**

- Free elective/minor - Credit Hours: 3.00
- General Education I - Credit Hours: 3.00
- Free elective (Recommended CS 39100) - Credit Hours: 1.00
- CS track requirement - Credit Hours: 3.00 \*\*\*
- CS track requirement - Credit Hours: 3.00 \*\*\*

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

## **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables;

regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

## 16 Credits

### Spring 3rd Year

- CS track requirement/elective - Credit Hours: 3.00 \*\*\*
- CS track elective/requirement - Credit Hours: 3.00 \*\*\*
- Great Issues - Credit Hours: 3.00
- General Education II - Credit Hours: 3.00
- Free elective/minor - Credit Hours: 3.00

## 15 Credits

### Fall 4th Year

- CS track elective - Credit Hours: 3.00 \*\*\*
- Lab Science I - Credit Hours: 3.00 - 4.00
- Multidisciplinary Experience/Free Elective/Minor - Credit Hours: 3.00
- General Education III - Credit Hours: 3.00
- Free elective/minor - Credit Hours: 3.00

## 15-16 Credits

### Spring 4th Year

- CS track elective - Credit Hours: 3.00 \*\*\*
- Lab Science II - Credit Hours: 3.00 - 4.00
- Free elective/minor - Credit Hours: 3.00
- Free elective/minor - Credit Hours: 3.00
- Free elective/minor - Credit Hours: 3.00

## 15-16 Credits

## Note

120 semester credits required for Bachelor of Science degree.

2.0 Major and Graduation GPA required for Bachelor of Science degree.

\*\*\*All CS core courses and all track requirements, regardless of department, must be completed with a grade of "C" or higher.

All prerequisites to CS core courses and track requirements, regardless of department, must be completed with a grade of C or higher.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

MyPurdue Plan is a knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Computer Science Minor

(Effective Fall 2016)

To apply for a CS minor, students must have completed with a 'C' grade or better both CS 18000 and a Math class as follows:

- CS 18000 (or receive a 5 on the AP Computer Science test, or receive a 4 on the AP Computer Science test and pass the CS 18000 test-out exam) **and**
- For the Fall 2016 semester, one of the following courses
  - MA 16100 or MA 16500 or (MA 22300 and MA 22400)
  - **or**, prior to the Fall 2016 semester, MA 16300, or MA 16700, or (MA 22100 and MA 22200), or MA 16021
  - **or** establish credit for Calculus I through AP credit, Transfer Credit, or credit by exam.

### Application process

1. Complete the CS Minor Application with your advisor.

2. Submit complete and signed application to the administrative assistant in the CS Undergraduate Advising Office (LWSN 1123) between 8:00 am - 12:00 pm, or 1:00 pm - 5:00 pm, Monday through Friday, or to an advisor during their posted non-major walk-in hours. If the application is approved, a minor in Computer Science will be granted upon completion of the following requirements:

- Five (5) CS courses from the list below. AP credit can be used for the minor application as described above, but will not count toward the five required CS courses.
- All courses' pre-requisites must be met in order to enroll in CS courses. Click the link for each course to see the required pre-requisites.
- All courses must be taken at the Purdue West Lafayette campus.

- A minimum grade of 'C' in all CS courses used towards the minor is required. (A 'C-' is not accepted.)
- **Enrollment in all CS courses is subject to space availability.** CS Minors are expected to take CS courses during off-peak sessions. Students are responsible for maintaining an up-to-date minor plan of study, for knowing registration timelines, and for requesting space through the correct process. Computer Science majors are given priority in registering for CS classes.
- CS Minors may take a total of five (5) CS major courses and no more.

## Required Courses (10 credits)

### **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

### **CS 18200 - Foundations Of Computer Science**

Credit Hours: 3.00. Logic and proofs; sets, functions, relations, sequences and summations; number representations; counting; fundamentals of the analysis of algorithms; graphs and trees; proof techniques; recursion; Boolean logic; finite state machines; pushdown automata; computability and undecidability. Typically offered Spring Fall.

### **CS 24000 - Programming In C**

Credit Hours: 3.00. The UNIX environment, C development cycle, data representation, operators, program structure, recursion, macros, C preprocessor, pointers and addresses, dynamic memory allocation, structures, unions, typedef, bit-fields, pointer/structure applications, UNIX file abstraction, file access, low-level I/O, concurrency. Typically offered Fall Spring.

## Note

\*Students with AP CS credit (as described above) may use their AP credit in place of CS 18000 as a pre-requisite for other CS courses, but AP credit will not count toward the five (5) CS courses. In this case, the student must choose three of the following Elective Courses.

^Math majors may use MA 37500 in place of CS 18200 as a pre-requisite for other CS courses, but Math 37500 will not count toward the five (5) CS courses. In this case, the student must choose three of the following Elective Courses.

## Elective Courses (6-8 credits)

Choose two of the following

### **CS 25000 - Computer Architecture**

Credit Hours: 4.00. Digital logic: transistors, gates, and combinatorial circuits; clocks; registers and register banks; arithmetic-logic units; data representation: big-endian and little-endian integers; ones and twos complement arithmetic; signed and unsigned values; Von-Neumann architecture and bottleneck; instruction sets; RISC and CISC designs; instruction pipelines and stalls; rearranging code; memory and address spaces; physical and virtual memory; interleaving; page tables; memory caches; bus architecture; polling and interrupts; DMA; device programming; assembly language; optimizations; parallelism; data pipelining. Typically offered Fall Spring.

### **CS 25100 - Data Structures And Algorithms**

Credit Hours: 3.00. Running time analysis of algorithms and their implementations, one-dimensional data structures, trees, heaps, additional sorting algorithms, binary search trees, hash tables, graphs, directed graphs, weighted graph algorithms, additional topics. Typically offered Fall Spring.

### **CS 25200 - Systems Programming**

Credit Hours: 4.00. Low-level programming; review of addresses, pointers, memory layout, and data representation; text, data, and bss segments; debugging and hex dumps; concurrent execution with threads and processes; address spaces; file names; descriptors and file pointers; inheritance; system calls and library functions; standard I/O and string libraries; simplified socket programming; building tools to help programmers; make and make files; shell scripts and quoting; unix tools including sed, echo, test, and find; scripting languages such as awk; version control; object and executable files (.o and a.out); symbol tables; pointers to functions; hierarchical directories; and DNS hierarchy; programming embedded systems. Typically offered Fall Spring.

### **CS 30700 - Software Engineering I**

Credit Hours: 3.00. An introduction to the methods and tools of software engineering; software life cycle; specification and design of software, software testing, cost and effort estimation; laboratory exercises with design, testing, and other tools. Typically offered Fall Spring.

### **CS 31400 - Numerical Methods**

Credit Hours: 3.00. Iterative methods for solving nonlinear equations; direct and iterative methods for solving linear systems; approximations of functions, derivatives, and integrals; error analysis. Typically offered Spring.

### **CS 33400 - Fundamentals Of Computer Graphics**

Credit Hours: 3.00. Fundamental principles and techniques of computer graphics. The course covers the basics of going from a

scene representation to a raster image using OpenGL. Specific topics include coordinate manipulations, perspective, basics of illumination and shading, color models, texture maps, clipping and basic raster algorithms, fundamentals of scene constructions. CS 31400 is recommended. Typically offered Fall.

## **CS 34800 - Information Systems**

Credit Hours: 3.00. File organization and index structures; object-oriented database languages; the relational database model with introductions to SQL and DBMS; hierarchical models and network models with introductions to HDDL, HDML, and DBTG Codasyl; data mining; data warehousing; database connectivity; distributed databases; the client/server paradigm; middleware, including ODBC, JDBC, CORBA, and MOM. Typically offered Fall.

## **CS 35500 - Introduction To Cryptography**

Credit Hours: 3.00. An introduction to cryptography basics: Classic historical ciphers including Caesar, Vigenere and Vernam ciphers; modern ciphers including DES, AES, Pohlig-Hellman, and RSA; signatures and digests; key exchange; simple protocols; block and stream ciphers; network-centric protocols. Typically offered Fall Spring.

## **CS 38100 - Introduction To The Analysis Of Algorithms**

Credit Hours: 3.00. Techniques for analyzing the time and space requirements of algorithms. Application of these techniques to sorting, searching, pattern-matching, graph problems, and other selected problems. Brief introduction to the intractable (NP-hard) problems. Typically offered Fall Spring.

## **CS 40800 - Software Testing**

Credit Hours: 3.00. Preliminaries: errors and testing; software quality, requirements, behavior, and correctness; testing, debugging, verification; control flow graphs, dominators; types of testing; Test selection: from requirements, finite state models, and combinatorial designs; regression testing and test minimization; Test adequacy assessment: control and data flow; mutation based; testing tools. Typically offered Fall.

## **CS 44800 - Introduction To Relational Database Systems**

Credit Hours: 3.00. An in-depth examination of relational database systems including theory and concepts as well as practical issues in relational databases. Modern database technologies such as object-relational and Web-based access to relational databases. Conceptual design and entity relationship modeling, relational algebra and calculus, data definition and manipulation languages using SQL, schema and view management, query processing and optimization, transaction management, security, privacy, integrity management. Typically offered Fall Spring.

## **CS 47100 - Introduction to Artificial Intelligence**

Credit Hours: 3.00. Students are expected to spend at least three hours per week gaining experience with artificial intelligence systems and developing software. Basic problem-solving strategies, heuristic search, problem reduction and AND/OR graphs, knowledge representation, expert systems, generating explanations, uncertainty reasoning, game playing, planning, machine learning, computer vision, and programming systems such as Lisp or Prolog.

## Standard Note

The student is ultimately responsible for knowing and completing all degree requirements.

The myPurduePlan powered by DegreeWorks is the knowledge source for specific requirements and completion.

# Department of Earth, Atmospheric, and Planetary Sciences

## Overview

The Department of Earth, Atmospheric, and Planetary Sciences is dedicated to the scientific study of a myriad of spatial and temporal scales of physical, chemical, and dynamical processes that range from such seemingly diverse events as continental drift to asteroid impacts to tornadoes.

The new millennium has brought even greater challenges to unravel the mysteries of the past, present and future states of a holistic Earth system that affects our socio-economic well-being, as well as the delicate balance of weather, climate, and earth processes.

EAPS is the multidisciplinary department of the College of Science, requiring the use of mathematics, physics, chemistry, statistics, and computer sciences to research problems; along with state of the art computer and laboratory facilities for calculation, visualization, and experimentation. Our faculty, students and staff are dedicated to the department's mission and strategic plan and we hope that you enjoy your virtual tour of our world.

Indrajeet Chaubey  
Department Head and Professor

## Faculty

<http://www.eaps.purdue.edu/people/faculty.html>

## Contact Information

Earth, Atmospheric, and Planetary Sciences Department  
550 Stadium Mall Drive  
Purdue University  
West Lafayette, IN 47907-2051

Phone: 765 494-3258  
Fax: 765 496-1210

# Graduate Information

For Graduate Information please see Earth, Atmospheric, and Planetary Sciences Graduate Program Information.

## Atmospheric Science, BS

### About the Program

Atmospheric science focuses on mathematics, physics, chemistry, computer science, and statistics as well as atmospheric science. In this major students have several elective credits which they can use to broaden and enhance their educational experience and to specialize in the areas of weather forecasting, research, environmental monitoring, business, or broadcasting. Students can also participate in real-world forecasting, field work, and related opportunities. Research is an integral part of the program, and the Earth, Atmospheric, and Planetary Sciences (EAPS) Department has an excellent faculty to student ratio which allows students to have one-to-one interaction with their professors.

Atmospheric Science/Meteorology Website

#### Degree Requirements and Supplemental InformationS

The full Program Requirements for 2016-17 Atmospheric Science include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

code-BS

Code-ATSC

120 Credits

"C-" or better required in ♦ courses

### Departmental/Program Major Courses (37 credits)

#### Required Major Courses (37 credits)

##### **EAPS 11700 - Introduction To Atmospheric Science**

Credit Hours: 3.00. The weather/climate system. Solar variability and Milankovitch Theory. Atmospheric scales of motion. Chemistry of greenhouse gases and aerosols. Fundamental laws of meteorological dynamics and radiation. Weather systems, air masses and fronts. Severe storms, hurricanes and tornadoes. (Required for atmospheric sciences majors.). Typically offered Spring.

- EAPS 100-level Earth System Elective ♦ - Credit Hours: 3.00

##### **EAPS 13700 - Freshman Seminar In Earth And Atmospheric Sciences**

Credit Hours: 1.00. Seminar presented by guests in different fields of the Earth and Atmospheric Sciences to expose students to the range of topics included in the department and in possible career paths. Typically offered Fall Spring.

### **EAPS 22500 - Science Of The Atmosphere**

Credit Hours: 3.00. An overview of the physics and dynamics of the atmosphere. Quantitative study of the energy balance of the atmosphere, condensation and precipitation processes, atmospheric motion and global circulation, severe storms, atmospheric chemistry. Contemporary issues such as human impact on climate, ozone depletion, numerical weather prediction and climate simulation, and modern measurement systems. Not available to students with credit in EAPS 22100. Intended for Science and Engineering majors only. Prior course work in calculus is required. Typically offered Spring.

### **EAPS 22600 - Introduction To Atmospheric Science Research**

Credit Hours: 1.00. Students work on two different research projects designed by EAPS faculty. Research topics are complimentary to topics covered in EAPS 22500 and may include observational analysis, numerical modeling, or both. Each module includes introducing the research problem and learning pertinent software and statistical analysis, performing the research and discussing outcomes, student-designed revising or extending of the experimental design to explore results of interest, and presenting the findings to the class and interested EAPS faculty. Typically offered Fall.

### **EAPS 32000 - Physics Of Climate**

Credit Hours: 3.00. Open to majors in the Schools of Science, Agriculture, and Engineering. To understand climate we describe and synthesize physical processes in the atmosphere and their coupling to the ocean, ice, and land. We quantitatively explore climatology with an equal balance of physical principles and scrutiny of available modern data. Topics include: visualization of atmospheric/land surface/oceanographic climatological data sets; theories of climate dynamics; and climate change. Beginning with radiative balance and simple energy balance models, the course progresses toward understanding the effects of radiative-convective forcing and rotation on the fluid envelopes. Analysis of data in an interactive computer-enabled environment is an important part of the course. By the end of this course, the student should know how the Earth System behaves at large scales and grasp the physical understandings of why. Typically offered Spring.

### **EAPS 42100 - Atmospheric Thermodynamics**

Credit Hours: 3.00. (AGRY 43100) Structure and composition of the atmosphere. Thermodynamics of dry and moist air, including adiabatic and pseudo-adiabatic processes, hydrostatic stability, and air mass determination. Prior course work in introductory atmospheric science, second semester physics or thermodynamics is required. Typically offered Fall.

### **EAPS 43100 - Synoptic Laboratory I**

Credit Hours: 1.00. (AGRY 44100) Analysis of vertical distributions of temperature and moisture with applications to adiabatic and pseudo-adiabatic processes, hydrostatic stability, and air mass determination. Prior course work in atmospheric thermodynamics is required. Typically offered Fall.

## **EAPS 42200 - Atmospheric Dynamics I**

Credit Hours: 3.00. (AGRY 43200) A study of the general system of equations governing mass and momentum changes in the atmosphere; special horizontal wind representations, thermal wind relationships; circulation, vorticity, divergence, and vertical motion. Prior course work in atmospheric thermodynamics and differential equations is required. Typically offered Spring.

## **EAPS 42300 - Atmospheric Dynamics II**

Credit Hours: 3.00. (AGRY 43300) An extension of EAPS 42200, with emphasis on perturbation theory and hydrodynamics stability, air mass and frontal theory, barotropic and baroclinic models, wave cyclone theory, and numerical weather prediction. Typically offered Fall.

## **EAPS 43200 - Synoptic Laboratory II**

Credit Hours: 1.00. Analysis of horizontal distributions of pressure, temperature, wind, vorticity, and vertical motions. Applications to synoptic-scale wave propagation. Prior course work in atmospheric thermodynamics and synoptic lab I is required. Typically offered Spring.

## **EAPS 43300 - Synoptic Lab III**

Credit Hours: 1.00. (AGRY 44300) Diagnoses of midtropospheric wave propagation and growth. Analysis of surface pressure fields and fronts and their relationships to upper air features. Extensive use is made of teletype and facsimile weather information. Prior course work in atmospheric dynamics and synoptic lab II is required. Typically offered Fall.

## **EAPS 53200 - Atmospheric Physics I**

Credit Hours: 3.00. Cloud and precipitation physics and basic atmospheric radiative transfer. Introduction to computer aided problem solving. Typically offered Spring.

## **EAPS 50900 - Data Analysis Techniques In Earth And Atmospheric Sciences**

Credit Hours: 3.00. Application of statistical techniques to analyze and interpret data containing substantial information about the dynamics of our planet Earth. Emphasis on fundamentals with elements of atmospheric/climate time series analysis and weather and climate extremes (necessary for understanding current research) interwoven with computer-intensive bootstrap methods (which work for complex data sets typical in geosciences). Offered Spring.

## **EAPS 49700 - Earth And Atmospheric Sciences Undergraduate Readings And Research**

Credit Hours: 1.00 to 6.00. Supervised reading and/or research in various fields. Permission of instructor required. Typically offered Fall Spring Summer.

## Other Departmental/Program Course Requirements (68-74 credits)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602 Calculus - Long I

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100. Typically offered Fall Spring Summer.

## **MA 26600 - Ordinary Differential Equations**

Credit Hours: 3.00. First order equations, second and n'th order linear equations, series solutions, solution by Laplace transform, systems of linear equations. It is preferable but not required to take MA 26500 either first or concurrently. Not open to students with credit in MA 26200, 27200, MA 36000, 36100, or MA 36600. Typically offered Fall Spring Summer.

## **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

## **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

## **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

## **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn

from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

### **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

### **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and

research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses could satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses could satisfy Humanities Behavioral/Social Science for core) - Credit Hours: 3.00
- Great Issues - Credit Hours: 3.00
- Multidisciplinary Elective (could be satisfied by Science, Technology & Society core classes) - Credit Hours: 3.00

## **Electives (9-15 credits - to reach 120 credits of countable credits)**

Recommend Science, Technology & Society core course as one elective

## **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology, and Society
- Written Communication
- Oral Communication
- Quantitative Reasoning
- For a complete listing of course selectives, visit the Provost's Website or [click here](#).

## **Program Requirements**

[http://www.eaps.purdue.edu/for\\_students/undergraduate/](http://www.eaps.purdue.edu/for_students/undergraduate/)

## Fall 1st Year

### **EAPS 11700 - Introduction To Atmospheric Science**

Credit Hours: 3.00. The weather/climate system. Solar variability and Milankovitch Theory. Atmospheric scales of motion. Chemistry of greenhouse gases and aerosols. Fundamental laws of meteorological dynamics and radiation. Weather systems, air masses and fronts. Severe storms, hurricanes and tornadoes. (Required for atmospheric sciences majors.). Typically offered Spring.

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

## 14-16 Credits

### Spring 1st Year

- EAPS 100-level Earth System Elective ♦ - Credit Hours: 3.00

### **EAPS 13700 - Freshman Seminar In Earth And Atmospheric Sciences**

Credit Hours: 1.00. Seminar presented by guests in different fields of the Earth and Atmospheric Sciences to expose students to the range of topics included in the department and in possible career paths. Typically offered Fall Spring.

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.  
CTL:IMA 1603 Calculus - Long II

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

- Language I Option - Credit Hours: 3.00

## 15-16 Credits

### Fall 2nd Year

## **EAPS 22500 - Science Of The Atmosphere**

Credit Hours: 3.00. An overview of the physics and dynamics of the atmosphere. Quantitative study of the energy balance of the atmosphere, condensation and precipitation processes, atmospheric motion and global circulation, severe storms, atmospheric chemistry. Contemporary issues such as human impact on climate, ozone depletion, numerical weather prediction and climate simulation, and modern measurement systems. Not available to students with credit in EAPS 22100. Intended for Science and Engineering majors only. Prior course work in calculus is required. Typically offered Spring.

## **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

## **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

- Language II Option - Credit Hours: 3.00

## **EAPS 22600 - Introduction To Atmospheric Science Research**

Credit Hours: 1.00. Students work on two different research projects designed by EAPS faculty. Research topics are complimentary to topics covered in EAPS 22500 and may include observational analysis, numerical modeling, or both. Each module includes introducing the research problem and learning pertinent software and statistical analysis, performing the research and discussing outcomes, student-designed revising or extending of the experimental design to explore results of interest, and presenting the findings to the class and interested EAPS faculty. Typically offered Fall.

- Free Elective - Credit Hours: 1.00

16 Credits

Spring 2nd Year

## **EAPS 32000 - Physics Of Climate**

Credit Hours: 3.00. Open to majors in the Schools of Science, Agriculture, and Engineering. To understand climate we describe and synthesize physical processes in the atmosphere and their coupling to the ocean, ice, and land. We quantitatively explore climatology with an equal balance of physical principles and scrutiny of available modern data. Topics include: visualization of atmospheric/land surface/oceanographic climatological data sets; theories of climate dynamics; and climate change. Beginning with radiative balance and simple energy balance models, the course progresses toward understanding the effects of radiative-convective forcing and rotation on the fluid envelopes. Analysis of data in an interactive computer-enabled environment is an important part of the course. By the end of this course, the student should know how the Earth System behaves at large scales and grasp the physical understandings of why. Typically offered Spring.

## **MA 26600 - Ordinary Differential Equations**

Credit Hours: 3.00. First order equations, second and n'th order linear equations, series solutions, solution by Laplace transform, systems of linear equations. It is preferable but not required to take MA 26500 either first or concurrently. Not open to students with credit in MA 26200, 27200, MA 36000, 36100, or MA 36600. Typically offered Fall Spring Summer.

## **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **EAPS 43100 - Synoptic Laboratory I**

Credit Hours: 1.00. (AGRY 44100) Analysis of vertical distributions of temperature and moisture with applications to adiabatic and pseudo-adiabatic processes, hydrostatic stability, and air mass determination. Prior course work in atmospheric thermodynamics is required. Typically offered Fall.

- Language III/Culture/Diversity Option - Credit Hours: 3.00

14 Credits

Fall 3rd Year

## **EAPS 42100 - Atmospheric Thermodynamics**

Credit Hours: 3.00. (AGRY 43100) Structure and composition of the atmosphere. Thermodynamics of dry and moist air, including adiabatic and pseudo-adiabatic processes, hydrostatic stability, and air mass determination. Prior course work in introductory atmospheric science, second semester physics or thermodynamics is required. Typically offered Fall.

## **EAPS 42200 - Atmospheric Dynamics I**

Credit Hours: 3.00. (AGRY 43200) A study of the general system of equations governing mass and momentum changes in the atmosphere; special horizontal wind representations, thermal wind relationships; circulation, vorticity, divergence, and vertical motion. Prior course work in atmospheric thermodynamics and differential equations is required. Typically offered Spring.

## **EAPS 43200 - Synoptic Laboratory II**

Credit Hours: 1.00. Analysis of horizontal distributions of pressure, temperature, wind, vorticity, and vertical motions. Applications to synoptic-scale wave propagation. Prior course work in atmospheric thermodynamics and synoptic lab I is required. Typically offered Spring.

## **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

- Technical Writing/Presentation Option - Credit Hours 3.00

14 Credits

Spring 3rd Year

## **EAPS 42300 - Atmospheric Dynamics II**

Credit Hours: 3.00. (AGRY 43300) An extension of EAPS 42200, with emphasis on perturbation theory and hydrodynamics stability, air mass and frontal theory, barotropic and baroclinic models, wave cyclone theory, and numerical weather prediction. Typically offered Fall.

## **EAPS 43300 - Synoptic Lab III**

Credit Hours: 1.00. (AGRY 44300) Diagnoses of midtropospheric wave propagation and growth. Analysis of surface pressure fields and fronts and their relationships to upper air features. Extensive use is made of teletype and facsimile weather information. Prior course work in atmospheric dynamics and synoptic lab II is required. Typically offered Fall.

## **EAPS 53200 - Atmospheric Physics I**

Credit Hours: 3.00. Cloud and precipitation physics and basic atmospheric radiative transfer. Introduction to computer aided problem solving. Typically offered Spring.

- STAT Statistics Option - Credit Hours: 3.00
- General Education I Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

16 Credits

Fall 4th Year

## **EAPS 50900 - Data Analysis Techniques In Earth And Atmospheric Sciences**

Credit Hours: 3.00. Application of statistical techniques to analyze and interpret data containing substantial information about the dynamics of our planet Earth. Emphasis on fundamentals with elements of atmospheric/climate time series analysis and weather and climate extremes (necessary for understanding current research) interwoven with computer-intensive bootstrap methods (which work for complex data sets typical in geosciences). Offered Spring.

## **EAPS 49700 - Earth And Atmospheric Sciences Undergraduate Readings And Research**

Credit Hours: 1.00 to 6.00. Supervised reading and/or research in various fields. Permission of instructor required. Typically offered Fall Spring Summer.

- Great Issues Option - Credit Hours: 3.00
- General Education II Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15 Credits

Spring 4th Year

- Multidisciplinary Experience/STS Elective - Credit Hours: 3.00
- General Education III Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 1.00

13 Credits

## Note

\*Satisfies a University Core Requirement

Students must earn a "C-" or better in all required ♦ courses.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

2.0 average in EAPS major classes required to graduate.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Environmental Geoscience, BS

### About the Program

With a multidisciplinary approach to environmental issues, students study math, chemistry, biogeochemistry, physics, computer science, statistics, GIS, and environmental policy as well as selecting elective options to focus their study on one of these areas: geochemistry of soils and sediments, hydrology, or air quality. Careers areas can include remediation of ground-water contamination, landfill management, landslide risk, urban planning, climate change, and many other contemporary environmental concerns. Undergraduate research is required in this major, and students have the opportunity to work one-to-one with your professors.

Environmental Geoscience Website

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Environmental Geoscience include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

code-BS

Code-ENVG

120 Credits

"C-" or better required in ♦ courses

## Departmental/Program Major Courses (54-55 credits)

### Required Major Courses (54-55 credits)

#### **EAPS 11800 - Introduction To Earth Sciences**

Credit Hours: 3.00. Introduction to a range of topics in Earth Science, including: Origin and geological history of Earth, including geological records of climate and evolution; Earth materials (minerals and rocks); Chemical and physical composition and structure of the Earth; Rock weathering, erosion, and sedimentary processes; Geological timescale; Geologic structures including their map and field expression; Tectonic processes; The hydrological cycle with emphasis on groundwater and physical and chemical oceanography; Energy and mineral resources; Astrobiology. (Required for Geology and Geophysics and Earth and Space Science Teaching majors.) Typically offered Spring.

#### **EAPS 10900 - The Dynamic Earth**

Credit Hours: 3.00. This course covers the formation and development of the solid earth, atmosphere, hydrosphere, and biosphere. The course studies the whole earth as a system of many interacting parts and focuses on the changes within and between these parts. This course is intended for all majors in earth and atmospheric sciences. Typically offered Fall.

#### **EAPS 13700 - Freshman Seminar In Earth And Atmospheric Sciences**

Credit Hours: 1.00. Seminar presented by guests in different fields of the Earth and Atmospheric Sciences to expose students to the range of topics included in the department and in possible career paths. Typically offered Fall Spring.

#### **EAPS 39100 - Topics In Earth And Atmospheric Sciences**

Credit Hours: 1.00 to 4.00. Intermediate special topics in the earth and atmospheric sciences. Permission of instructor required. Typically offered Fall Spring Summer.

#### **AGRY 33700 - Environmental Hydrology**

Credit Hours: 3.00. This course is designed to provide undergraduate students with both the basics of how water moves through the environment and current theories as to how hydrologic response is modified by environmental change at a variety of temporal and spatial scales. Typically offered Spring.

### **EAPS 30900 - Computer-Aided Analysis For Geosciences**

Credit Hours: 3.00. Application of computer analysis techniques including error analysis, line and surface fitting, spatial and temporal correlations, contouring, interpolation, and map projections. These methods are discussed in terms of specific geologic applications. All exercises and examples are developed using commercial mathematical software package. A three-hour-per-week computer laboratory tutorial provides hands-on experience with the techniques discussed in class. Prior course work in computer programming is required. Typically offered Spring.

### **AGEC 20400 - Introduction To Resource Economics And Environmental Policy**

Credit Hours: 3.00. The course provides an overview of microeconomic theory and its application to issues related to evaluating resource economic issues and environmental policy. Topics discussed include efficiency, sustainability, valuation, externalities, governmental policies, and benefit cost analysis. Typically offered Spring.

### **POL 22300 - Introduction To Environmental Policy**

Credit Hours: 3.00. (FNR 22310) Study of decision making as modern societies attempt to cope with environmental and natural resources problems. Focuses on the American political system, with some attention to the international dimension. Current policies and issues will be examined. Typically offered Fall Spring.

### **ASM 54000 - Geographic Information System Application**

Credit Hours: 3.00. Fundamentals of GIS analysis applied to environmental, agricultural, and engineering-related problems. Topics include data sources, spatial analysis; projections; creating data and metadata, and conceptualizing and solving spatial problems using GIS. Typically offered Fall.

### **EEE 36000 - Environmental And Ecological Engineering Laboratory**

Credit Hours: 1.00 to 3.00. An introduction to laboratory methods of analysis of Environmental and Ecological Engineering systems. Topics will change from semester to semester and will be announced in advance. The list of possible topics includes experimental design, treatment of data, the analytical determination of chemical and biological constituents in water, soil, and air; analysis of environmental and ecological engineering processes; analysis of life-cycle characteristics and impacts of consumer products and commodities; methods of prevention and remediation of manufacturing waste streams. Typically offered Fall Spring.

### **EAPS 38500 - Principles Of Engineering Geology**

Credit Hours: 3.00. Application of geology to evaluation of design and construction problems relating to dams, highways, tunnels, and reservoirs; review of construction material sources and their utilization. A field investigation is required. Prior course work in mineralogy, petrology or geology for engineers is required. Typically offered Spring.

### **EEE 35500 - Engineering Environmental Sustainability**

Credit Hours: 3.00. (CE 35500) An introduction to the examination of global-scale resource utilization, food, energy and commodity production, population dynamics, and their ecosystem impacts. Typically offered Fall Spring.

- Environmental Program Elective - Credit Hours: 3.00
- Environmental Program Elective - Credit Hours: 3.00 Recommended: EAPS 44000 - Geochemistry Of Earth Elements
- Environmental Program Elective - Credit Hours: 3.00
- Environmental Elective with Lab - Credit Hours: 4.00
- Environmental Elective with Lab - Credit Hours: 4.00

### **EAPS 49700 - Earth And Atmospheric Sciences Undergraduate Readings And Research**

Credit Hours: 1.00 to 6.00. Supervised reading and/or research in various fields. Permission of instructor required. Typically offered Fall Spring Summer.

### **EAPS 41900 - Internship In Environmental Geosciences**

Credit Hours: 1.00 to 6.00. This course provides students with an opportunity to gain practical work experience in environmental geoscience. The student works with a faculty advisor to set up an internship consisting of the equivalent of at least six weeks of full-time employment with a government agency, business, or consulting company. Internships typically involve field, laboratory, and office work. A portion of the internship may be part-time work during a regular semester, but at least three consecutive weeks must be full-time work. One credit hour per week of unpaid internship. Six week internship. Prior course work in upper level EAPS courses is required. Permission of department required. Typically offered Fall Spring Summer.

### **Environmental Electives**

### **AGRY 12000 - Water And Food Security**

Credit Hours: 3.00. General science introduction to global and regional water resources issues, especially with respect to food security. It will address the role of water in agriculture throughout the world and agriculture's impact on water resources. Students will focus first on developing the scientific underpinnings of water supply and crop water use. With this background, they will explore key issues relating to water scarcity and balancing agricultural and urban demands for water, water quality and soil salinization, water footprints of food and the use of virtual water embedded in food to offset national waer deficits, regulation and roles science and policy in solving water problems. Typically offered Fall Spring.

## **AGRY 25500 - Soil Science**

Credit Hours: 3.00. (NRES 25500) Differences in soils; soils genesis; physical, chemical, and biological properties of soils; relation of soils to problems of land use and pollution; soil management relative to tillage, erosion, drainage, moisture supply, temperature, aeration, fertility, and plant nutrition. Introduction to fertilizer chemistry and use. Not available to students who have taken AGRY 27000. Typically offered Fall Spring.

## **AGRY 38500 - Environmental Soil Chemistry**

Credit Hours: 4.00. (NRES 38500) Designed as an upper level introductory course covering environmental soil chemistry concepts in framework most applicable to inorganic and organic chemical contamination of soil and water resources and intended for students in environmental science fields that may not have a strong chemistry and/or math background. (el.5). Typically offered Fall.

## **CE 54900 - Computational Watershed Hydrology**

Credit Hours: 3.00. Use of professional computer programs for the calculation of the runoff from complex basins. Generation of unit hydrographs. Calculation of losses, channel and reservoir routing, parameter optimization, and application of Kinematic wave technique to urban catchments. Offered in alternate years. Typically offered Fall.

## **CE 55700 - Air Quality Management**

Credit Hours: 3.00. Discussion of fugitive, mobile, and point sources of air pollution with attendant effects on materials, plants, and humans. Development and status of state and federal regulations with emphasis on the development and use of mathematical dispersion models including meteorological fundamentals and atmospheric transport. Discussion of concepts for ambient air quality control strategies including urban planning and transportation considerations. Typically offered Fall.

## **CE 59700 - Civil Engineering Projects**

Arrange Hours and Credit. Hours and credits to be arranged. Permission of instructor required. Typically offered Fall Spring Summer.

## **EAPS 22500 - Science Of The Atmosphere**

Credit Hours: 3.00. An overview of the physics and dynamics of the atmosphere. Quantitative study of the energy balance of the atmosphere, condensation and precipitation processes, atmospheric motion and global circulation, severe storms, atmospheric chemistry. Contemporary issues such as human impact on climate, ozone depletion, numerical weather prediction and climate simulation, and modern measurement systems. Not available to students with credit in EAPS 22100. Intended for Science and Engineering majors only. Prior course work in calculus is required. Typically offered Spring.

## **EAPS 35300 - Earth Surface Processes**

Credit Hours: 3.00. Introduction to a variety of topics in sediment transport and deposition, emphasizing linkages between active processes, landscape evolution, and the rock record. Topics include: introductory fluid mechanics; sediment transport by water, ice, and wind, and the development of fluvial bedforms, glacial landscapes, and sand dunes; groundwater geochemistry and the development of karst and caves. Each major topic is accompanied by field projects that emphasize local geologic history. A weekend field trip is required. (Required for Geoscience and Earth Science teaching majors.) Typically offered Fall.

## **EAPS 38500 - Principles Of Engineering Geology**

Credit Hours: 3.00. Application of geology to evaluation of design and construction problems relating to dams, highways, tunnels, and reservoirs; review of construction material sources and their utilization. A field investigation is required. Prior course work in mineralogy, petrology or geology for engineers is required. Typically offered Spring.

## **EAPS 44000 - Geochemistry Of Earth Elements**

Credit Hours: 3.00. This course provides an overview of the processes controlling the distribution of elements within the earth's lithosphere, hydrosphere, atmosphere, and biosphere. The two lecture hours per week stress how elements' distributions within our planet are dictated by periodicity and affinity for reactions. These lectures are supplemented by a 3-hour problem-solving session used for discussion of quantitative problems assigned as homework. Prior course work in second semester chemistry and second semester physics is required. Typically offered Fall Spring.

## **EAPS 51800 - Soil Biogeochemistry**

Credit Hours: 3.00. This course will provide an introduction to the physical and microbial processes governing the cycling of photosynthetically-produced organic matter on land and in streams and rivers. Organic geochemical transformations in the soil and litter will be highlighted along with methods of characterization of the organic constituents. Biogeochemical concepts of stabilization and destabilization of soil organic matter and stress response of terrestrial ecosystems will be reinforced through manipulation of actual data sets. Permission of instructor required. Typically offered Spring.

## **EAPS 53500 - Atmospheric Observations And Measurements**

Credit Hours: 3.00. A course that introduces students to direct and remotely sensed observations of the atmosphere. Directly measured quantities discussed include temperature, pressure, moisture, wind, solar radiation, chemical properties of the atmosphere, etc. Remote sensing of cloud, precipitation, and air motion by weather radars, satellites, profilers, lidars, and other emerging technologies is reviewed. Students will gain experience in observation techniques and data interpretation, and will learn uncertainty and error assessment. Prior course work in atmospheric science and statistics is required. Typically offered Fall.

## **EAPS 58400 - Hydrogeology**

Credit Hours: 3.00. Investigates the qualitative and quantitative aspects of ground water location, occurrence, movement, evaluation, and development, and the influence of man upon this resource. Geologic and engineering aspects of ground water systems are discussed. Classroom teaching is complemented by problem sets and field trips. Typically offered Fall.

### **EEE 35500 - Engineering Environmental Sustainability**

Credit Hours: 3.00. (CE 35500) An introduction to the examination of global-scale resource utilization, food, energy and commodity production, population dynamics, and their ecosystem impacts. Typically offered Fall Spring.

### **HSCI 55200 - Introduction To Aerosol Science**

Credit Hours: 3.00. The principles of aerosol behavior and sampling, with particular emphasis on applications in the health sciences. Topics include aerosol aerodynamics, aerosol filtration, pulmonary deposition of aerosols, methods of environmental sampling, and generation of laboratory aerosols. Typically offered Fall Spring.

### **Environmental Elective with Lab**

### **EAPS 24300 - Earth Materials I**

Credit Hours: 4.00. Elements of crystallography, physical and chemical properties of rock-forming minerals, and minerals of economic importance. Origin and occurrence of minerals. Prior course work in dynamic earth or physical geology is required. Typically offered Fall.

### **EAPS 24400 - Earth Materials II**

Credit Hours: 4.00. The study of common igneous, sedimentary, and metamorphic rocks. The origin and occurrence of rocks, weathering, and alteration processes. Prior course work in earth materials or mineralogy is required. Typically offered Spring.

### **CHM 32100 - Analytical Chemistry I**

Credit Hours: 4.00. Quantitative measurements on complex chemical systems that show matrix effects or require isolation of a component prior to its determination; general approaches to quantitative problems at the trace level; critical comparisons of competitive procedures with emphasis on principles of separation processes, including chromatography; recognition and evaluation of possible sources of error; approaches for optimizing conditions so as to minimize time and/or effort required to attain prescribed levels of accuracy and precision. Required of students majoring in chemistry. Typically offered Fall.

### **Other Departmental /Program Course Requirements (57-63 credits)**

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602 Calculus - Long I

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

## **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

## **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

## **PHYS 22000 - General Physics**

Credit Hours: 4.00. Mechanics, heat, and sound, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1751 Algebra-based Physics I

## **PHYS 23300 - Physics For Life Sciences I**

Credit Hours: 4.00. Physics For Life Sciences I builds upon prerequisite knowledge in college level biology, chemistry, and mathematics to present introductory physics that will be useful for applying physical principles, insights, and problem solving approaches for students with life science majors. Content will feature the Newtonian framework with emphasis on friction, drag and viscosity, random motion and diffusion, fluid flow, the Coulomb force, molecular forces and bonding, momentum, conservation of energy, entropy, and the first and second laws of thermodynamics. Typically offered Fall Spring Summer.

or

## **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

## **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

## **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

## **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

### **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

### **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- General Education Elective I (Select courses could satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education Elective II (Select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education Elective III (Select courses could satisfy Humanities Behavioral/Social Science for core) - Credit Hours: 3.00
- Great Issues EAPS 36400 - Natural Hazards: Science And Society or EAPS 32700 - Climate, Science And Society (Recommended) - Credit Hours: 3.00
- Multidisciplinary Elective - (could be satisfied by Science, Technology & Society core classes) BIOL 12100 - Biology I: Diversity, Ecology, And Behavior (Recommended) - Credit Hours: 3.00

**Electives (2-9 credits if needed to reach 120 credits of countable credits)**

## **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

# Program Requirements

[http://www.eaps.purdue.edu/for\\_students/undergraduate/](http://www.eaps.purdue.edu/for_students/undergraduate/)

## Fall 1st Year

### **EAPS 11800 - Introduction To Earth Sciences**

Credit Hours: 3.00. Introduction to a range of topics in Earth Science, including: Origin and geological history of Earth, including geological records of climate and evolution; Earth materials (minerals and rocks); Chemical and physical composition and structure of the Earth; Rock weathering, erosion, and sedimentary processes; Geological timescale; Geologic structures including their map and field expression; Tectonic processes; The hydrological cycle with emphasis on groundwater and physical and chemical oceanography; Energy and mineral resources; Astrobiology. (Required for Geology and Geophysics and Earth and Space Science Teaching majors.) Typically offered Spring.

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

16 Credits

## Spring 1st Year

## **EAPS 10900 - The Dynamic Earth**

Credit Hours: 3.00. This course covers the formation and development of the solid earth, atmosphere, hydrosphere, and biosphere. The course studies the whole earth as a system of many interacting parts and focuses on the changes within and between these parts. This course is intended for all majors in earth and atmospheric sciences. Typically offered Fall.

## **EAPS 13700 - Freshman Seminar In Earth And Atmospheric Sciences**

Credit Hours: 1.00. Seminar presented by guests in different fields of the Earth and Atmospheric Sciences to expose students to the range of topics included in the department and in possible career paths. Typically offered Fall Spring.

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

- Language I Option - Credit Hours: 3.00

16 Credits

Fall 2nd Year

## **EAPS 39100 - Topics In Earth And Atmospheric Sciences**

Credit Hours: 1.00 to 4.00. Intermediate special topics in the earth and atmospheric sciences. Permission of instructor required. Typically offered Fall Spring Summer.

- Science, Technology & Society \* BIOL 12100 - Biology I: Diversity, Ecology, And Behavior Recommended - Credit Hours: 2.00 - 3.00
- Environmental Elective - Credit Hours: 3.00
- Environmental Elective w/ Lab - Credit Hours: 4.00
- Language II Option - Credit Hours: 3.00

15 Credits

Spring 2nd Year

### **AGRY 33700 - Environmental Hydrology**

Credit Hours: 3.00. This course is designed to provide undergraduate students with both the basics of how water moves through the environment and current theories as to how hydrologic response is modified by environmental change at a variety of temporal and spatial scales. Typically offered Spring.

- PHYS Physics - Credit Hours: 4.00
- STAT Statistics Option STAT 30100 - Elementary Statistical Methods Recommended - Credit Hours: 3.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00
- General Education I Option - Credit Hours: 3.00

16 Credits

Fall 3rd Year

### **EEE 36000 - Environmental And Ecological Engineering Laboratory**

Credit Hours: 1.00 to 3.00. An introduction to laboratory methods of analysis of Environmental and Ecological Engineering systems. Topics will change from semester to semester and will be announced in advance. The list of possible topics includes experimental design, treatment of data, the analytical determination of chemical and biological constituents in water, soil, and air; analysis of environmental and ecological engineering processes; analysis of life-cycle characteristics and impacts of consumer products and commodities; methods of prevention and remediation of manufacturing waste streams. Typically offered Fall Spring.

- Environmental Elective - Credit Hours: 3.00
- Environmental Elective - Credit Hours: 3.00
- C S Computer Programming - Credit Hours 4.00 CS 17700 - Programming With Multimedia Objects Recommended
- EAPS Elective - Credit Hours: 3.00 EAPS 44000 - Geochemistry Of Earth Elements Recommended

16 Credits

Spring 3rd Year

- Technical Writing/Communication - Credit Hours 3.00 COM 21700 - Science Writing And Presentation Recommended

## **EAPS 30900 - Computer-Aided Analysis For Geosciences**

Credit Hours: 3.00. Application of computer analysis techniques including error analysis, line and surface fitting, spatial and temporal correlations, contouring, interpolation, and map projections. These methods are discussed in terms of specific geologic applications. All exercises and examples are developed using commercial mathematical software package. A three-hour-per-week computer laboratory tutorial provides hands-on experience with the techniques discussed in class. Prior course work in computer programming is required. Typically offered Spring.

- Great Issues Option - Credit Hours 3.00 EAPS 36400 - Natural Hazards: Science And Society or EAPS 32700 - Climate, Science And Society Recommended

## **EAPS 49700 - Earth And Atmospheric Sciences Undergraduate Readings And Research**

Credit Hours: 1.00 to 6.00. Supervised reading and/or research in various fields. Permission of instructor required. Typically offered Fall Spring Summer.

## **EAPS 41900 - Internship In Environmental Geosciences**

Credit Hours: 1.00 to 6.00. This course provides students with an opportunity to gain practical work experience in environmental geoscience. The student works with a faculty advisor to set up an internship consisting of the equivalent of at least six weeks of full-time employment with a government agency, business, or consulting company. Internships typically involve field, laboratory, and office work. A portion of the internship may be part-time work during a regular semester, but at least three consecutive weeks must be full-time work. One credit hour per week of unpaid internship. Six week internship. Prior course work in upper level EAPS courses is required. Permission of department required. Typically offered Fall Spring Summer.

- Free Elective - Credit Hours 3.00

16 Credits

Fall 4th Year

## **ASM 54000 - Geographic Information System Application**

Credit Hours: 3.00. Fundamentals of GIS analysis applied to environmental, agricultural, and engineering-related problems. Topics include data sources, spatial analysis; projections; creating data and metadata, and conceptualizing and solving spatial problems using GIS. Typically offered Fall.

- Environmental Elective - Credit Hours: 3.00
- Environmental Elective w/Lab - Credit Hours: 4.00
- General Education II Option\* - Credit Hours 3.00

13 Credits

Spring 4th Year

### **EAPS 38500 - Principles Of Engineering Geology**

Credit Hours: 3.00. Application of geology to evaluation of design and construction problems relating to dams, highways, tunnels, and reservoirs; review of construction material sources and their utilization. A field investigation is required. Prior course work in mineralogy, petrology or geology for engineers is required. Typically offered Spring.

### **EEE 35500 - Engineering Environmental Sustainability**

Credit Hours: 3.00. (CE 35500) An introduction to the examination of global-scale resource utilization, food, energy and commodity production, population dynamics, and their ecosystem impacts. Typically offered Fall Spring.

### **AGEC 20400 - Introduction To Resource Economics And Environmental Policy**

Credit Hours: 3.00. The course provides an overview of microeconomic theory and its application to issues related to evaluating resource economic issues and environmental policy. Topics discussed include efficiency, sustainability, valuation, externalities, governmental policies, and benefit cost analysis. Typically offered Spring.

### **POL 22300 - Introduction To Environmental Policy**

Credit Hours: 3.00. (FNR 22310) Study of decision making as modern societies attempt to cope with environmental and natural resources problems. Focuses on the American political system, with some attention to the international dimension. Current policies and issues will be examined. Typically offered Fall Spring.

- General Education III Option - Credit Hours: 3.00 \*
- Free Elective - Credit Hours: 3.00

12 Credits

## **Note**

\*Satisfies a University Core Requirement

Students must earn a "C-" or better in all required ♦ courses.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

2.0 average in EAPS major classes required to graduate.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Geology and Geophysics, BS

## About the Program

Within the geology and geophysics major, students study math, chemistry, physics, and enroll in coursework in physical and historical geology, earth materials, surface processes, plate tectonics, structural geology, sedimentation and stratigraphy, computer-aided analysis, field methods, and a summer geology field camp. Students have a number of electives which can be used to take advanced coursework in seismology, crustal tectonics, engineering geology, hydrogeology, and a wide variety of other topics relevant to geologists. Faculty led classes, labs, and field experiences as well as undergraduate research (encouraged) are all components of this program.

Geology and Geophysics Website

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Geology and Geophysics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

code-BS

Code-GEOP

120 Credits

"C-" or better required in ^ courses

## Departmental/Program Major Courses (48 credits)

## Required Major Courses (48 credits)

### **EAPS 10900 - The Dynamic Earth**

Credit Hours: 3.00. This course covers the formation and development of the solid earth, atmosphere, hydrosphere, and biosphere. The course studies the whole earth as a system of many interacting parts and focuses on the changes within and between these parts. This course is intended for all majors in earth and atmospheric sciences. Typically offered Fall.

### **EAPS 11200 - Earth Through Time**

Credit Hours: 3.00. The history of the planet Earth from its beginnings to the present. This course will explore the causes and effects of processes that have changed the Earth's surface and subsurface through time, the impacts of these changes on the evolution of life, and how scientist interpret Earth history from the geologic record. The laboratory will provide hands-on experience in interpreting various geologic and fossil records. This course may be taken on its own, or as a year-long lab series with EAPS 11100. EAPS 11100 and EAPS 11200 will fulfill the two course sequence laboratory experience outside the major department. Typically offered Spring.

### **EAPS 11800 - Introduction To Earth Sciences**

Credit Hours: 3.00. Introduction to a range of topics in Earth Science, including: Origin and geological history of Earth, including geological records of climate and evolution; Earth materials (minerals and rocks); Chemical and physical composition and structure of the Earth; Rock weathering, erosion, and sedimentary processes; Geological timescale; Geologic structures including their map and field expression; Tectonic processes; The hydrological cycle with emphasis on groundwater and physical and chemical oceanography; Energy and mineral resources; Astrobiology. (Required for Geology and Geophysics and Earth and Space Science Teaching majors.) Typically offered Spring.

### **EAPS 13700 - Freshman Seminar In Earth And Atmospheric Sciences**

Credit Hours: 1.00. Seminar presented by guests in different fields of the Earth and Atmospheric Sciences to expose students to the range of topics included in the department and in possible career paths. Typically offered Fall Spring.

### **EAPS 24300 - Earth Materials I**

Credit Hours: 4.00. Elements of crystallography, physical and chemical properties of rock-forming minerals, and minerals of economic importance. Origin and occurrence of minerals. Prior course work in dynamic earth or physical geology is required. Typically offered Fall.

### **EAPS 35300 - Earth Surface Processes**

Credit Hours: 3.00. Introduction to a variety of topics in sediment transport and deposition, emphasizing linkages between active processes, landscape evolution, and the rock record. Topics include: introductory fluid mechanics; sediment transport by water, ice, and wind, and the development of fluvial bedforms, glacial landscapes, and sand dunes; groundwater geochemistry and the development of karst and caves. Each major topic is accompanied by field projects that emphasize local geologic history. A weekend field trip is required. (Required for Geoscience and Earth Science teaching majors.) Typically offered Fall.

### **EAPS 35400 - Plate Tectonics**

Credit Hours: 3.00. This course will explore plate tectonic processes from the scale of plate motions to the individual stresses that deform rocks. Emphasis will be focused on sources of stress and how this stress is manifested in the lithosphere through faulting, folding, earthquake generation, and plate motions. Seismic waves and what information they provide about the interior of the Earth will be discussed. Additionally, extensional, compressional, and transform plate boundaries will be covered. This course is an introduction to geophysical processes and serves as a stepping-stone to upper level geophysics course such as EAPS 35200 and EAPS 45000. Typically offered Fall Spring.

### **EAPS 47400 - Sedimentation And Stratigraphy**

Credit Hours: 4.00. Systematic study of continental and marine depositional environments. Interpretation of sedimentary facies, structures, and microfacies. Principles and applications of stratigraphy, including applications of paleontology, field relations, paleomagnetism, well logs, seismic reflections, and chemistry. Field investigations may be required. Prior course work in earth materials, mineralogy and petrology is required. Typically offered Spring.

### **EAPS 30900 - Computer-Aided Analysis For Geosciences**

Credit Hours: 3.00. Application of computer analysis techniques including error analysis, line and surface fitting, spatial and temporal correlations, contouring, interpolation, and map projections. These methods are discussed in terms of specific geologic applications. All exercises and examples are developed using commercial mathematical software package. A three-hour-per-week computer laboratory tutorial provides hands-on experience with the techniques discussed in class. Prior course work in computer programming is required. Typically offered Spring.

### **EAPS 35200 - Structural Geology**

Credit Hours: 3.00. This course deals with the nature and evolution of structures in rock deformed naturally by flow and fracture, as deduced from experimental, theoretical and field studies. Specific topics include: structures in three dimensions using descriptive geometry and stereonet, field measurements of rock geometry, tensors, strain and stress, the theory of brittle and plastic rock behavior, theory and field observation of folds and faults, structural analysis of an outcrop, the structure and mechanics of mountain belts. Students will be expected to show competency with using a general set skills, techniques, and tools commonly used by professional geoscientists. Typically offered Spring.

### **EAPS 39000 - Geologic Field Methods**

Credit Hours: 3.00. Introduction to geologic mapping principles on quadrangle (7 1/2 min., 15 min., 1:250,000 scales) maps. Application of aerial photography, GPS, and GIS techniques. Emphasis on construction of cross sections, measurement of stratigraphic sections, and preparation of geologic reports. Several weekend field exercises will be required. Typically offered Spring.

- EAPS xxxxx EAPS Professional Elective (3xxxx and above) - Credit Hours: 3.00
- EAPS xxxxx EAPS Professional Elective (3xxxx and above) - Credit Hours: 3.00

## **EAPS 49000 - Field Geology In Rocky Mountains**

Credit Hours: 6.00. Field studies in sedimentary, igneous, and metamorphic terrains. Studies may involve geologic mapping, stratigraphic section measuring, structural analysis and interpretation, geomorphic interpretation, and interpretation of geologic history. Field excursions include visits to several classical geologic localities in the Colorado Plateau, Great Basin, and Rocky Mountains with discussions and interpretations of features observed. Transportation fee plus room and board at field station required. Rigorous field work requires physical conditioning. Six-week session, including field excursion. Prior course work in earth materials, surface processes, and plate tectonics is required. Permission of instructor required. Typically offered Summer.

- Science/Engineering Elective (2xxxx or above) - Credit Hours: 3.00
- Science/Engineering Elective (2xxxx or above) - Credit Hours: 3.00

## **Other Departmental /Program Course Requirements (61-67 credits)**

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

## **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

## **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

## **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

## **PHYS 22000 - General Physics**

Credit Hours: 4.00. Mechanics, heat, and sound, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1751 Algebra-based Physics I

## **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **PHYS 22100 - General Physics**

Credit Hours: 4.00. Electricity, light, and modern physics, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1752 Algebra-based Physics II

- C S Computer Programming Selective CS 17700 (Rec), 15800, 18000 (satisfies Teambuilding and Collaboration Experience)
- STAT Statistics Option STAT 30100 (Rec- *(satisfies Information Literacy Selective for core)*), STAT 35000, 50300, 51100

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses could satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses could satisfy Humanities Behavioral/Social Science for core) - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00
- Multidisciplinary Experience (could be satisfied by Science, Technology & Society core classes) - Credit Hours: 3.00

## **Electives (5-11 credits)**

(5-11 credits if needed to reach 120 credits of countable credits)

## **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

[http://www.eaps.purdue.edu/for\\_students/undergraduate/](http://www.eaps.purdue.edu/for_students/undergraduate/)

### Fall 1st Year

#### **EAPS 11800 - Introduction To Earth Sciences**

Credit Hours: 3.00. Introduction to a range of topics in Earth Science, including: Origin and geological history of Earth, including geological records of climate and evolution; Earth materials (minerals and rocks); Chemical and physical composition and structure of the Earth; Rock weathering, erosion, and sedimentary processes; Geological timescale; Geologic structures including their map and field expression; Tectonic processes; The hydrological cycle with emphasis on groundwater and physical and chemical oceanography; Energy and mineral resources; Astrobiology. (Required for Geology and Geophysics and Earth and Space Science Teaching majors.) Typically offered Spring.

#### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

#### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

#### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

16 Credits

Spring 1st Year

### **EAPS 11200 - Earth Through Time**

Credit Hours: 3.00. The history of the planet Earth from its beginnings to the present. This course will explore the causes and effects of processes that have changed the Earth's surface and subsurface through time, the impacts of these changes on the evolution of life, and how scientist interpret Earth history from the geologic record. The laboratory will provide hands-on experience in interpreting various geologic and fossil records. This course may be taken on its own, or as a year-long lab series with EAPS 11100. EAPS 11100 and EAPS 11200 will fulfill the two course sequence laboratory experience outside the major department. Typically offered Spring.

### **EAPS 10900 - The Dynamic Earth**

Credit Hours: 3.00. This course covers the formation and development of the solid earth, atmosphere, hydrosphere, and biosphere. The course studies the whole earth as a system of many interacting parts and focuses on the changes within and between these parts. This course is intended for all majors in earth and atmospheric sciences. Typically offered Fall.

### **EAPS 13700 - Freshman Seminar In Earth And Atmospheric Sciences**

Credit Hours: 1.00. Seminar presented by guests in different fields of the Earth and Atmospheric Sciences to expose students to the range of topics included in the department and in possible career paths. Typically offered Fall Spring.

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory

thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

- Language I Option - Credit Hours: 3.00

16 Credits

Fall 2nd Year

### **EAPS 24300 - Earth Materials I**

Credit Hours: 4.00. Elements of crystallography, physical and chemical properties of rock-forming minerals, and minerals of economic importance. Origin and occurrence of minerals. Prior course work in dynamic earth or physical geology is required. Typically offered Fall.

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 22000 - General Physics**

Credit Hours: 4.00. Mechanics, heat, and sound, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1751 Algebra-based Physics I

- Language II Option - Credit Hours: 3.00
- General Education I Option - Credit Hours: 3.00 \*
- Science/Engr Elective<sup>a</sup> - Credit Hours: 3.00

17 Credits

Spring 2nd Year

### **EAPS 35400 - Plate Tectonics**

Credit Hours: 3.00. This course will explore plate tectonic processes from the scale of plate motions to the individual stresses that

deform rocks. Emphasis will be focused on sources of stress and how this stress is manifested in the lithosphere through faulting, folding, earthquake generation, and plate motions. Seismic waves and what information they provide about the interior of the Earth will be discussed. Additionally, extensional, compressional, and transform plate boundaries will be covered. This course is an introduction to geophysical processes and serves as a stepping-stone to upper level geophysics course such as EAPS 35200 and EAPS 45000. Typically offered Fall Spring.

## **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **PHYS 22100 - General Physics**

Credit Hours: 4.00. Electricity, light, and modern physics, for students not specializing in physics. Typically offered Fall Spring Summer. CTL:IPS 1752 Algebra-based Physics II

- Technical Writing/Presentation - Credit Hours: 3.00 \*
- Language III/Culture/Diversity Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15 Credits

Fall 3rd Year

## **EAPS 35300 - Earth Surface Processes**

Credit Hours: 3.00. Introduction to a variety of topics in sediment transport and deposition, emphasizing linkages between active processes, landscape evolution, and the rock record. Topics include: introductory fluid mechanics; sediment transport by water, ice, and wind, and the development of fluvial bedforms, glacial landscapes, and sand dunes; groundwater geochemistry and the development of karst and caves. Each major topic is accompanied by field projects that emphasize local geologic history. A weekend field trip is required. (Required for Geoscience and Earth Science teaching majors.) Typically offered Fall.

## **EAPS 47400 - Sedimentation And Stratigraphy**

Credit Hours: 4.00. Systematic study of continental and marine depositional environments. Interpretation of sedimentary facies, structures, and microfacies. Principles and applications of stratigraphy, including applications of paleontology, field relations, paleomagnetism, well logs, seismic reflections, and chemistry. Field investigations may be required. Prior course work in earth materials, mineralogy and petrology is required. Typically offered Spring.

- C S Computer Programming - Credit Hours: 4.00

- General Education II Option - Credit Hours: 3.00 \*

14 Credits

Spring 3rd Year

### **EAPS 30900 - Computer-Aided Analysis For Geosciences**

Credit Hours: 3.00. Application of computer analysis techniques including error analysis, line and surface fitting, spatial and temporal correlations, contouring, interpolation, and map projections. These methods are discussed in terms of specific geologic applications. All exercises and examples are developed using commercial mathematical software package. A three-hour-per-week computer laboratory tutorial provides hands-on experience with the techniques discussed in class. Prior course work in computer programming is required. Typically offered Spring.

### **EAPS 35200 - Structural Geology**

Credit Hours: 3.00. This course deals with the nature and evolution of structures in rock deformed naturally by flow and fracture, as deduced from experimental, theoretical and field studies. Specific topics include: structures in three dimensions using descriptive geometry and stereonet, field measurements of rock geometry, tensors, strain and stress, the theory of brittle and plastic rock behavior, theory and field observation of folds and faults, structural analysis of an outcrop, the structure and mechanics of mountain belts. Students will be expected to show competency with using a general set skills, techniques, and tools commonly used by professional geoscientists. Typically offered Spring.

### **EAPS 39000 - Geologic Field Methods**

Credit Hours: 3.00. Introduction to geologic mapping principles on quadrangle (7 1/2 min., 15 min., 1:250,000 scales) maps. Application of aerial photography, GPS, and GIS techniques. Emphasis on construction of cross sections, measurement of stratigraphic sections, and preparation of geologic reports. Several weekend field exercises will be required. Typically offered Spring.

- Great Issues Option - Credit Hours: 3.00

12 Credits

Summer

### **EAPS 49000 - Field Geology In Rocky Mountains**

Credit Hours: 6.00. Field studies in sedimentary, igneous, and metamorphic terrains. Studies may involve geologic mapping, stratigraphic section measuring, structural analysis and interpretation, geomorphic interpretation, and interpretation of geologic history. Field excursions include visits to several classical geologic localities in the Colorado Plateau, Great Basin, and Rocky Mountains with discussions and interpretations of features observed. Transportation fee plus room and board at field station required. Rigorous field work requires physical conditioning. Six-week session, including field excursion. Prior course work in earth materials, surface processes, and plate tectonics is required. Permission of instructor required. Typically offered Summer.

## 6 Credits

### Fall 4th Year

- EAPS Professional Elective - Credit Hours: 3.00 <sup>b</sup>
- Multidisciplinary Experience/STS Elective - Credit Hours: 3.00 \*
- STAT\* Statistics Option - STAT 30100 Rec - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## 12 Credits

### Spring 4th Year

- EAPS Professional Elective - Credit Hours: 3.00 <sup>b</sup>
- Science/Engr Elective - Credit Hours: 3.00 <sup>a</sup>
- General Education III Option - Credit Hours: 3.00 \*
- Free Elective - Credit Hours: 3.00

## 12 Credits

## Note

\*Satisfies a University Core Requirement

<sup>a</sup>20000 level or above

<sup>b</sup>30000 level or above

Students must earn a "C-" or better in all required ^ courses.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

2.0 average in EAPS major classes required to graduate.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Planetary Sciences, BS

### About the Program

Planetary sciences is a multidisciplinary study of planetary dynamics and includes course work in planetary geology, planetary atmospheres, planetary physics, spacecraft design and operation, and astronomy with elective options in astrobiology, impact cratering, and related topics with which to focus their study. All students receive a strong background in math, chemistry, physics, computer science, geophysics, and remote sensing and are encouraged to get involved in undergraduate research in this unique program.

Planetary Sciences Website

#### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Planetary Sciences include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

code-BS

Code-PLSI

120 Credits

"C-" or better required in ♦ courses

### Departmental/Program Major Courses (40 credits)

### Required Major Courses (40 credits)

## **EAPS 10500 - The Planets**

Credit Hours: 3.00. This course deals with current knowledge of the physical, chemical, and geological nature of the planets and their atmospheres derived in part from data provided by manned and unmanned space probes and other techniques. Similarities and differences between the earth and other planets are described and discussed within the role of planetary formation. Typically offered Fall Spring.

## **EAPS 11700 - Introduction To Atmospheric Science**

Credit Hours: 3.00. The weather/climate system. Solar variability and Milankovitch Theory. Atmospheric scales of motion. Chemistry of greenhouse gases and aerosols. Fundamental laws of meteorological dynamics and radiation. Weather systems, air masses and fronts. Severe storms, hurricanes and tornadoes. (Required for atmospheric sciences majors.) Typically offered Spring.

## **EAPS 11800 - Introduction To Earth Sciences**

Credit Hours: 3.00. Introduction to a range of topics in Earth Science, including: Origin and geological history of Earth, including geological records of climate and evolution; Earth materials (minerals and rocks); Chemical and physical composition and structure of the Earth; Rock weathering, erosion, and sedimentary processes; Geological timescale; Geologic structures including their map and field expression; Tectonic processes; The hydrological cycle with emphasis on groundwater and physical and chemical oceanography; Energy and mineral resources; Astrobiology. (Required for Geology and Geophysics and Earth and Space Science Teaching majors.) Typically offered Spring.

## **EAPS 13700 - Freshman Seminar In Earth And Atmospheric Sciences**

Credit Hours: 1.00. Seminar presented by guests in different fields of the Earth and Atmospheric Sciences to expose students to the range of topics included in the department and in possible career paths. Typically offered Fall Spring.

- EAPS Elective (could satisfy Science, Technology & Society for core) - LINK - Credit Hours: 3.00

## **ASTR 36300 - The Solar System**

Credit Hours: 3.00. This course is intended for students in science or engineering. The components of the course consist of an overview of solar system objects and an overview of the physical processes that control the evolution of solar system objects since formation. The overview of solar system includes observations of the Sun, planets, asteroids and Kuiper-belt objects, comets, and interplanetary dust. Specific processes that are discussed include hydrostatic equilibrium, orbital dynamics, radioactive decay, and heat flow. The role of these processes in shaping planetary surfaces and atmosphere is explored. Typically offered Fall.

## **EAPS 55600 - Planetary Geology**

Credit Hours: 3.00. The application of petrology and structural geology to other planets. Topics include: theories of star and solar system formation, orbital dynamics and Kepler's laws, petrology and geochemistry of meteorites, age dating techniques, structure and composition of the terrestrial, giant, and icy planets, planetary surfaces, planetary atmospheres, and theories of the formation of the moon. Offered in alternate years. Prior course work in earth materials is required. Typically offered Fall.

### **EAPS 39100 - Topics In Earth And Atmospheric Sciences**

Credit Hours: 1.00 to 4.00. Intermediate special topics in the earth and atmospheric sciences. Permission of instructor required. Typically offered Fall Spring Summer.

### **EAPS 57700 - Geologic Remote Sensing And Spectroscopy**

Credit Hours: 3.00. The objectives of this course are: 1) to develop awareness and knowledge of the various types of remote sensing data that are used to study the evolution of the Earth's surface; 2) to understand how these tools work and the range of geologic topics that they are applied to; 3) to develop critical thinking skills essential for interpretation of multidimensional spatial data; 4) to provide a supervised research experience; 5) to strengthen scientific communication skills; and 6) to develop some of the fundamental practical skills (computer-based experience) that are needed to analyze these data. General background in geology, geophysics, and/or planetary science desirable. Typically offered Fall.

### **EAPS 30900 - Computer-Aided Analysis For Geosciences**

Credit Hours: 3.00. Application of computer analysis techniques including error analysis, line and surface fitting, spatial and temporal correlations, contouring, interpolation, and map projections. These methods are discussed in terms of specific geologic applications. All exercises and examples are developed using commercial mathematical software package. A three-hour-per-week computer laboratory tutorial provides hands-on experience with the techniques discussed in class. Prior course work in computer programming is required. Typically offered Spring.

### **AAE 45000 - Spacecraft Design**

Credit Hours: 3.00. Senior students perform a team-based spacecraft design, requiring application of the education and skills developed in the aerospace curriculum. Components include analysis methods for preliminary design, development of an initial vehicle concept, and development of a complete numerical model of the mission, culminating in oral and written reports by the teams. Typically offered Fall Spring.

- Planetary Science Elective\* - Credit Hours: 3.00
- Planetary Science Elective\* - Credit Hours: 3.00
- Planetary Science Elective\* - Credit Hours: 3.00
- Science/Engineering Elective (based on areas of interest) - Credit Hours: 3.00
- Science/Engineering Elective (based on areas of interest) - Credit Hours: 3.00

\*EAPS 31900, 32000, 35200, 35300, 39000, 42000, 42100, 42200, 42300, 43100, 43200, 43300, 44000, 45500, 47400, (49000 or EAPS 3xxxx field geology), or EAPS 57700 or EAPS 30900 if not taken as part of Core.

## Other Departmental /Program Course Requirements (69-75 credits)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100. Typically offered Fall Spring Summer.

### **MA 26200 - Linear Algebra And Differential Equations**

Credit Hours: 4.00. Linear algebra, elements of differential equations. Not open to students with credit in MA 26500 or MA 26600. Typically offered Fall Spring Summer.

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **CS 15800 - C Programming**

Credit Hours: 3.00. Introduction to structured programming in C. Data types and expression evaluation. Programmer-defined functions including passing parameters by value and by address. Selection topics include if/else/else-if, conditional expressions, and switch. Repetition topics include while, do-while, for, and recursion. External file input and output. Arrays, analysis of searching and sorting algorithms, and strings. Pointers and dynamic memory allocation. Students are expected to complete assignments in a collaborative environment. CS 15800 may be used to satisfy College of Science requirement of participation in at least one team-building and collaboration experience. Typically offered Summer Fall Spring.

## **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

## **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

## **STAT 30100 - Elementary Statistical Methods**

Credit Hours: 3.00. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, correlation and regression. Software is used throughout. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: college algebra. Typically offered Summer Fall Spring.

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses could satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses could satisfy Humanities Behavioral/Social Science for core) - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00
- Multidisciplinary Elective (could be satisfied by Science, Technology & Society core classes) - Credit Hours: 3.00

## Electives

(5-11 credits if needed to reach 120 credits of countable credits) - [LINK](#)

## University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

[http://www.eaps.purdue.edu/for\\_students/undergraduate/](http://www.eaps.purdue.edu/for_students/undergraduate/)

### Fall 1st Year

#### **EAPS 11700 - Introduction To Atmospheric Science**

Credit Hours: 3.00. The weather/climate system. Solar variability and Milankovitch Theory. Atmospheric scales of motion. Chemistry of greenhouse gases and aerosols. Fundamental laws of meteorological dynamics and radiation. Weather systems, air masses and fronts. Severe storms, hurricanes and tornadoes. (Required for atmospheric sciences majors.). Typically offered Spring.

#### **EAPS 11800 - Introduction To Earth Sciences**

Credit Hours: 3.00. Introduction to a range of topics in Earth Science, including: Origin and geological history of Earth, including geological records of climate and evolution; Earth materials (minerals and rocks); Chemical and physical composition and structure of the Earth; Rock weathering, erosion, and sedimentary processes; Geological timescale; Geologic structures including their map and field expression; Tectonic processes; The hydrological cycle with emphasis on groundwater and physical and chemical oceanography; Energy and mineral resources; Astrobiology. (Required for Geology and Geophysics and Earth and Space Science Teaching majors.) Typically offered Spring.

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

16 Credits

Spring 1st Year

### **EAPS 10500 - The Planets**

Credit Hours: 3.00. This course deals with current knowledge of the physical, chemical, and geological nature of the planets and their atmospheres derived in part from data provided by manned and unmanned space probes and other techniques. Similarities and differences between the earth and other planets are described and discussed within the role of planetary formation. Typically offered Fall Spring.

### **EAPS 13700 - Freshman Seminar In Earth And Atmospheric Sciences**

Credit Hours: 1.00. Seminar presented by guests in different fields of the Earth and Atmospheric Sciences to expose students to the range of topics included in the department and in possible career paths. Typically offered Fall Spring.

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

- Language I Option - Credit Hours: 3.00

16 Credits

Fall 2nd Year

## **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

## **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

- General Education I Option\* - Credit Hours: 3.00
- Language II Option - Credit Hours: 3.00

14 Credits

## Spring 2nd Year

- EAPS Elective - Credit Hours: 3.00

### **MA 26200 - Linear Algebra And Differential Equations**

Credit Hours: 4.00. Linear algebra, elements of differential equations. Not open to students with credit in MA 26500 or MA 26600. Typically offered Fall Spring Summer.

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

- Technical Writing/Presentation\* - Credit Hours: 3.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00

16 Credits

## Fall 3rd Year

- Planetary Science Elective - Credit Hours: 3.00

### **ASTR 36300 - The Solar System**

Credit Hours: 3.00. This course is intended for students in science or engineering. The components of the course consist of an overview of solar system objects and an overview of the physical processes that control the evolution of solar system objects since formation. The overview of solar system includes observations of the Sun, planets, asteroids and Kuiper-belt objects, comets, and interplanetary dust. Specific processes that are discussed include hydrostatic equilibrium, orbital dynamics, radioactive decay, and heat flow. The role of these processes in shaping planetary surfaces and atmosphere is explored. Typically offered Fall.

- STAT Statistics - Credit Hours: 3.00
- CS Computer Programming Option - Credit Hours: 4.00

### **EAPS 55600 - Planetary Geology**

Credit Hours: 3.00. The application of petrology and structural geology to other planets. Topics include: theories of star and solar system formation, orbital dynamics and Kepler's laws, petrology and geochemistry of meteorites, age dating techniques, structure

and composition of the terrestrial, giant, and icy planets, planetary surfaces, planetary atmospheres, and theories of the formation of the moon. Offered in alternate years. Prior course work in earth materials is required. Typically offered Fall.

## 16 Credits

### Spring 3rd Year

- Planetary Science Elective<sup>+</sup> - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00
- Science/Engr Elective - Credit Hours: 3.00
- Science/Engr Elective - Credit Hours: 3.00

## 15 Credits

### Fall 4th Year

#### **EAPS 39100 - Topics In Earth And Atmospheric Sciences**

Credit Hours: 1.00 to 4.00. Intermediate special topics in the earth and atmospheric sciences. Permission of instructor required. Typically offered Fall Spring Summer.

- Planetary Science Elective<sup>+</sup> - Credit Hours: 3.00
- Multidisciplinary Experience/STS Selective\* - Credit Hours: 3.00
- General Education II Option\* - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## 15 Credits

### Spring 4th Year

#### **AAE 45000 - Spacecraft Design**

Credit Hours: 3.00. Senior students perform a team-based spacecraft design, requiring application of the education and skills developed in the aerospace curriculum. Components include analysis methods for preliminary design, development of an initial vehicle concept, and development of a complete numerical model of the mission, culminating in oral and written reports by the teams. Typically offered Fall Spring.

## **EAPS 57700 - Geologic Remote Sensing And Spectroscopy**

Credit Hours: 3.00. The objectives of this course are: 1) to develop awareness and knowledge of the various types of remote sensing data that are used to study the evolution of the Earth's surface; 2) to understand how these tools work and the range of geologic topics that they are applied to; 3) to develop critical thinking skills essential for interpretation of multidimensional spatial data; 4) to provide a supervised research experience; 5) to strengthen scientific communication skills; and 6) to develop some of the fundamental practical skills (computer-based experience) that are needed to analyze these data. General background in geology, geophysics, and/or planetary science desirable. Typically offered Fall.

## **EAPS 30900 - Computer-Aided Analysis For Geosciences**

Credit Hours: 3.00. Application of computer analysis techniques including error analysis, line and surface fitting, spatial and temporal correlations, contouring, interpolation, and map projections. These methods are discussed in terms of specific geologic applications. All exercises and examples are developed using commercial mathematical software package. A three-hour-per-week computer laboratory tutorial provides hands-on experience with the techniques discussed in class. Prior course work in computer programming is required. Typically offered Spring.

- General Education III Option\* - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

12 Credits

## **Note**

\*Satisfies a University Core Requirement

†Electives for advanced courses and specializations.

^EAPS 55600 and 39100 Astrobiology are offered alternate years and may be switched in the above schedule.

Students must earn a "C-" or better in all required ♦ courses.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

2.0 average in EAPS major classes required to graduate.

## **Degree Requirements**

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## **Critical Course**

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Earth, Atmospheric, and Planetary Sciences Minor

The following courses describe the minimum coursework necessary to earn a minor in Earth, Atmospheric, and Planetary Sciences.

ALL COURSES FOR THIS MINOR MUST BE TAKEN AT PURDUE UNIVERSITY

### Requirements for the Minor

#### **EAPS 11100 - Physical Geology**

Credit Hours: 3.00. Geologic processes and the development of land forms. Laboratory covers the study of minerals and rocks, the interpretations of topographic and geologic maps, and field investigations. Typically offered Summer Fall Spring. CTL: Physical Geology

#### **EAPS 22100 - Survey Of Atmospheric Science**

Credit Hours: 3.00. (NRES 23000) An introductory course for both science and nonscience students. A general study of the atmosphere, basic meteorological principles, and weather systems. Relationships of the changing atmosphere to climate ozone depletion, and other contemporary issues. Typically offered Summer Fall Spring.

#### **EAPS 22500 - Science Of The Atmosphere**

Credit Hours: 3.00. An overview of the physics and dynamics of the atmosphere. Quantitative study of the energy balance of the atmosphere, condensation and precipitation processes, atmospheric motion and global circulation, severe storms, atmospheric chemistry. Contemporary issues such as human impact on climate, ozone depletion, numerical weather prediction and climate simulation, and modern measurement systems. Not available to students with credit in EAPS 22100. Intended for Science and Engineering majors only. Prior course work in calculus is required. Typically offered Spring.

#### **EAPS 23000 - Laboratory In Atmospheric Science**

Credit Hours: 1.00. A laboratory course that introduces the fundamentals of atmospheric science through quantitative exercises.

The theoretical exercises include the vertical structure of the atmosphere, the Earth's energy budget, atmospheric moisture, saturation and stability, clouds and precipitation and atmospheric motion. Data and map analysis exercises include mid-latitude cyclones, thunderstorms and tornadoes, hurricanes and controls of climate. Prior or current course work in introductory atmospheric science is required. This course may not be taken for credit by students in the atmospheric science option of the Department of Earth and Atmospheric Sciences. Typically offered Summer Fall Spring.

## Note

A minor in Earth, Atmospheric & Planetary Science consists of at least 10 credit hours beyond the courses listed above.

No more than one of the courses taken to meet the requirement of at least 10 additional EAPS credit hours may be at the 10000 level.

# Department of Mathematics

## Overview

The Department of Mathematics is one of seven departments making up Purdue's College of Science. The Department has an international reputation as an outstanding center for mathematical education, scholarship and research. Together with visiting researchers, its 65 professors provide it with active involvement in current developments in many major areas of mathematics. Faculty research interests can be found in the Faculty Research Areas list or in our Faculty directory.

The Department offers the Bachelor of Science, Master of Science and Doctor of Philosophy degrees. Also, the Department is closely associated with other programs, including Actuarial Science, Statistics, and Computer Science.

Please explore our website or contact us directly for more information about our undergraduate or graduate programs, faculty, research, job opportunities or information on how to support us. The annual department newsletter, PUview, is a good place to read about Departmental news.

### Actuarial Science Program

The Purdue Actuarial Science Program is an interdisciplinary program offered jointly by the Department of Mathematics and Department of Statistics.

The program offers a major in Actuarial Science that prepares students for an actuarial career as well as providing complete preparation for the first five exams set by the Society of Actuaries and the Casualty Actuarial Society. Students receive an Actuarial Science Degree, a Statistics Degree, and a Management Minor. We do not offer graduate degrees in Actuarial Science. For more information contact Julie Morris.

### Program Information

- [Admissions Information \(Includes application forms and online application\)](#)
- [Actuarial Sciences Faculty](#)
- [Purdue Exam Awards \(and Application\)](#)
- [SOA Exam Applications](#)
- [Purdue Actuarial Club](#)

### Links

- [BeAnActuary.org](http://BeAnActuary.org)

- [Actuary.com](http://www.actuary.com)
- Society of Actuaries
- Casualty Actuarial Society
- American Academy of Actuaries
- Conference of Consulting Actuaries
- American Society of Pension Professionals & Actuaries
- Canadian Institute of Actuaries
- Institute of Actuaries (UK)
- International Actuarial Association (IAA)
- Purdue Department of Statistics
- Purdue Department of Mathematics
- Undergraduate Mathematics Information
- Undergraduate Statistics Information

## Faculty

<http://www.math.purdue.edu/people/faculty/>

## Contact Information

The Department's Main Office (Room 835 of the MATH building) is open from eight am to five pm on all weekdays, except University holidays. The main office is closed from 12 to 1 p.m. in the summer. A phone number for the department is (765) 494-1901. The full address is:

Department of Mathematics  
 Purdue University  
 150 North University Street  
 West Lafayette, Indiana 47907-2067

## Graduate Information

For Graduate Information please see Mathematics Graduate Program Information .

## Actuarial Science Honors, BS

## About the Program

Actuarial Science is a joint program of Mathematics and Statistics that emphasizes course work in Mathematics, Statistics, Economics, and Management. Students can prepare for four to five of the nine course exams to become an actuary and also will be eligible for all three VEEs (Validation by Educational Experience) upon successful completion of all required and recommended courses. In addition, students also earn a second major in Statistics and most also earn a minor in Management.

[Actuarial Science Website](#)

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Actuarial Science Honors include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

MATH-BS  
Code-ASHO  
120 credits

## Departmental/Program Major Courses (90-116 credits)

### Required Major Courses (63-66 credits)

Average GPA in courses must be 2.50 [excluding Calculus I, II, III] AND B or higher in major courses excluding MGMT 20000 and MGMT 20100 AND 3.5 Average GPA in major courses mark with a •

#### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

#### **MA 37300 - Financial Mathematics**

Credit Hours: 4.00. A mathematical treatment of some fundamental concepts of financial mathematics and financial economics, and their application to real world business situations and basic risk management. Includes discussions of valuing investments, capital budgeting, valuing contingent cash flows, yield curves, spot rates, forward rates, short sales, Macaulay duration, modified duration, convexity, and immunization, financial derivatives, and their use in risk management. Provides preparation for the SOA/CAS Actuarial Exam FM/2. Typically offered Fall Spring.

#### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

#### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete

and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

### **STAT 47201 - Actuarial Models- Life Contingencies**

Credit Hours: 4.00. Mathematical foundation of actuarial science, emphasizing probability models for life contingencies as the basis for analyzing life insurance and life annuities and determining premiums and reserves. This course provides the background for Course MLC of the Society of Actuaries and Course 3L of the Casualty Actuarial Society. Typically offered Fall.

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

### **STAT 47301 - Introduction To Arbitrage-Free Pricing Of Financial Derivatives**

Credit Hours: 3.00. This course exposes students to a number of financial economics concepts related to arbitrage-free option pricing in the binomial market model and the Black-Scholes model. Specific models include: (1) Options and parity relationship between options (2) Option Pricing under the Binomial model (3) Option Pricing under the Black-Scholes model (4) Option hedging and the market maker's overnight profit (5) Black Scholes theory with Brownian motion and Ito calculus (6) Risk-neutral option pricing and Monte Carlo valuation (7) Stochastic interest rates and Stochastic Volatility. This course provides the background for Course MFE of the Society of Actuaries and Course 3F of the Casualty Actuarial Society. Typically offered Fall Spring.

### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

### **STAT 47900 - Loss Models**

Credit Hours: 3.00. This material provides an introduction to modeling and covers important actuarial methods that are useful in modeling. Students will be introduced to survival, severity, frequency and aggregate models, and use statistical methods to estimate parameters of such models given sample data. The student will further learn to identify steps in the modeling process, understand the underlying assumptions implicit in each family of models, recognize which assumptions are applicable in a given business application, and appropriately adjust the models for impact of insurance coverage modifications. The student will be introduced to a variety of tools for the calibration and evaluation of the models. Permission of instructor required. Typically offered Spring.

## **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

## **STAT 42000 - Introduction To Time Series**

Credit Hours: 3.00. An introduction to time series analysis suitable for actuarial science, engineering, and sciences. Model building and forecasting with ARMA and ARIMA models. Resampling methods for confidence intervals. Multivariate, state-space, and nonlinear models. Volatility models (ARCH and GARCH). Smoothing in time series. Typically offered Fall Spring.

## **MGMT 20000 - Introductory Accounting**

Credit Hours: 3.00. The objectives of the course are to help students: (1) understand what is in financial statements and what the statements say about a business, (2) identify the business activities that caused the amounts that appear in the statements, and (3) understand how, when, and at what amount the effects of manager and employee actions will appear in the statements. Typically offered Fall Spring Summer. CTL:IPO 1801 Accounting I

## **MGMT 20100 - Management Accounting I**

Credit Hours: 3.00. An introduction to management's internal use of accounting information--for decision making, production management, product costing, motivating and evaluating performance, and budgeting. Typically offered Fall Spring Summer. CCN:IPO 1802 Accounting II

## **MGMT 31000 - Financial Management**

Credit Hours: 3.00. Management of the financial affairs of the industrial enterprise. Working capital management, current asset management, capital budgeting, stock and bond valuation, and capital structure decisions. Typically offered Fall Spring Summer.

## **MGMT 30400 - Introduction To Financial Management**

Credit Hours: 3.00. Introductory course providing a foundation in corporate finance and covering topics such as: discounted cash flow valuation, bond valuation, equity valuation, option valuation, factors influencing a firm's cost of capital, and international finance issues. Typically offered Fall Spring.

## **MGMT 41100 - Investment Management**

Credit Hours: 3.00. Examination of investment alternatives relevant to the individual and/or family-unit investor. Operations of the markets in which securities are traded. Theory and application of security valuation, portfolio construction, capital markets, and performance evaluation. Particular attention given to fixed income securities, common stocks, options, investment companies, and other popular investment alternatives. Typically offered Fall Spring.

### **ECON 25100 - Microeconomics**

Credit Hours: 3.00. Microeconomics studies the choices individuals make and the incentives that influence those choices. Emphasis is on the incentives that determine market prices and resource allocation. The role of public policy in influencing incentives and efficiency is also addressed. Typically offered Fall Spring Summer. CTL:ISH 1042 Microeconomics

### **ECON 25200 - Macroeconomics**

Credit Hours: 3.00. Introduction to macroeconomic theory. The course develops a theoretical framework permitting an analysis of the forces affecting national income, employment, interest rates, and the rate of inflation. Emphasis is placed upon the role of government fiscal and monetary policy in promoting economic growth and stable prices. Typically offered Fall Spring Summer. CTL:ISH 1041 Macroeconomics

### **Calculus I Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **Calculus II Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.  
CTL:IMA 1603 Calculus - Long II

## **Calculus III Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

## **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

## **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

## **Program Requirement (0 credits)**

Documentation of passing two exams given by the Society of Actuaries

- Exam 1 - Credit Hours: 0.00
- Exam 2 - Credit Hours: 0.00

## **Other Departmental/Program Course Requirements (27-50 credits)**

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and

research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Laboratory Science I Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Computing Option LINK - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience\* LINK - Credit Hours: 0.00 - 4.00
- Great Issues Option LINK - Credit Hours: 3.00
- Multidisciplinary Experience\* LINK (Select courses COULD satisfies Science, Technology, and Society Selective for core) - met within major

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information

## **Electives (4-30 credits)**

## **University Core Requirements**

LINK

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science

- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

- Calculus I Option - Credit Hours: 4.00 - 5.00 ♦

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 2.00 or

### **MA 17000 - Introduction To Actuarial Science**

Credit Hours: 2.00. (STAT 17000) An introduction to actuarial science from the point of view of practicing actuaries from life insurance, casualty insurance and consulting; introduction to insurance and the mathematical theory of interest; application of spreadsheets to problems related to actuarial science. Typically offered Fall.

### **STAT 17000 - Introduction To Actuarial Science**

Credit Hours: 2.00. (MA 17000) An introduction to actuarial science from the point of view of practicing actuaries from life insurance, casualty insurance and consulting; introduction to insurance and the mathematical theory of interest; application of spreadsheets to problems related to actuarial science. Typically offered Fall.

- Free Elective - Credit Hours: 3.00

15-18 Credits

## Spring 1st Year

- Calculus II Option - Credit Hours: 4.00 - 5.00

### **MA 37300 - Financial Mathematics**

Credit Hours: 4.00. A mathematical treatment of some fundamental concepts of financial mathematics and financial economics, and their application to real world business situations and basic risk management. Includes discussions of valuing investments, capital budgeting, valuing contingent cash flows, yield curves, spot rates, forward rates, short sales, Macaulay duration, modified duration, convexity, and immunization, financial derivatives, and their use in risk management. Provides preparation for the SOA/CAS Actuarial Exam FM/2. Typically offered Fall Spring.

- Computing Option (CS 17700 & meets Teambuilding & Collaboration) - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 1.00

15-18 Credits

## Fall 2nd Year

- Calculus III Option - Credit Hours: 4.00 - 5.00

### **MGMT 20000 - Introductory Accounting**

Credit Hours: 3.00. The objectives of the course are to help students: (1) understand what is in financial statements and what the statements say about a business, (2) identify the business activities that caused the amounts that appear in the statements, and (3) understand how, when, and at what amount the effects of manager and employee actions will appear in the statements. Typically offered Fall Spring Summer. CTL:IPO 1801 Accounting I

### **ECON 25100 - Microeconomics**

Credit Hours: 3.00. Microeconomics studies the choices individuals make and the incentives that influence those choices. Emphasis is on the incentives that determine market prices and resource allocation. The role of public policy in influencing incentives and efficiency is also addressed. Typically offered Fall Spring Summer. CTL:ISH 1042 Microeconomics

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory

analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Language III/Culture/Diversity Option - Credit Hours: 3.00

16-17 Credits

Spring 2nd Year

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

### **MGMT 20100 - Management Accounting I**

Credit Hours: 3.00. An introduction to management's internal use of accounting information--for decision making, production management, product costing, motivating and evaluating performance, and budgeting. Typically offered Fall Spring Summer. CCN:IPO 1802 Accounting II

### **ECON 25200 - Macroeconomics**

Credit Hours: 3.00. Introduction to macroeconomic theory. The course develops a theoretical framework permitting an analysis of the forces affecting national income, employment, interest rates, and the rate of inflation. Emphasis is placed upon the role of government fiscal and monetary policy in promoting economic growth and stable prices. Typically offered Fall Spring Summer. CTL:ISH 1041 Macroeconomics

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

15-18 Credits

Fall 3rd Year

### **STAT 47201 - Actuarial Models- Life Contingencies**

Credit Hours: 4.00. Mathematical foundation of actuarial science, emphasizing probability models for life contingencies as the basis for analyzing life insurance and life annuities and determining premiums and reserves. This course provides the background for Course MLC of the Society of Actuaries and Course 3L of the Casualty Actuarial Society. Typically offered Fall.

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

### **MGMT 31000 - Financial Management**

Credit Hours: 3.00. Management of the financial affairs of the industrial enterprise. Working capital management, current asset management, capital budgeting, stock and bond valuation, and capital structure decisions. Typically offered Fall Spring Summer.

### **MGMT 30400 - Introduction To Financial Management**

Credit Hours: 3.00. Introductory course providing a foundation in corporate finance and covering topics such as: discounted cash flow valuation, bond valuation, equity valuation, option valuation, factors influencing a firm's cost of capital, and international finance issues. Typically offered Fall Spring.

- Laboratory Science I Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 2.00

15-16 Credits

Spring 3rd Year

### **STAT 47301 - Introduction To Arbitrage-Free Pricing Of Financial Derivatives**

Credit Hours: 3.00. This course exposes students to a number of financial economics concepts related to arbitrage-free option pricing in the binomial market model and the Black-Scholes model. Specific models include: (1) Options and parity relationship between options (2) Option Pricing under the Binomial model (3) Option Pricing under the Black-Scholes model (4) Option hedging and the market maker's overnight profit (5) Black Scholes theory with Brownian motion and Ito calculus (6) Risk-neutral option pricing and Monte Carlo valuation (7) Stochastic interest rates and Stochastic Volatility. This course provides the background for Course MFE of the Society of Actuaries and Course 3F of the Casualty Actuarial Society. Typically offered Fall Spring.

- Laboratory Science II Option - Credit Hours: 3.00 - 4.00
- General Education I Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15-16 Credits

Fall 4th Year

### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

## **MGMT 41100 - Investment Management**

Credit Hours: 3.00. Examination of investment alternatives relevant to the individual and/or family-unit investor. Operations of the markets in which securities are traded. Theory and application of security valuation, portfolio construction, capital markets, and performance evaluation. Particular attention given to fixed income securities, common stocks, options, investment companies, and other popular investment alternatives. Typically offered Fall Spring.

- Free Elective (Science, Technology & Society Selective Course) - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00 - 3.00

15-16 Credits

Spring 4th Year

## **STAT 42000 - Introduction To Time Series**

Credit Hours: 3.00. An introduction to time series analysis suitable for actuarial science, engineering, and sciences. Model building and forecasting with ARMA and ARIMA models. Resampling methods for confidence intervals. Multivariate, state-space, and nonlinear models. Volatility models (ARCH and GARCH). Smoothing in time series. Typically offered Fall Spring.

- Great Issue Option - Credit Hours: 3.00
- General Education II Option - Credit Hours: 3.00

## **STAT 47900 - Loss Models**

Credit Hours: 3.00. This material provides an introduction to modeling and covers important actuarial methods that are useful in modeling. Students will be introduced to survival, severity, frequency and aggregate models, and use statistical methods to estimate parameters of such models given sample data. The student will further learn to identify steps in the modeling process, understand the underlying assumptions implicit in each family of models, recognize which assumptions are applicable in a given business application, and appropriately adjust the models for impact of insurance coverage modifications. The student will be introduced to a variety of tools for the calibration and evaluation of the models. Permission of instructor required. Typically offered Spring.

- Free Elective (STAT 49000 - Life Contingencies II) - Credit Hours: 2.00

14 Credits

## **Note**

Students must earn a 2.5 average GPA among required MA/STAT/MGMT/ECON courses excluding Calculus I, II, III, and STAT 35000 AND A or B in major courses excluding MGMT 20000 and 20100 AND 3.5 Average GPA in major courses marked with a • and pass two SOA exams.

120 semester credits required for Bachelor of Science degree.

3.3 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Actuarial Science, BS

## About the Program

Actuarial Science is a joint program of Mathematics and Statistics that emphasizes course work in Mathematics, Statistics, Economics, and Management. Students can prepare for four to five of the nine course exams to become an actuary and also will be eligible for all three VEEs (Validation by Educational Experience) upon successful completion of all required and recommended courses. In addition, students also earn a second major in Statistics and most also earn a minor in Management.

Actuarial Science Website

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Actuarial Science include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

MATH-BS  
Code-ACSC

## Departmental/Program Major Courses (84-110 credits)

## Required Major Courses (57-60 credits)

Average GPA in courses must be 2.50 excluding Calculus I, II, and III

- Calculus I Selective - Select from MA 16100 or MA 16500 (satisfies Quantitative Reasoning for core) - Credit Hours: 4.00 - 5.00 ♦
- Calculus II Selective - Select from MA 16200 or MA 16600 (satisfies Quantitative Reasoning for core) - Credit Hours: 4.00 - 5.00
- Calculus III Selective - Select from MA 26100 or MA 27101 (satisfies Quantitative Reasoning for core) - Credit Hours: 4.00 - 5.00

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **MA 37300 - Financial Mathematics**

Credit Hours: 4.00. A mathematical treatment of some fundamental concepts of financial mathematics and financial economics, and their application to real world business situations and basic risk management. Includes discussions of valuing investments, capital budgeting, valuing contingent cash flows, yield curves, spot rates, forward rates, short sales, Macaulay duration, modified duration, convexity, and immunization, financial derivatives, and their use in risk management. Provides preparation for the SOA/CAS Actuarial Exam FM/2. Typically offered Fall Spring.

### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

### **STAT 47201 - Actuarial Models- Life Contingencies**

Credit Hours: 4.00. Mathematical foundation of actuarial science, emphasizing probability models for life contingencies as the basis for analyzing life insurance and life annuities and determining premiums and reserves. This course provides the background for Course MLC of the Society of Actuaries and Course 3L of the Casualty Actuarial Society. Typically offered Fall.

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

### **STAT 47301 - Introduction To Arbitrage-Free Pricing Of Financial Derivatives**

Credit Hours: 3.00. This course exposes students to a number of financial economics concepts related to arbitrage-free option pricing in the binomial market model and the Black-Scholes model. Specific models include: (1) Options and parity relationship between options (2) Option Pricing under the Binomial model (3) Option Pricing under the Black-Scholes model (4) Option hedging and the market maker's overnight profit (5) Black Scholes theory with Brownian motion and Ito calculus (6) Risk-neutral option pricing and Monte Carlo valuation (7) Stochastic interest rates and Stochastic Volatility. This course provides the background for Course MFE of the Society of Actuaries and Course 3F of the Casualty Actuarial Society. Typically offered Fall Spring.

### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

### **STAT 42000 - Introduction To Time Series**

Credit Hours: 3.00. An introduction to time series analysis suitable for actuarial science, engineering, and sciences. Model building and forecasting with ARMA and ARIMA models. Resampling methods for confidence intervals. Multivariate, state-space, and nonlinear models. Volatility models (ARCH and GARCH). Smoothing in time series. Typically offered Fall Spring.

## **MGMT 20000 - Introductory Accounting**

Credit Hours: 3.00. The objectives of the course are to help students: (1) understand what is in financial statements and what the statements say about a business, (2) identify the business activities that caused the amounts that appear in the statements, and (3) understand how, when, and at what amount the effects of manager and employee actions will appear in the statements. Typically offered Fall Spring Summer. CTL:IPO 1801 Accounting I

## **MGMT 20100 - Management Accounting I**

Credit Hours: 3.00. An introduction to management's internal use of accounting information--for decision making, production management, product costing, motivating and evaluating performance, and budgeting. Typically offered Fall Spring Summer. CCN:IPO 1802 Accounting II

## **MGMT 31000 - Financial Management**

Credit Hours: 3.00. Management of the financial affairs of the industrial enterprise. Working capital management, current asset management, capital budgeting, stock and bond valuation, and capital structure decisions. Typically offered Fall Spring Summer.

## **MGMT 30400 - Introduction To Financial Management**

Credit Hours: 3.00. Introductory course providing a foundation in corporate finance and covering topics such as: discounted cash flow valuation, bond valuation, equity valuation, option valuation, factors influencing a firm's cost of capital, and international finance issues. Typically offered Fall Spring.

## **ECON 25100 - Microeconomics**

Credit Hours: 3.00. Microeconomics studies the choices individuals make and the incentives that influence those choices. Emphasis is on the incentives that determine market prices and resource allocation. The role of public policy in influencing incentives and efficiency is also addressed. Typically offered Fall Spring Summer. CTL:ISH 1042 Microeconomics

## **ECON 25200 - Macroeconomics**

Credit Hours: 3.00. Introduction to macroeconomic theory. The course develops a theoretical framework permitting an analysis of the forces affecting national income, employment, interest rates, and the rate of inflation. Emphasis is placed upon the role of government fiscal and monetary policy in promoting economic growth and stable prices. Typically offered Fall Spring Summer. CTL:ISH 1041 Macroeconomics

**Other Departmental/Program Course Requirements (35-60 credits)**

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option \* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option \* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Laboratory Science I Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Computing Option - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience \* - Credit Hours: 0.00 - 4.00
- Great Issues Option - Credit Hours: 3.00

## **Electives (10-36 credits)**

## **University Core Requirements**

LINK

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

- Calculus I Option - Credit Hours: 4.00 - 5.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 2.00:

### **MA 17000 - Introduction To Actuarial Science**

Credit Hours: 2.00. (STAT 17000) An introduction to actuarial science from the point of view of practicing actuaries from life insurance, casualty insurance and consulting; introduction to insurance and the mathematical theory of interest; application of spreadsheets to problems related to actuarial science. Typically offered Fall.

### **STAT 17000 - Introduction To Actuarial Science**

Credit Hours: 2.00. (MA 17000) An introduction to actuarial science from the point of view of practicing actuaries from life

insurance, casualty insurance and consulting; introduction to insurance and the mathematical theory of interest; application of spreadsheets to problems related to actuarial science. Typically offered Fall.

- Free Elective - Credit Hours: 3.00

## 15-18 Credits

### Spring 1st Year

- Calculus II Option - Credit Hours: 4.00 - 5.00

### **MA 37300 - Financial Mathematics**

Credit Hours: 4.00. A mathematical treatment of some fundamental concepts of financial mathematics and financial economics, and their application to real world business situations and basic risk management. Includes discussions of valuing investments, capital budgeting, valuing contingent cash flows, yield curves, spot rates, forward rates, short sales, Macaulay duration, modified duration, convexity, and immunization, financial derivatives, and their use in risk management. Provides preparation for the SOA/CAS Actuarial Exam FM/2. Typically offered Fall Spring.

- Computing Option (rec. CS 17700 & meets Teambuilding and Collaboration Experience) - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Teambuilding Experience - Credit Hours: 0.00
- Free Elective - Credit Hours: 1.00

## 15-18 Credits

### Fall 2nd Year

- Calculus III Selective - Credit Hours: 4.00 - 5.00

### **MGMT 20000 - Introductory Accounting**

Credit Hours: 3.00. The objectives of the course are to help students: (1) understand what is in financial statements and what the statements say about a business, (2) identify the business activities that caused the amounts that appear in the statements, and (3) understand how, when, and at what amount the effects of manager and employee actions will appear in the statements. Typically offered Fall Spring Summer. CTL:IPO 1801 Accounting I

### **ECON 25100 - Microeconomics**

Credit Hours: 3.00. Microeconomics studies the choices individuals make and the incentives that influence those choices. Emphasis is on the incentives that determine market prices and resource allocation. The role of public policy in influencing incentives and efficiency is also addressed. Typically offered Fall Spring Summer. CTL:ISH 1042 Microeconomics

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Language Selective III - Credit Hours: 3.00 - 4.00

16-18 Credits

Spring 2nd Year

## **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

## **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

## **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

## **MGMT 20100 - Management Accounting I**

Credit Hours: 3.00. An introduction to management's internal use of accounting information--for decision making, production

management, product costing, motivating and evaluating performance, and budgeting. Typically offered Fall Spring Summer.  
CCN:IPO 1802 Accounting II

## **ECON 25200 - Macroeconomics**

Credit Hours: 3.00. Introduction to macroeconomic theory. The course develops a theoretical framework permitting an analysis of the forces affecting national income, employment, interest rates, and the rate of inflation. Emphasis is placed upon the role of government fiscal and monetary policy in promoting economic growth and stable prices. Typically offered Fall Spring Summer.  
CTL:ISH 1041 Macroeconomics

- Technical Writing Option and Technical Presenting Option (COM 21700) - Credit Hours: 3.00 - 6.00

17 Credits

Fall 3rd Year

## **STAT 47201 - Actuarial Models- Life Contingencies**

Credit Hours: 4.00. Mathematical foundation of actuarial science, emphasizing probability models for life contingencies as the basis for analyzing life insurance and life annuities and determining premiums and reserves. This course provides the background for Course MLC of the Society of Actuaries and Course 3L of the Casualty Actuarial Society. Typically offered Fall.

## **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

## **MGMT 31000 - Financial Management**

Credit Hours: 3.00. Management of the financial affairs of the industrial enterprise. Working capital management, current asset management, capital budgeting, stock and bond valuation, and capital structure decisions. Typically offered Fall Spring Summer.

## **MGMT 30400 - Introduction To Financial Management**

Credit Hours: 3.00. Introductory course providing a foundation in corporate finance and covering topics such as: discounted cash flow valuation, bond valuation, equity valuation, option valuation, factors influencing a firm's cost of capital, and international finance issues. Typically offered Fall Spring.

- Laboratory Science I Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 2.00

15 Credits

Spring 3rd Year

### **STAT 47301 - Introduction To Arbitrage-Free Pricing Of Financial Derivatives**

Credit Hours: 3.00. This course exposes students to a number of financial economics concepts related to arbitrage-free option pricing in the binomial market model and the Black-Scholes model. Specific models include: (1) Options and parity relationship between options (2) Option Pricing under the Binomial model (3) Option Pricing under the Black-Scholes model (4) Option hedging and the market maker's overnight profit (5) Black Scholes theory with Brownian motion and Ito calculus (6) Risk-neutral option pricing and Monte Carlo valuation (7) Stochastic interest rates and Stochastic Volatility. This course provides the background for Course MFE of the Society of Actuaries and Course 3F of the Casualty Actuarial Society. Typically offered Fall Spring.

- Laboratory Science II Option - Credit Hours: 3.00 - 4.00
- General Education I Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

15 Credits

Fall 4th Year

### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

- Free Elective - Credit Hours: 3.00 or

## **MGMT 41100 - Investment Management**

Credit Hours: 3.00. Examination of investment alternatives relevant to the individual and/or family-unit investor. Operations of the markets in which securities are traded. Theory and application of security valuation, portfolio construction, capital markets, and performance evaluation. Particular attention given to fixed income securities, common stocks, options, investment companies, and other popular investment alternatives. Typically offered Fall Spring.

- Free Elective/Science, Technology & Society Selective Course - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

16 Credits

Spring 4th Year

## **STAT 42000 - Introduction To Time Series**

Credit Hours: 3.00. An introduction to time series analysis suitable for actuarial science, engineering, and sciences. Model building and forecasting with ARMA and ARIMA models. Resampling methods for confidence intervals. Multivariate, state-space, and nonlinear models. Volatility models (ARCH and GARCH). Smoothing in time series. Typically offered Fall Spring.

- Great Issue Option - Credit Hours: 3.00
- General Education II Option - Credit Hours: 3.00

## **STAT 47900 - Loss Models**

Credit Hours: 3.00. This material provides an introduction to modeling and covers important actuarial methods that are useful in modeling. Students will be introduced to survival, severity, frequency and aggregate models, and use statistical methods to estimate parameters of such models given sample data. The student will further learn to identify steps in the modeling process, understand the underlying assumptions implicit in each family of models, recognize which assumptions are applicable in a given business application, and appropriately adjust the models for impact of insurance coverage modifications. The student will be introduced to a variety of tools for the calibration and evaluation of the models. Permission of instructor required. Typically offered Spring.

## **STAT 49000 - Topics In Statistics For Undergraduates**

Credit Hours: 1.00 to 5.00. Supervised reading course or special topics course at the senior level for undergraduates are given under this number. Permission of instructor required. Typically offered Fall Spring Summer.

14 Credits

## Note

Students must earn a 2.5 average GPA among required MA/STAT/MGMT/ECON courses excluding Calculus I, II, and III.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Applied Mathematics, BS

## About the Program

Math students enjoy a great deal of personal attention. Most math classes for math majors are 40 students or less, and many upper-level classes have fewer than 25 students. In addition, the math curriculum is flexible enough that students can take classes in other interest areas or pursue double major or a minor without too much difficulty. Math specializations include:

- Applied mathematics
- Business mathematics
- Mathematics
- Mathematics teaching
- Mathematics with computer sciences option
- Mathematics with statistics option
- Operations research

Important note: When applying for any specialization within Mathematics, select "Mathematics" as your major. You will have the opportunity to specialize as you progress through the curriculum.

Mathematics Website

## **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Applied Mathematics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

MATH-BS  
Code-APMA  
120 Credits

## **Departmental/Program Major Courses (73-102 credits)**

### **Required Major Courses (43-46 credits)**

Average GPA in courses must be 2.00 excluding Calculus I, II, and III

#### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

#### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

#### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

#### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

#### **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

### **CS 31400 - Numerical Methods**

Credit Hours: 3.00. Iterative methods for solving nonlinear equations; direct and iterative methods for solving linear systems; approximations of functions, derivatives, and integrals; error analysis. Typically offered Spring.

### **MA 51400 - Numerical Analysis**

Credit Hours: 3.00. (CS 51400) Iterative methods for solving nonlinear; linear difference equations, applications to solution of polynomial equations; differentiation and integration formulas; numerical solution of ordinary differential equations; roundoff error bounds. Typically offered Fall Spring.

### **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

### **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

### **MA 30300 - Differential Equations and Partial Differential Equations for Engineering and the Sciences**

Credit Hours: 3.00. This is a methods course for juniors in any branch of engineering and science, designed to follow MA 26200. Basic techniques for solving systems of linear ordinary differential equations. Series solutions for second order equations, including Bessel functions, Laplace transform, Fourier series, numerical methods, separation of variables for partial differential equations and Sturm-Liouville theory. Not open to students with credit in MA 30400. Typically offered Fall Spring Summer.

### **MA 30400 - Differential Equations And Analysis Of Nonlinear Systems For Engineering And The Sciences**

Credit Hours: 3.00. This is a differential equations course designed to follow MA 26500-MA 26600. Same description as MA 30300 except that material on the qualitative behavior of solutions to nonlinear systems is substituted for material on Laplace transforms. Not open to students with credit in MA 30300. Typically offered Summer Fall Spring.

### Calculus I Selective - Select from (4-5 credits)

(satisfies Quantitative Reasoning for core)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602 Calculus - Long I

### Calculus II Selective - Select from (4-5 credits)

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

### Calculus III Selective - Select from (4-5 credits)

(satisfies Quantitative Reasoning for core)

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

### **Advanced Calculus Selective (3 credits)**

### **MA 36200 - Topics In Vector Calculus**

Credit Hours: 3.00. Multivariate calculus; partial differentiation; implicit function theorems and transformations; line and surface integrals; vector fields; theorems of Gauss, Green, and Stokes. Credit granted for only one of MA 36200 and MA 51000. Typically offered Fall Spring.

### **MA 44200 - Multivariate Analysis I Honors**

Credit Hours: 3.00. Topics covered may include a unified modern treatment of functions of several variables. Topics covered include the topology of Euclidean spaces, mappings of Euclidean spaces, exterior algebra, Lebesgue integration, and integration on manifolds. Typically offered Spring.

### **Applied Math Selective (3 credits)**

### **MA 42500 - Elements Of Complex Analysis**

Credit Hours: 3.00. Complex numbers and complex-valued functions; differentiation of complex functions; power series, uniform convergence; integration, contour integrals; elementary conformal mapping. Typically offered Spring.

### **MA 42800 - Introduction To Fourier Analysis**

Credit Hours: 3.00. Topics include: Fourier series, convolutions, kernels, summation methods, Fourier transforms, applications to the wave, heat, and Laplace equations. Prerequisites: Vector calculus and linear algebra. Typically offered Fall Spring.

### **MA 52300 - Introduction To Partial Differential Equations**

Credit Hours: 3.00. First order quasi-linear equations and their applications to physical and social sciences; the Cauchy-Kovalevsky theorem; characteristics, classification and canonical forms of linear equations; equations of mathematical physics; study of Laplace, wave and heat equations; methods of solution. Typically offered Fall Spring Summer.

### **Math/Statistics Selective (3 credits)**

#### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

#### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

#### **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

#### **MA 37500 - Introduction To Discrete Mathematics**

Credit Hours: 3.00. Induction, permutations, combinations, finite probability, relations, graphs, trees, graph algorithms, recurrence relations, generating functions. Problem solving in all these areas. Credit granted for only one of MA 27600 and 37500. Typically offered Fall Spring.

## **MA 42100 - Linear Programming And Optimization Techniques**

Credit Hours: 3.00. Solution of linear programming problems by the simplex method, duality theory, transportation problems, assignment problems, network analysis, dynamic programming. Typically offered Fall Spring.

## **MA 42500 - Elements Of Complex Analysis**

Credit Hours: 3.00. Complex numbers and complex-valued functions; differentiation of complex functions; power series, uniform convergence; integration, contour integrals; elementary conformal mapping. Typically offered Spring.

## **MA 42800 - Introduction To Fourier Analysis**

Credit Hours: 3.00. Topics include: Fourier series, convolutions, kernels, summation methods, Fourier transforms, applications to the wave, heat, and Laplace equations. Prerequisites: Vector calculus and linear algebra. Typically offered Fall Spring.

## **Other Departmental/Program Course Requirements (35-62 credits)**

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Laboratory Science I Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00

- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Computing Option - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience\* - Credit Hours: 0.00 - 4.00
- Multidisciplinary Experience (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00
- Great Issues Option - Credit Hours: 3.00

## **Electives (18-47 credits)**

## **University Core Requirements**

LINK

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## **Program Requirements**

### **Fall 1st Year**

- Calculus I Option - Credit Hours: 4.00 - 5.00 ♦

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00

### **MA 10800 - Mathematics As A Profession And A Discipline**

Credit Hours: 1.00. A "walking tour" of a few topics in mathematics, conducted by a series of guest lecturers. Some talks focus on interesting areas of mathematics, such as chaos theory, fractals, or the mathematics of sending pictures over the Internet. Others focus on where people with degrees in mathematics or statistics work and what they do. This class is open to anyone with an interest in mathematics, regardless of major. Typically offered Fall.

- Free Elective - Credit Hours: 3.00 - 4.00

## 15-17 Credits

### Spring 1st Year

- Calculus II Option - Credit Hours: 4.00 - 5.00
- Computing Option (rec. CS 17700 & meets Teambuilding and Collaboration Experiences) - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

## 15-18 Credits

### Fall 2nd Year

- Calculus III Option - Credit Hours: 4.00 - 5.00
- Laboratory Science I Option - Credit Hours: 3.00 - 4.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00

### **MA 30100 - An Introduction To Proof Through Real Analysis**

Credit Hours: 3.00. An introduction to abstract reasoning in the context of real analysis. Topics may include axioms for the real

numbers, mathematical induction, formal definition of limits, density, decimal representations, convergence of sequences and series, continuity, differentiability, the extreme value, mean value and intermediate value theorems, and cardinality. The emphasis, however, is more on the concept of proof than on any one given topic. Typically offered Fall Spring.

- Free Elective - Credit Hours: 2.00

15-18 Credits

Spring 2nd Year

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Laboratory Science II Option - Credit Hours: 3.00 - 4.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Free Elective - Credit Hours: 0.00 - 3.00

15-16 Credits

Fall 3rd Year

### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

- General Education I Option - Credit Hours: 3.00
- Free Elective/Science, Technology & Society Selective Course - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

15 Credits

Spring 3rd Year

### **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

- Advance Calculus Selective - Credit Hours: 3.00

### **CS 31400 - Numerical Methods**

Credit Hours: 3.00. Iterative methods for solving nonlinear equations; direct and iterative methods for solving linear systems; approximations of functions, derivatives, and integrals; error analysis. Typically offered Spring.

### **MA 51400 - Numerical Analysis**

Credit Hours: 3.00. (CS 51400) Iterative methods for solving nonlinear; linear difference equations, applications to solution of

polynomial equations; differentiation and integration formulas; numerical solution of ordinary differential equations; roundoff error bounds. Typically offered Fall Spring.

- General Education II Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15 Credits

Fall 4th Year

### **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

### **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

### **MA 30300 - Differential Equations and Partial Differential Equations for Engineering and the Sciences**

Credit Hours: 3.00. This is a methods course for juniors in any branch of engineering and science, designed to follow MA 26200. Basic techniques for solving systems of linear ordinary differential equations. Series solutions for second order equations, including Bessel functions, Laplace transform, Fourier series, numerical methods, separation of variables for partial differential equations and Sturm-Liouville theory. Not open to students with credit in MA 30400. Typically offered Fall Spring Summer.

### **MA 30400 - Differential Equations And Analysis Of Nonlinear Systems For Engineering And The Sciences**

Credit Hours: 3.00. This is a differential equations course designed to follow MA 26500-MA 26600. Same description as MA 30300 except that material on the qualitative behavior of solutions to nonlinear systems is substituted for material on Laplace transforms. Not open to students with credit in MA 30300. Typically offered Summer Fall Spring.

- Multidisciplinary Experience - Credit Hours: 0.00 - 3.00
- General Education III Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00 - 6.00

## 15-18 Credits

### Spring 4th Year

- Applied Math Selective - Credit Hours: 3.00
- Math/Statistics Elective - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## 15 Credits

### Note

Student should earn minimum of a B- see advisor for further details.

Students must earn a 2.0 average in MATH/STAT/CS courses required for major.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## **Mathematics Education, BS**

# About the Program

Math students enjoy a great deal of personal attention. Most math classes for math majors have 40 or fewer students, and many upper-level classes have fewer than 25 students. In addition, the math curriculum is flexible enough that students can take classes in other interest areas or pursue a double major or a minor without too much difficulty. Math specializations include:

- Applied mathematics
- Business mathematics
- Mathematics
- Mathematics teaching
- Mathematics with computer science option
- Mathematics with statistics option
- Operations research

Important note: When applying for any specialization within Mathematics, select "Mathematics" as your major. You will have the opportunity to specialize as you progress through the curriculum.

Mathematics Website

## Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Mathematics Education include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

MATH-BS  
Code-MAED  
120 Credits

## Departmental/Program Major Courses (98-115 credits)

### Required Major Courses (44-47 credits)

Average GPA in courses below [higher of grade between STAT 35000 and MA Selective is used] must be 2.50

#### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

#### **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations,

basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

### **MA 46000 - Geometry**

Credit Hours: 3.00. This is a course in Euclidean geometry. It begins at the high-school level and then moves quickly to intermediate and advanced topics. Emphasis on proofs. Typically offered Fall Spring.

### **MA 37500 - Introduction To Discrete Mathematics**

Credit Hours: 3.00. Induction, permutations, combinations, finite probability, relations, graphs, trees, graph algorithms, recurrence relations, generating functions. Problem solving in all these areas. Credit granted for only one of MA 27600 and 37500. Typically offered Fall Spring.

### **STAT 31100 - Introductory Probability**

Credit Hours: 3.00. Formulation of probability problems, discrete and continuous random variables, expectation, standard distributions, applications to statistical problems, and problems in the physical sciences. Credit cannot be given for more than one of STAT 22500, 31100, or STAT 41600. Prerequisite: two semesters of college calculus. Typically offered Spring.

### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

### **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample

spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

### **MA 30100 - An Introduction To Proof Through Real Analysis**

Credit Hours: 3.00. An introduction to abstract reasoning in the context of real analysis. Topics may include axioms for the real numbers, mathematical induction, formal definition of limits, density, decimal representations, convergence of sequences and series, continuity, differentiability, the extreme value, mean value and intermediate value theorems, and cardinality. The emphasis, however, is more on the concept of proof than on any one given topic. Typically offered Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

### **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

### **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

Calculus I Option - Select from (4-5 credits)

(satisfies Quantitative Reasoning for core)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602 Calculus - Long I

### **Calculus II Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

### **Calculus III Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals.

Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

### **MA Selective (3 credits)**

MA Elective must be 300 level or higher (CANNOT be MA 37300, MA 30300, MA 30400). Approved courses can be found at LINK or MA 34100/MA 44000, MA 35300, MA 36200/MA 44200, MA 48400 (you must apply and be accepted for MA 48400 - see advisor for more details)

### **Educational Program Course Requirements (33 credits)**

Average GPA in courses must be 3.00 - no grade lower than C-

### **EDCI 27000 - Introduction To Educational Technology And Computing**

Credit Hours: 3.00. Addresses fundamentals of educational technology, including the integration of instructional design, media, computers and related technologies within the classroom setting. Typically offered Fall Spring Summer.

### **EDCI 20500 - Exploring Teaching As A Career**

Credit Hours: 3.00. Students will become familiar with the work of teachers and begin to develop their educational philosophies through examining what it means to teach and to learn and the nature and purpose of schools. Students will critically evaluate teaching as their chosen profession. This course includes a required weekly field-based experience in an elementary, middle, or high school classroom. Typically offered Fall Spring.

### **EDCI 28500 - Multiculturalism And Education**

Credit Hours: 3.00. This course integrates an understanding of multiculturalism with principles of democratic education. Historical, sociological, cultural, political, philosophical, and pedagogical foundations of multiculturalism are explored and related to issues of pedagogy in a pluralistic society. This course is taken concurrently with EDCI 20500, which includes a school-based Theory into Practice field experience. Some discussion topics and assignments will be based on that field experience. It is highly recommended that EDCI 27000 be taken with or before taking this course. Typically offered Fall Spring Summer.

### **EDPS 23500 - Learning And Motivation**

Credit Hours: 3.00. Introduction to concepts of learning and motivation in educational contexts (i.e., Educational Psychology). Influence of development, culture, and individual differences on learning and motivation. Uses of assessment and technology in promoting learning and motivation. A field-based experiential component is included. Typically offered Fall Spring Summer.

### **EDPS 26500 - The Inclusive Classroom**

Credit Hours: 3.00. Characteristics of students with special needs/talents; strategies for helping students learn and develop in general educational settings. Emphasis placed upon research evidence, case studies, problem-based learning, and development of a plan for an inclusive classroom. A field-based component is included. Typically offered Spring Summer Fall.

### **EDST 20010 - Educational Policies And Laws**

Credit Hours: 1.00 to 3.00. The interactive course will provide an understanding of the history of schooling in the United States. A special emphasis will be placed on reviewing historical and contemporary educational policies and educational laws as each subject is critical to understanding social, historical, and cultural issues in the United States. Focus will also be on contemporary applications of historical ideas in the classroom and in school systems. Typically offered Fall Spring.

### **EDPS 32700 - Assessment Literacy**

Credit Hours: 1.00 to 3.00. Evaluating the impact of instruction on student performance is one of the most important skills for an educator. Effective teachers ask themselves, "How do I know if students are truly learning? Are they meeting educational objectives in the content area?" Using well-chosen assessment approaches, teachers can address these questions. In this course, students will acquire assessment literacy: the ability to gather accurate information about student achievement, and use that information to make instructional decisions that will improve learning. Course activities will focus on assessment tasks relevant to P- 12 classroom settings. Typically offered Fall Spring.

### **EDCI 42500 - Teaching Of Mathematics In Secondary Schools**

Credit Hours: 2.00 or 3.00. This course is designed for students who are planning to be secondary mathematics teachers in the twenty-first century. The course content is organized around tools and tasks for teaching secondary mathematics content, theories of teaching and learning mathematics, and organizing for classroom instruction. Must have completed at least 18 credit hours of Mathematics previous to this course. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Fall Spring.

### **EDCI 42600 - Teaching Mathematics In The Middle And Junior High School**

Credit Hours: 2.00. Designed to prepare the prospective teacher to plan, present, and evaluate mathematics lessons, determine goals, manage instruction, and use a variety of instructional strategies. Must have completed at least 18 credit hours in Mathematics previous to this course. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Fall Spring.

## **EDCI 49800 - Supervised Teaching**

Credit Hours: 8.00 to 16.00. Teaching full time in a school classroom under the supervision of the teacher in charge of the class and a University supervisor. Completion of education methods courses and other Gate requirements for the major area and admittance to teacher education required. Typically offered Fall Spring Summer.

## **Other Departmental/Program Course Requirements (21-35 credits)**

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communications for core) - Credit Hours: 3.00 - 6.00
- Laboratory Science I Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information

## **Electives (5-22 credits)**

## **University Core Requirements**

LINK

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy

- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

- Calculus I Option - Credit Hours: 4.00 - 5.00 ♦

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00

### **MA 10800 - Mathematics As A Profession And A Discipline**

Credit Hours: 1.00. A "walking tour" of a few topics in mathematics, conducted by a series of guest lecturers. Some talks focus on interesting areas of mathematics, such as chaos theory, fractals, or the mathematics of sending pictures over the Internet. Others focus on where people with degrees in mathematics or statistics work and what they do. This class is open to anyone with an interest in mathematics, regardless of major. Typically offered Fall.

### **EDCI 20500 - Exploring Teaching As A Career**

Credit Hours: 3.00. Students will become familiar with the work of teachers and begin to develop their educational philosophies through examining what it means to teach and to learn and the nature and purpose of schools. Students will critically evaluate teaching as their chosen profession. This course includes a required weekly field-based experience in an elementary, middle, or high school classroom. Typically offered Fall Spring.

- Free Elective - Credit Hours: 1.00

## 15-18 Credits

### Spring 1st Year

- Calculus II Option - Credit Hours: 4.00 - 5.00

### **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 1.00

### **EDCI 28500 - Multiculturalism And Education**

Credit Hours: 3.00. This course integrates an understanding of multiculturalism with principles of democratic education. Historical, sociological, cultural, political, philosophical, and pedagogical foundations of multiculturalism are explored and related to issues of pedagogy in a pluralistic society. This course is taken concurrently with EDCI 20500, which includes a school-based Theory into Practice field experience. Some discussion topics and assignments will be based on that field experience. It is highly recommended that EDCI 27000 be taken with or before taking this course. Typically offered Fall Spring Summer.

## 15-17 Credits

### Fall 2nd Year

- Calculus III Option - Credit Hours: 4.00 - 5.00

### **MA 46000 - Geometry**

Credit Hours: 3.00. This is a course in Euclidean geometry. It begins at the high-school level and then moves quickly to intermediate and advanced topics. Emphasis on proofs. Typically offered Fall Spring.

- Laboratory Science I Option - Credit Hours: 3.00 - 4.00

### **EDCI 27000 - Introduction To Educational Technology And Computing**

Credit Hours: 3.00. Addresses fundamentals of educational technology, including the integration of instructional design, media, computers and related technologies within the classroom setting. Typically offered Fall Spring Summer.

- Free Elective - Credit Hours: 3.00

16-18 Credits

Spring 2nd Year

### **MA 37500 - Introduction To Discrete Mathematics**

Credit Hours: 3.00. Induction, permutations, combinations, finite probability, relations, graphs, trees, graph algorithms, recurrence relations, generating functions. Problem solving in all these areas. Credit granted for only one of MA 27600 and 37500. Typically offered Fall Spring.

### **STAT 31100 - Introductory Probability**

Credit Hours: 3.00. Formulation of probability problems, discrete and continuous random variables, expectation, standard distributions, applications to statistical problems, and problems in the physical sciences. Credit cannot be given for more than one of STAT 22500, 31100, or STAT 41600. Prerequisite: two semesters of college calculus. Typically offered Spring.

### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

### **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

- Laboratory Science II Option - Credit Hours: 3.00 - 4.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Free Elective - Credit Hours: 0.00 - 3.00

15-16 Credits

Fall 3rd Year

### **MA 30100 - An Introduction To Proof Through Real Analysis**

Credit Hours: 3.00. An introduction to abstract reasoning in the context of real analysis. Topics may include axioms for the real numbers, mathematical induction, formal definition of limits, density, decimal representations, convergence of sequences and series, continuity, differentiability, the extreme value, mean value and intermediate value theorems, and cardinality. The emphasis, however, is more on the concept of proof than on any one given topic. Typically offered Fall Spring.

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **EDPS 23500 - Learning And Motivation**

Credit Hours: 3.00. Introduction to concepts of learning and motivation in educational contexts (i.e., Educational Psychology). Influence of development, culture, and individual differences on learning and motivation. Uses of assessment and technology in promoting learning and motivation. A field-based experiential component is included. Typically offered Fall Spring Summer.

### **EDPS 26500 - The Inclusive Classroom**

Credit Hours: 3.00. Characteristics of students with special needs/talents; strategies for helping students learn and develop in general educational settings. Emphasis placed upon research evidence, case studies, problem-based learning, and development of a plan for an inclusive classroom. A field-based component is included. Typically offered Spring Summer Fall.

## **EDST 20010 - Educational Policies And Laws**

Credit Hours: 1.00 to 3.00. The interactive course will provide an understanding of the history of schooling in the United States. A special emphasis will be placed on reviewing historical and contemporary educational policies and educational laws as each subject is critical to understanding social, historical, and cultural issues in the United States. Focus will also be on contemporary applications of historical ideas in the classroom and in school systems. Typically offered Fall Spring.

- Free Elective - Credit Hours: 3.00

16 Credits

Spring 3rd Year

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

## **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

- Great Issues Option - Credit Hours: 3.00

## **EDPS 32700 - Assessment Literacy**

Credit Hours: 1.00 to 3.00. Evaluating the impact of instruction on student performance is one of the most important skills for an educator. Effective teachers ask themselves, "How do I know if students are truly learning? Are they meeting educational objectives in the content area?" Using well-chosen assessment approaches, teachers can address these questions. In this course, students will acquire assessment literacy: the ability to gather accurate information about student achievement, and use that

information to make instructional decisions that will improve learning. Course activities will focus on assessment tasks relevant to P- 12 classroom settings. Typically offered Fall Spring.

- EDPS 32700 - Assessment Literacy (1 cr) and
- EDPS 49100 - Topics And Issues In Education (1 cr) - Recommended
- General Education I Option - Credit Hours: 3.00

15 Credits

Fall 4th Year

### **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

### **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

- MA Selective - Credit Hours: 3.00
- General Education II Option - Credit Hours: 3.00

### **EDCI 42500 - Teaching Of Mathematics In Secondary Schools**

Credit Hours: 2.00 or 3.00. This course is designed for students who are planning to be secondary mathematics teachers in the twenty-first century. The course content is organized around tools and tasks for teaching secondary mathematics content, theories of teaching and learning mathematics, and organizing for classroom instruction. Must have completed at least 18 credit hours of Mathematics previous to this course. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Fall Spring.

- Free Elective (Science, Technology & Society Selective Course) - Credit Hours: 3.00

15 Credits

Spring 4th Year

### **EDCI 42600 - Teaching Mathematics In The Middle And Junior High School**

Credit Hours: 2.00. Designed to prepare the prospective teacher to plan, present, and evaluate mathematics lessons, determine goals, manage instruction, and use a variety of instructional strategies. Must have completed at least 18 credit hours in Mathematics previous to this course. No undergraduate students may be enrolled in any of these undergraduate courses until they have been admitted to teacher education. Typically offered Fall Spring.

## **EDCI 49800 - Supervised Teaching**

Credit Hours: 8.00 to 16.00. Teaching full time in a school classroom under the supervision of the teacher in charge of the class and a University supervisor. Completion of education methods courses and other Gate requirements for the major area and admittance to teacher education required. Typically offered Fall Spring Summer.

- Free Elective - Credit Hours: 1.00

## 13 Credits

## Note

Student should earn minimum of a B- see advisor for further details.

Students must earn a 2.5 average in MATH/STAT/CS courses required for major.

120 semester credits required for Bachelor of Science degree.

2.5 Graduation GPA required for Bachelor of Science degree.

\*For Licensing - Students must pass GATE C

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

# Mathematics Honors, BS

## About the Program

Math students enjoy a great deal of personal attention. Most math classes for math majors have 40 or fewer students, and many upper-level classes have fewer than 25 students. In addition, the math curriculum is flexible enough that students can take classes in other interest areas or pursue a double major or a minor without too much difficulty. Math specializations include:

- Applied mathematics
- Business mathematics
- Mathematics
- Mathematics teaching
- Mathematics with computer science option
- Mathematics with statistics option
- Operations research

Important note: When applying for any specialization within Mathematics, select "Mathematics" as your major. You will have the opportunity to specialize as you progress through the curriculum.

Mathematics Website

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Core Mathematics Honors include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

MATH-BS

Code-MAHO

120 Credits

### Departmental/Program Major Courses (70-99 credits)

#### Required Major Courses (40-43 credits)

Average GPA in courses must be 3.50 or higher excluding Calculus I, II and III. Average GPA in MA 44000, MA 44200, and MA 45000 must be 3.50 or higher.

#### MA 35100 - Elementary Linear Algebra

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

## **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

## **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

## **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

## **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

## **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

- MA Selective - LINK (if student takes MA 34100, he or she must take MA 44000 for this MA Selective) - Credit Hours: 3.00
- MA Selective - LINK (if student takes MA 36200 or MA 51000, he or she must take MA 44200 for this MA Selective) - Credit Hours: 3.00
- MA Selective - LINK - Credit Hours: 3.00

## **Calculus I Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **Calculus II Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

### **Calculus III Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100. Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

## Advanced Calculus Selective (3 credits)

### **MA 36200 - Topics In Vector Calculus**

Credit Hours: 3.00. Multivariate calculus; partial differentiation; implicit function theorems and transformations; line and surface integrals; vector fields; theorems of Gauss, Green, and Stokes. Credit granted for only one of MA 36200 and MA 51000. Typically offered Fall Spring.

### **MA 44200 - Multivariate Analysis I Honors**

Credit Hours: 3.00. Topics covered may include a unified modern treatment of functions of several variables. Topics covered include the topology of Euclidean spaces, mappings of Euclidean spaces, exterior algebra, Lebesgue integration, and integration on manifolds. Typically offered Spring.

## Other Departmental/Program Course Requirements (30-56 credits)

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00 \*
- Language II Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00 \*
- Language III/Culture/Diversity Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00 \*
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Laboratory Science I Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00

- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Computing Options - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience - Credit Hours: 0.00 - 4.00 \*
- Great Issues Option - Credit Hours: 3.00
- Multidisciplinary Experience (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00 \*

## **Electives (21-50 credits)**

### **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society
- Written Communication
- Oral Communication
- Quantitative Reasoning

### **Program Requirements**

#### **Fall 1st Year**

- Calculus I Option - Credit Hours: 4.00 - 5.00 ♦

#### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00

### **MA 10800 - Mathematics As A Profession And A Discipline**

Credit Hours: 1.00. A "walking tour" of a few topics in mathematics, conducted by a series of guest lecturers. Some talks focus on interesting areas of mathematics, such as chaos theory, fractals, or the mathematics of sending pictures over the Internet. Others focus on where people with degrees in mathematics or statistics work and what they do. This class is open to anyone with an interest in mathematics, regardless of major. Typically offered Fall.

- Free Elective - Credit Hours: 4.00

## 15-18 Credits

### Spring 1st Year

- Calculus II Option - Credit Hours: 4.00 - 5.00
- Computing Option (CS 17700 Meets Teambuilding and Collaboration Experience) - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 2.00
- Free Elective - Credit Hours: 3.00

## 15-18 Credits

### Fall 2nd Year

- Calculus III Option - Credit Hours: 4.00 - 5.00
- Laboratory Science I Option - Credit Hours: 3.00 - 4.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00

### **MA 30100 - An Introduction To Proof Through Real Analysis**

Credit Hours: 3.00. An introduction to abstract reasoning in the context of real analysis. Topics may include axioms for the real

numbers, mathematical induction, formal definition of limits, density, decimal representations, convergence of sequences and series, continuity, differentiability, the extreme value, mean value and intermediate value theorems, and cardinality. The emphasis, however, is more on the concept of proof than on any one given topic. Typically offered Fall Spring.

- Free Elective - Credit Hours: 2.00

15-18 Credits

Spring 2nd Year

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Laboratory Science II Option - Credit Hours: 3.00 - 4.00

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Free Elective - Credit Hours: 0.00 - 3.00

15-16 Credits

Fall 3rd Year

### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

- General Education I Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

15 Credits

Spring 3rd Year

### **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

- Advance Calculus Selective - Credit Hours: 3.00
- General Education II Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15 Credits

Fall 4th Year

### **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

## **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

- Multidisciplinary Experience - Credit Hours: 0.00 - 4.00
- General Education III Option - Credit Hours: 3.00
- Free Elective (Science, Technology & Society Selective Course) - Credit Hours: 3.00 - 6.00

15-18 Credits

Spring 4th Year

## **MA 44200 - Multivariate Analysis I Honors**

Credit Hours: 3.00. Topics covered may include a unified modern treatment of functions of several variables. Topics covered include the topology of Euclidean spaces, mappings of Euclidean spaces, exterior algebra, Lebesgue integration, and integration on manifolds. Typically offered Spring.

- Math Selective - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15 Credits

## **Note**

Student should earn minimum of a B- see advisor for further details.

Average GPA in courses must be 3.50 or higher excluding Calculus III Option AND Average GPA in MA 44000, MA 44200, and MA 45000 must be 3.50 or higher.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## **Degree Requirements**

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Mathematics, BS

# About the Program

Math students enjoy a great deal of personal attention. Most math classes for math majors have 40 or fewer students, and many upper-level classes have fewer than 25 students. In addition, the math curriculum is flexible enough that students can take classes in other interest areas or pursue a double major or a minor without too much difficulty. Math specializations include:

- Applied mathematics
- Business mathematics
- Mathematics
- Mathematics teaching
- Mathematics with computer science option
- Mathematics with statistics option
- Operations research

Important note: When applying for any specialization within Mathematics, select "Mathematics" as your major. You will have the opportunity to specialize as you progress through the curriculum.

Mathematics Website

### **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Core Mathematics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

MATH-BS  
Code-MATH  
120 Credits

## Departmental/Program Major Courses (70-99 credits)

### Required Major Courses (40-43 credits)

Average GPA in courses must be 2.00 excluding Calculus I, II and III.

#### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

#### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

#### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

#### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

#### **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

#### **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

## **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

- MA Selective - LINK - Credit Hours: 3.00
- MA Selective - LINK - Credit Hours: 3.00
- MA Selective - LINK - Credit Hours: 3.00

## **Calculus I Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## **Calculus II Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.  
CTL:IMA 1603 Calculus - Long II

## Calculus III Option - Select from (4-5 credits)

(satisfies Quantitative Reasoning for core)

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

## Advanced Calculus Selective

### **MA 36200 - Topics In Vector Calculus**

Credit Hours: 3.00. Multivariate calculus; partial differentiation; implicit function theorems and transformations; line and surface integrals; vector fields; theorems of Gauss, Green, and Stokes. Credit granted for only one of MA 36200 and MA 51000. Typically offered Fall Spring.

### **MA 44200 - Multivariate Analysis I Honors**

Credit Hours: 3.00. Topics covered may include a unified modern treatment of functions of several variables. Topics covered include the topology of Euclidean spaces, mappings of Euclidean spaces, exterior algebra, Lebesgue integration, and integration on manifolds. Typically offered Spring.

## Other Departmental/Program Course Requirements (30-56 credits)

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00 \*
- Language II Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00 \*
- Language III/Culture/Diversity Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00 \*
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Laboratory Science I Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Computing Option - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience - Credit Hours: 0.00 - 4.00 \*
- Great Issues Option - Credit Hours: 3.00
- Multidisciplinary Experience (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00 \*

## **Electives (21-50 credits)**

### **University Core Requirements**

- Human Cultures Humanities

- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

- Calculus I Option - Credit Hours: 4.00 - 5.00 ♦

#### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

#### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00

#### **MA 10800 - Mathematics As A Profession And A Discipline**

Credit Hours: 1.00. A "walking tour" of a few topics in mathematics, conducted by a series of guest lecturers. Some talks focus on interesting areas of mathematics, such as chaos theory, fractals, or the mathematics of sending pictures over the Internet. Others focus on where people with degrees in mathematics or statistics work and what they do. This class is open to anyone with an interest in mathematics, regardless of major. Typically offered Fall.

- Free Elective - Credit Hours: 3.00 - 4.00

### 15-17 Credits

### Spring 1st Year

- Calculus II Option - Credit Hours: 4.00 - 5.00

- Computing Option (rec. CS 17700 & meets Teambuilding and Collaboration Experience) - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 2.00
- Free Elective - Credit Hours: 3.00

## 15-18 Credits

### Fall 2nd Year

- Calculus III Option - Credit Hours: 4.00 - 5.00
- Laboratory Science I Option - Credit Hours: 3.00 - 4.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00

### **MA 30100 - An Introduction To Proof Through Real Analysis**

Credit Hours: 3.00. An introduction to abstract reasoning in the context of real analysis. Topics may include axioms for the real numbers, mathematical induction, formal definition of limits, density, decimal representations, convergence of sequences and series, continuity, differentiability, the extreme value, mean value and intermediate value theorems, and cardinality. The emphasis, however, is more on the concept of proof than on any one given topic. Typically offered Fall Spring.

- Free Elective - Credit Hours: 2.00

## 15-18 Credits

### Spring 2nd Year

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Laboratory Science II Option - Credit Hours: 3.00 - 4.00

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Free Elective - Credit Hours: 0.00 - 3.00

15-16 Credits

Fall 3rd Year

## **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

## **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

## **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

- General Education I Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

15 Credits

Spring 3rd Year

## **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

- Advanced Calculus Selective - Credit Hours: 3.00
- General Education II Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## 15 Credits

### Fall 4th Year

#### **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

#### **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

- MA Selective - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 3.00
- General Education III Option - Credit Hours: 3.00
- Free Elective (Science, Technology & Society Selective Course) - Credit Hours: 3.00 - 6.00

## 15-18 Credits

### Spring 4th Year

- Math Selective - Credit Hours: 3.00
- Math Selective - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## 15 Credits

## Note

Student should earn minimum of a B- see advisor for further details.

Students must earn a 2.0 average in MATH/STAT/CS courses required for major (excluding Calculus I, II, III)

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Mathematics-Computer Science, BS

## About the Program

Math students enjoy a great deal of personal attention. Most math classes for math majors have 40 or fewer students, and many upper-level classes have fewer than 25 students. In addition, the math curriculum is flexible enough that students can take classes in other interest areas or pursue a double major or a minor without too much difficulty. Math specializations include:

- Applied mathematics
- Business mathematics
- Mathematics
- Mathematics teaching
- Mathematics with computer science option
- Mathematics with statistics option
- Operations research

Important note: When applying for any specialization within Mathematics, select "Mathematics" as your major. You will have the opportunity to specialize as you progress through the curriculum.

Mathematics Website

### **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Mathematics with Computer Science include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

MATH-BS  
Code-MACS  
120 Credits

## **Departmental/Program Major Courses (73-102 credits)**

### **Required Major Courses (43-46 credits)**

Average GPA in courses must be 2.00 excluding Calculus I, II, and III

#### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

#### **MA 37500 - Introduction To Discrete Mathematics**

Credit Hours: 3.00. Induction, permutations, combinations, finite probability, relations, graphs, trees, graph algorithms, recurrence relations, generating functions. Problem solving in all these areas. Credit granted for only one of MA 27600 and 37500. Typically offered Fall Spring.

#### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

#### **CS 24000 - Programming In C**

Credit Hours: 3.00. The UNIX environment, C development cycle, data representation, operators, program structure, recursion,

macros, C preprocessor, pointers and addresses, dynamic memory allocation, structures, unions, typedef, bit-fields, pointer/structure applications, UNIX file abstraction, file access, low-level I/O, concurrency. Typically offered Fall Spring.

## **CS 25100 - Data Structures And Algorithms**

Credit Hours: 3.00. Running time analysis of algorithms and their implementations, one-dimensional data structures, trees, heaps, additional sorting algorithms, binary search trees, hash tables, graphs, directed graphs, weighted graph algorithms, additional topics. Typically offered Fall Spring.

## **CS 31400 - Numerical Methods**

Credit Hours: 3.00. Iterative methods for solving nonlinear equations; direct and iterative methods for solving linear systems; approximations of functions, derivatives, and integrals; error analysis. Typically offered Spring.

## **MA 51400 - Numerical Analysis**

Credit Hours: 3.00. (CS 51400) Iterative methods for solving nonlinear; linear difference equations, applications to solution of polynomial equations; differentiation and integration formulas; numerical solution of ordinary differential equations; roundoff error bounds. Typically offered Fall Spring.

## **Calculus I Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## **Calculus II Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

### **Calculus III Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

### **MACS Math Selective (6 credits)**

### **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

## **MA 38500 - Introduction To Logic**

Credit Hours: 3.00. Propositional calculus and predicate calculus with applications to mathematical proofs, valid arguments, switching theory, and formal languages. Typically offered Spring.

## **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

## **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

## **CS Selective - (3 credits)**

## **CS 38100 - Introduction To The Analysis Of Algorithms**

Credit Hours: 3.00. Techniques for analyzing the time and space requirements of algorithms. Application of these techniques to sorting, searching, pattern-matching, graph problems, and other selected problems. Brief introduction to the intractable (NP-hard) problems. Typically offered Fall Spring.

## **CS 33400 - Fundamentals Of Computer Graphics**

Credit Hours: 3.00. Fundamental principles and techniques of computer graphics. The course covers the basics of going from a scene representation to a raster image using OpenGL. Specific topics include coordinate manipulations, perspective, basics of illumination and shading, color models, texture maps, clipping and basic raster algorithms, fundamentals of scene constructions. CS 31400 is recommended. Typically offered Fall.

## **CS 48300 - Introduction To The Theory Of Computation**

Credit Hours: 3.00. Turing machines and the Church-Turing thesis; decidability; halting problem; reducibility; undecidable problems; decidability of logical theories; Kolmogorov complexity; time classes; P, NP, NP-complete; space classes; Savitch's theorem, PSPACE-completeness, NL-completeness; hierarchy theorems; approximation theorems; probabilistic algorithms; applications of complexity to parallel computation and cryptography. Typically offered Fall Spring.

## **CS 51400 - Numerical Analysis**

Credit Hours: 3.00. (MA 51400) Iterative methods for solving nonlinear equations; linear difference equations, applications to solution of polynomial equations; differentiation and integration formulas; numerical solution of ordinary differential equations; roundoff error bounds. Typically offered Fall.

## **CS 51500 - Numerical Linear Algebra**

Credit Hours: 3.00. Direct and iterative solvers of dense and sparse linear systems of equations, numerical schemes for handling symmetric algebraic eigenvalue problems, and the singular-value decomposition and its applications in linear least squares problems. Typically offered Spring.

## **CS 52000 - Computational Methods In Optimization**

Credit Hours: 3.00. A treatment of numerical algorithms and software for optimization problems with a secondary emphasis on linear and nonlinear systems of equations: unconstrained and constrained optimization; line search methods; trust region methods; Quasi-Newton methods; linear programming; calculating derivatives; quadratic programming; global optimization, including simulated annealing. Typically offered Spring.

## **MA/STAT Selective (3 credits)**

### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

### **MA 36200 - Topics In Vector Calculus**

Credit Hours: 3.00. Multivariate calculus; partial differentiation; implicit function theorems and transformations; line and surface integrals; vector fields; theorems of Gauss, Green, and Stokes. Credit granted for only one of MA 36200 and MA 51000. Typically offered Fall Spring.

### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

## **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

## **MA 42100 - Linear Programming And Optimization Techniques**

Credit Hours: 3.00. Solution of linear programming problems by the simplex method, duality theory, transportation problems, assignment problems, network analysis, dynamic programming. Typically offered Fall Spring.

## **MA 42500 - Elements Of Complex Analysis**

Credit Hours: 3.00. Complex numbers and complex-valued functions; differentiation of complex functions; power series, uniform convergence; integration, contour integrals; elementary conformal mapping. Typically offered Spring.

## **STAT 42000 - Introduction To Time Series**

Credit Hours: 3.00. An introduction to time series analysis suitable for actuarial science, engineering, and sciences. Model building and forecasting with ARMA and ARIMA models. Resampling methods for confidence intervals. Multivariate, state-space, and nonlinear models. Volatility models (ARCH and GARCH). Smoothing in time series. Typically offered Fall Spring.

## **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

## **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

## **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

### **MA 44200 - Multivariate Analysis I Honors**

Credit Hours: 3.00. Topics covered may include a unified modern treatment of functions of several variables. Topics covered include the topology of Euclidean spaces, mappings of Euclidean spaces, exterior algebra, Lebesgue integration, and integration on manifolds. Typically offered Spring.

### **MA 51800 - Advanced Discrete Mathematics**

Credit Hours: 3.00. The course covers mathematics useful in analyzing computer algorithms. Topics include recurrence relations, evaluation of sums, integer functions, elementary number theory, binomial coefficients, generating functions, discrete probability, and asymptotic methods. Typically offered Spring.

## **Other Departmental/Program Course Requirements (30-56 credits)**

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Laboratory Science I Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00

- STAT 35000 - Introduction To Statistics
- Computing Option - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience\* - Credit Hours: 0.00 - 4.00
- Great Issues Option - Credit Hours: 3.00
- Multidisciplinary Experience\* (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00

## Electives (18-47 credits)

## University Core Requirements

LINK

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

- Calculus I Option - Credit Hours: 4.00 - 5.00 ♦

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00

## **MA 10800 - Mathematics As A Profession And A Discipline**

Credit Hours: 1.00. A "walking tour" of a few topics in mathematics, conducted by a series of guest lecturers. Some talks focus on interesting areas of mathematics, such as chaos theory, fractals, or the mathematics of sending pictures over the Internet. Others focus on where people with degrees in mathematics or statistics work and what they do. This class is open to anyone with an interest in mathematics, regardless of major. Typically offered Fall.

## **CS 17700 - Programming With Multimedia Objects**

Credit Hours: 4.00. Introduction to computers and programming: number representations, primitive data types and operations, basic control structures, programming applets and applications using graphical user interfaces, programming for detecting events and performing actions, processing multimedia objects such as images and sounds. Throughout the course, examples are drawn from a variety of fields in the natural sciences. Not open to CS majors with a grade of C or better in CS 18000. Not open to non-CS majors with a grade of C or better in any course in computer programming. Typically offered Fall Spring.

15-18 Credits

Spring 1st Year

- Calculus II Option - Credit Hours: 4.00 - 5.00

## **CS 18000 - Problem Solving And Object-Oriented Programming**

Credit Hours: 4.00. Problem solving and algorithms, implementation of algorithms in a high level programming language, conditionals, the iterative approach and debugging, collections of data, searching and sorting, solving problems by decomposition, the object-oriented approach, subclasses of existing classes, handling exceptions that occur when the program is running, graphical user interfaces (GUIs), data stored in files, abstract data types, a glimpse at topics from other CS courses. Intended primarily for students majoring in computer sciences. Credit cannot be obtained for both CS 18000 and any of 15600, CS 15800 and CS 15900. Not open to students with credit in CS 18100 or CS 24000. Typically offered Fall Spring.

- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 1.00

15-17 Credits

Fall 2nd Year

- Calculus III Option - Credit Hours: 4.00 - 5.00

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- General Education I Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

15-17 Credits

Spring 2nd Year

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **MA 37500 - Introduction To Discrete Mathematics**

Credit Hours: 3.00. Induction, permutations, combinations, finite probability, relations, graphs, trees, graph algorithms, recurrence relations, generating functions. Problem solving in all these areas. Credit granted for only one of MA 27600 and 37500. Typically offered Fall Spring.

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- General Education II Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 0.00 - 3.00

15 Credits

Fall 3rd Year

## **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

## **CS 24000 - Programming In C**

Credit Hours: 3.00. The UNIX environment, C development cycle, data representation, operators, program structure, recursion, macros, C preprocessor, pointers and addresses, dynamic memory allocation, structures, unions, typedef, bit-fields, pointer/structure applications, UNIX file abstraction, file access, low-level I/O, concurrency. Typically offered Fall Spring.

- Laboratory Science I Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

15-16 Credits

### **Spring 3rd Year**

- MACS Math Selective I - Credit Hours: 3.00

## **CS 25100 - Data Structures And Algorithms**

Credit Hours: 3.00. Running time analysis of algorithms and their implementations, one-dimensional data structures, trees, heaps, additional sorting algorithms, binary search trees, hash tables, graphs, directed graphs, weighted graph algorithms, additional topics. Typically offered Fall Spring.

- Laboratory Science II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 6.00

15-16 Credits

### **Fall 4th Year**

## **CS 31400 - Numerical Methods**

Credit Hours: 3.00. Iterative methods for solving nonlinear equations; direct and iterative methods for solving linear systems; approximations of functions, derivatives, and integrals; error analysis. Typically offered Spring.

## MA 51400 - Numerical Analysis

Credit Hours: 3.00. (CS 51400) Iterative methods for solving nonlinear; linear difference equations, applications to solution of polynomial equations; differentiation and integration formulas; numerical solution of ordinary differential equations; roundoff error bounds. Typically offered Fall Spring.

- MACS Math Selective II - Credit Hours: 3.00
- General Education III Option - Credit Hours: 3.00
- Free Elective (Science, Technology & Society Selective Course) - Credit Hours: 6.00

## 15 Credits

### Spring 4th Year

- MA/STAT Selective - Credit Hours: 3.00
- CS Selective - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 0.00 - 4.00
- Great Issues Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00 - 6.00

## 15-18 Credits

## Note

Student should earn minimum of a B- see advisor for further details.

Students must earn a 2.0 average in MATH/STAT/CS courses required for major.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Mathematics/Business, BS

### About the Program

Math students enjoy a great deal of personal attention. Most math classes for math majors have 40 or fewer students, and many upper-level classes have fewer than 25 students. In addition, the math curriculum is flexible enough that students can take classes in other interest areas or pursue a double major or a minor without too much difficulty. Math specializations include:

- Applied mathematics
- Business mathematics
- Mathematics
- Mathematics teaching
- Mathematics with computer science option
- Mathematics with statistics option
- Operations research

Important note: When applying for any specialization within Mathematics, select "Mathematics" as your major. You will have the opportunity to specialize as you progress through the curriculum.

#### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Business Mathematics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

Mathematics Website

MATH-BS  
Code-MABU  
120 Credits

### Departmental/Program Major Courses (76-105 credits)

#### Required Major Courses (49-52 credits)

Average GPA in courses must be 2.00 excluding Calculus I, II and III

#### **MGMT 20000 - Introductory Accounting**

Credit Hours: 3.00. The objectives of the course are to help students: (1) understand what is in financial statements and what the statements say about a business, (2) identify the business activities that caused the amounts that appear in the statements, and (3) understand how, when, and at what amount the effects of manager and employee actions will appear in the statements. Typically offered Fall Spring Summer. CTL:IPO 1801 Accounting I

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

### **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

### **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

### **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

### **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

### **Calculus I Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **Calculus II Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

### **Calculus III Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100. Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

## Option Course Selective I (6 credits)

### **MA 37500 - Introduction To Discrete Mathematics**

Credit Hours: 3.00. Induction, permutations, combinations, finite probability, relations, graphs, trees, graph algorithms, recurrence relations, generating functions. Problem solving in all these areas. Credit granted for only one of MA 27600 and 37500. Typically offered Fall Spring.

### **MA 42100 - Linear Programming And Optimization Techniques**

Credit Hours: 3.00. Solution of linear programming problems by the simplex method, duality theory, transportation problems, assignment problems, network analysis, dynamic programming. Typically offered Fall Spring.

### **CS 31400 - Numerical Methods**

Credit Hours: 3.00. Iterative methods for solving nonlinear equations; direct and iterative methods for solving linear systems; approximations of functions, derivatives, and integrals; error analysis. Typically offered Spring.

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

### **STAT 51700 - Statistical Inference**

Credit Hours: 3.00. A basic course in statistical theory covering standard statistical methods and their application. Estimation including unbiased, maximum likelihood and moment estimation; testing hypotheses for standard distributions and contingency tables; confidence intervals and regions; introduction to nonparametric tests and linear regression. Typically offered Fall Spring.

## Option Course Selective II (6 credits)

## **MA 37300 - Financial Mathematics**

Credit Hours: 4.00. A mathematical treatment of some fundamental concepts of financial mathematics and financial economics, and their application to real world business situations and basic risk management. Includes discussions of valuing investments, capital budgeting, valuing contingent cash flows, yield curves, spot rates, forward rates, short sales, Macaulay duration, modified duration, convexity, and immunization, financial derivatives, and their use in risk management. Provides preparation for the SOA/CAS Actuarial Exam FM/2. Typically offered Fall Spring.

## **MGMT 30400 - Introduction To Financial Management**

Credit Hours: 3.00. Introductory course providing a foundation in corporate finance and covering topics such as: discounted cash flow valuation, bond valuation, equity valuation, option valuation, factors influencing a firm's cost of capital, and international finance issues. Typically offered Fall Spring.

## **MGMT 31000 - Financial Management**

Credit Hours: 3.00. Management of the financial affairs of the industrial enterprise. Working capital management, current asset management, capital budgeting, stock and bond valuation, and capital structure decisions. Typically offered Fall Spring Summer.

## **MGMT 41100 - Investment Management**

Credit Hours: 3.00. Examination of investment alternatives relevant to the individual and/or family-unit investor. Operations of the markets in which securities are traded. Theory and application of security valuation, portfolio construction, capital markets, and performance evaluation. Particular attention given to fixed income securities, common stocks, options, investment companies, and other popular investment alternatives. Typically offered Fall Spring.

## **MGMT 54400 - Database Management Systems**

Credit Hours: 3.00. Covers the theory and practice of database design and usage. Students will learn the importance of data modeling concepts and how to use these effectively and how to plan and design a database, including issues such as data security and control. The following course is recommended: MGMT 29000 Programming for Business Applications or CS 15900 or CS 17700 or CNIT 17500, all with a C- or higher. Typically offered Fall Spring.

## **MGMT 32300 - Principles Of Marketing**

Credit Hours: 3.00. This mixed lecture and case course provides an overview of the functional area of marketing. The course is taught from a managerial perspective; it focuses on inputs to the marketing decision-making process, the process itself, and its results. No credit for students in the School of Management, except economics majors. Typically offered Fall Spring.

## Other Departmental/Program Course Requirements (27-53 credits)

\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00 \*
- Language II Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00 \*
- Language III/Culture/Diversity Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00 \*
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Laboratory Science I Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- STAT 35000 - Introduction To Statistics
- Computing Option - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience - Credit Hours: 0.00 - 4.00 \*
- Great Issues Option - Credit Hours: 3.00
- Multidisciplinary Experience (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00 \*

## Electives (15-44 credits)

### University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2

- Science, Technology & Society
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

- Calculus I Option - Credit Hours: 4.00 - 5.00 ♦

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00

### **MA 10800 - Mathematics As A Profession And A Discipline**

Credit Hours: 1.00. A "walking tour" of a few topics in mathematics, conducted by a series of guest lecturers. Some talks focus on interesting areas of mathematics, such as chaos theory, fractals, or the mathematics of sending pictures over the Internet. Others focus on where people with degrees in mathematics or statistics work and what they do. This class is open to anyone with an interest in mathematics, regardless of major. Typically offered Fall.

- Free Elective - Credit Hours: 3.00 - 4.00

### 15-17 Credits

### Spring 1st Year

- Calculus II Option - Credit Hours: 4.00 - 5.00
- Computing Option (rec. CS 17700 will also meet Teambuilding & Collaboration) - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

15-18 Credits

Fall 2nd Year

- Calculus III Option - Credit Hours: 4.00 - 5.00

### **MGMT 20000 - Introductory Accounting**

Credit Hours: 3.00. The objectives of the course are to help students: (1) understand what is in financial statements and what the statements say about a business, (2) identify the business activities that caused the amounts that appear in the statements, and (3) understand how, when, and at what amount the effects of manager and employee actions will appear in the statements. Typically offered Fall Spring Summer. CTL:IPO 1801 Accounting I

- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00

### **MA 30100 - An Introduction To Proof Through Real Analysis**

Credit Hours: 3.00. An introduction to abstract reasoning in the context of real analysis. Topics may include axioms for the real numbers, mathematical induction, formal definition of limits, density, decimal representations, convergence of sequences and series, continuity, differentiability, the extreme value, mean value and intermediate value theorems, and cardinality. The emphasis, however, is more on the concept of proof than on any one given topic. Typically offered Fall Spring.

- Free Elective - Credit Hours: 2.00

15-17 Credits

Spring 2nd Year

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

- Option Course Selective I - Credit Hours: 3.00

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors,

credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Free Elective - Credit Hours: 0.00 - 3.00

15 Credits

Fall 3rd Year

## **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

## **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

## **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

## **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

- Laboratory Science I Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective (Science, Technology & Society Selective Course) - Credit Hours: 3.00

15-16 Credits

Spring 3rd Year

### **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

- Option Course Selective I - Credit Hours: 3.00
- General Education I Option - Credit Hours: 3.00
- Laboratory Science II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00

15-16 Credits

Fall 4th Year

### **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

### **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

## **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

- Option Course Selective II - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 0.00 - 4.00
- General Education II Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 0.00 - 2.00

15-18 Credits

## **Spring 4th Year**

- Option Course Selective II - Credit Hours: 3.00

## **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

- Great Issues Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15 Credits

## **Note**

Student should earn minimum of a B-, see advisor for further details.

Students must earn a 2.0 average in MATH/STAT/MGMT courses required for major excluding Calculus III Option and STAT 35000.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Mathematics/Operations Research, BS

## About the Program

Math students enjoy a great deal of personal attention. Most math classes for math majors have 40 or fewer students, and many upper-level classes have fewer than 25 students. In addition, the math curriculum is flexible enough that students can take classes in other interest areas or pursue a double major or a minor without too much difficulty. Math specializations include:

- Applied mathematics
- Business mathematics
- Mathematics
- Mathematics teaching
- Mathematics with computer science option
- Mathematics with statistics option
- Operations research

Important note: When applying for any specialization within Mathematics, select "Mathematics" as your major. You will have the opportunity to specialize as you progress through the curriculum.

Mathematics Website

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Operations Research Mathematics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

MATH-BS  
Code-MAOR  
120 Credits

## Departmental/Program Major Courses (73-102 credits)

### Required Major Courses (43-46 credits)

Average GPA in courses must be 2.00 excluding Calculus I, II, and III

#### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

#### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

#### **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

#### **CS 31400 - Numerical Methods**

Credit Hours: 3.00. Iterative methods for solving nonlinear equations; direct and iterative methods for solving linear systems; approximations of functions, derivatives, and integrals; error analysis. Typically offered Spring.

#### **MA 51400 - Numerical Analysis**

Credit Hours: 3.00. (CS 51400) Iterative methods for solving nonlinear; linear difference equations, applications to solution of polynomial equations; differentiation and integration formulas; numerical solution of ordinary differential equations; roundoff error bounds. Typically offered Fall Spring.

## **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

## **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

## **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

## **STAT 51700 - Statistical Inference**

Credit Hours: 3.00. A basic course in statistical theory covering standard statistical methods and their application. Estimation including unbiased, maximum likelihood and moment estimation; testing hypotheses for standard distributions and contingency tables; confidence intervals and regions; introduction to nonparametric tests and linear regression. Typically offered Fall Spring.

## **Calculus I Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed

for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100 , or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## Calculus II Option - Select from (4-5 credits)

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

## Calculus III Option - Select from (4-5 credits)

(satisfies Quantitative Reasoning for core)

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

## MA, CS, STAT Selective (3 credits)

### **CS 52000 - Computational Methods In Optimization**

Credit Hours: 3.00. A treatment of numerical algorithms and software for optimization problems with a secondary emphasis on linear and nonlinear systems of equations: unconstrained and constrained optimization; line search methods; trust region methods; Quasi-Newton methods; linear programming; calculating derivatives; quadratic programming; global optimization, including simulated annealing. Typically offered Spring.

### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

### **MA 52300 - Introduction To Partial Differential Equations**

Credit Hours: 3.00. First order quasi-linear equations and their applications to physical and social sciences; the Cauchy-Kovalevsky theorem; characteristics, classification and canonical forms of linear equations; equations of mathematical physics; study of Laplace, wave and heat equations; methods of solution. Typically offered Fall Spring Summer.

### **MA 54300 - Ordinary Differential Equations And Dynamical Systems**

Credit Hours: 3.00. This course focuses on the theory of ordinary differential equations and methods of proof for developing this theory. Topics include basic results for linear systems, the local theory for nonlinear systems (existence and uniqueness, dependence on parameters, flows and linearization, stable manifold theorem) and the global theory for nonlinear systems (global existence, limit sets and periodic orbits, Poincare maps). Permission of instructor required. Typically offered Spring.

### **STAT 42000 - Introduction To Time Series**

Credit Hours: 3.00. An introduction to time series analysis suitable for actuarial science, engineering, and sciences. Model building and forecasting with ARMA and ARIMA models. Resampling methods for confidence intervals. Multivariate, state-space, and nonlinear models. Volatility models (ARCH and GARCH). Smoothing in time series. Typically offered Fall Spring.

Advanced Calculus Selective (3 credits)

### **MA 36200 - Topics In Vector Calculus**

Credit Hours: 3.00. Multivariate calculus; partial differentiation; implicit function theorems and transformations; line and surface integrals; vector fields; theorems of Gauss, Green, and Stokes. Credit granted for only one of MA 36200 and MA 51000. Typically offered Fall Spring.

### **MA 44200 - Multivariate Analysis I Honors**

Credit Hours: 3.00. Topics covered may include a unified modern treatment of functions of several variables. Topics covered include the topology of Euclidean spaces, mappings of Euclidean spaces, exterior algebra, Lebesgue integration, and integration on manifolds. Typically offered Spring.

### **Probability/Discrete Mathematics Selective (3 credits)**

#### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

#### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

#### **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

#### **MA 37500 - Introduction To Discrete Mathematics**

Credit Hours: 3.00. Induction, permutations, combinations, finite probability, relations, graphs, trees, graph algorithms,

recurrence relations, generating functions. Problem solving in all these areas. Credit granted for only one of MA 27600 and 37500. Typically offered Fall Spring.

## MAOR Math Selective (3 credits)

### **MA 42100 - Linear Programming And Optimization Techniques**

Credit Hours: 3.00. Solution of linear programming problems by the simplex method, duality theory, transportation problems, assignment problems, network analysis, dynamic programming. Typically offered Fall Spring.

### **IE 33500 - Operations Research - Optimization**

Credit Hours: 3.00. Introduction to deterministic optimization modeling and algorithms in operations research. Emphasis on formulation and solution of linear programs, networks flows, and integer programs. Typically offered Fall Spring.

## Other Departmental/Program Course Requirements (30-56 credits)

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Laboratory Science I Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00

- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
  - STAT 35000 - Introduction To Statistics
  - Computing Option - Credit Hours: 3.00 - 4.00
  - Teambuilding and Collaboration Experience\* - Credit Hours: 0.00 - 4.00
  - Great Issues Option - Credit Hours: 3.00
  - Multidisciplinary Experience\* (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00
- \*Requirement may be met with a zero credit experiential learning option. See your advisor for more information

## Electives (18-47 credits)

## University Core Requirements

LINK

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

- Calculus I Option♦ - Credit Hours: 4.00 - 5.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00

## **MA 10800 - Mathematics As A Profession And A Discipline**

Credit Hours: 1.00. A "walking tour" of a few topics in mathematics, conducted by a series of guest lecturers. Some talks focus on interesting areas of mathematics, such as chaos theory, fractals, or the mathematics of sending pictures over the Internet. Others focus on where people with degrees in mathematics or statistics work and what they do. This class is open to anyone with an interest in mathematics, regardless of major. Typically offered Fall.

- Free Elective - Credit Hours: 3.00 - 4.00

## **15-17 Credits**

### **Spring 1st Year**

- Calculus II Option - Credit Hours: 4.00 - 5.00
- Computing Option (CS 17700 Meets Teambuilding and Collaboration Experience) - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

## **15-18 Credits**

### **Fall 2nd Year**

- Calculus III Option - Credit Hours: 4.00 - 5.00

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00

## **MA 30100 - An Introduction To Proof Through Real Analysis**

Credit Hours: 3.00. An introduction to abstract reasoning in the context of real analysis. Topics may include axioms for the real numbers, mathematical induction, formal definition of limits, density, decimal representations, convergence of sequences and

series, continuity, differentiability, the extreme value, mean value and intermediate value theorems, and cardinality. The emphasis, however, is more on the concept of proof than on any one given topic. Typically offered Fall Spring.

- Free Elective - Credit Hours: 2.00

## 15-17 Credits

### Spring 2nd Year

- Probability/Discrete Mathematics Selective - Credit Hours: 3.00

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

- General Education I Option - Credit Hours: 3.00
- Technical Writing Option and Technical Presenting Option COM 21700 - Credit Hours: 3.00 - 6.00
- Free Elective - Credit Hours: 0.00 - 3.00

## 15 Credits

### Fall 3rd Year

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

### **STAT 51700 - Statistical Inference**

Credit Hours: 3.00. A basic course in statistical theory covering standard statistical methods and their application. Estimation including unbiased, maximum likelihood and moment estimation; testing hypotheses for standard distributions and contingency tables; confidence intervals and regions; introduction to nonparametric tests and linear regression. Typically offered Fall Spring.

- MA, CS, STAT Selective - Credit Hours: 3.00
- Laboratory Science I Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15-16 Credits

## Spring 3rd Year

- Advance Calculus Selective - Credit Hours: 3.00

### **CS 31400 - Numerical Methods**

Credit Hours: 3.00. Iterative methods for solving nonlinear equations; direct and iterative methods for solving linear systems; approximations of functions, derivatives, and integrals; error analysis. Typically offered Spring.

### **MA 51400 - Numerical Analysis**

Credit Hours: 3.00. (CS 51400) Iterative methods for solving nonlinear; linear difference equations, applications to solution of polynomial equations; differentiation and integration formulas; numerical solution of ordinary differential equations; roundoff error bounds. Typically offered Fall Spring.

- Laboratory Science II Option - Credit Hours: 3.00 - 4.00
- Great Issues Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15-16 Credits

## Fall 4th Year

### **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

### **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

### **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

- General Education II Option - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 0.00 - 4.00
- Free Elective (Science, Technology & Society Selective Course) - Credit Hours: 3.00 - 6.00

## 15-17 Credits

### Spring 4th Year

- MAOR Math Selective - Credit Hours: 3.00

### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

- General Education III Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

## 15 Credits

### Note

Student should earn minimum of a B- see advisor for further details.

Students must earn a 2.0 average in MATH/STAT/CS/IE courses required for major.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Mathematics/Statistics, BS

### About the Program

Math students enjoy a great deal of personal attention. Most math classes for math majors are 40 students or less, and many upperlevel classes have fewer than 25 students. In addition, the math curriculum is flexible enough that students can take classes in other interest areas or pursue double major or a minor without too much difficulty. Math specializations include:

- Applied mathematics
- Business mathematics
- Mathematics
- Mathematics teaching
- Mathematics with computer sciences option
- Mathematics with statistics option
- Operations research

Important note: When applying for any specialization within Mathematics, select "Mathematics" as your major. You will have the opportunity to specialize as you progress through the curriculum.

Mathematics Website

### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Mathematics/Statistics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

MATH-BS  
Code-MASI  
120 Credits

### Departmental/Program Major Courses (69-99 credits)

### Required Major Courses (42-46 credits)

Average GPA in courses must be 2.00 excluding Calculus I, II, and III

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

## **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

## **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

## **STAT 51700 - Statistical Inference**

Credit Hours: 3.00. A basic course in statistical theory covering standard statistical methods and their application. Estimation including unbiased, maximum likelihood and moment estimation; testing hypotheses for standard distributions and contingency tables; confidence intervals and regions; introduction to nonparametric tests and linear regression. Typically offered Fall Spring.

## **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

## **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

## **Calculus I Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **Calculus II Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

### **Calculus III Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100. Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

## Advanced Calculus Selective (3 credits)

### **MA 36200 - Topics In Vector Calculus**

Credit Hours: 3.00. Multivariate calculus; partial differentiation; implicit function theorems and transformations; line and surface integrals; vector fields; theorems of Gauss, Green, and Stokes. Credit granted for only one of MA 36200 and MA 51000. Typically offered Fall Spring.

### **MA 44200 - Multivariate Analysis I Honors**

Credit Hours: 3.00. Topics covered may include a unified modern treatment of functions of several variables. Topics covered include the topology of Euclidean spaces, mappings of Euclidean spaces, exterior algebra, Lebesgue integration, and integration on manifolds. Typically offered Spring.

## Advanced MA Selective (3-4 credits)

### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

### **MA 37500 - Introduction To Discrete Mathematics**

Credit Hours: 3.00. Induction, permutations, combinations, finite probability, relations, graphs, trees, graph algorithms, recurrence relations, generating functions. Problem solving in all these areas. Credit granted for only one of MA 27600 and 37500. Typically offered Fall Spring.

### **MA 42100 - Linear Programming And Optimization Techniques**

Credit Hours: 3.00. Solution of linear programming problems by the simplex method, duality theory, transportation problems, assignment problems, network analysis, dynamic programming. Typically offered Fall Spring.

## **MA 42500 - Elements Of Complex Analysis**

Credit Hours: 3.00. Complex numbers and complex-valued functions; differentiation of complex functions; power series, uniform convergence; integration, contour integrals; elementary conformal mapping. Typically offered Spring.

## **MA 42800 - Introduction To Fourier Analysis**

Credit Hours: 3.00. Topics include: Fourier series, convolutions, kernels, summation methods, Fourier transforms, applications to the wave, heat, and Laplace equations. Prerequisites: Vector calculus and linear algebra. Typically offered Fall Spring.

## **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

## **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

## **STAT Selective (3 credits)**

## **STAT 51300 - Statistical Quality Control**

Credit Hours: 3.00. A strong background in control charts including adaptations, acceptance sampling for attributes and variables data, standard acceptance plans, sequential analysis, statistics of combinations, moments and probability distributions, applications. Offered in alternate years. Typically offered Fall Spring.

## **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2^n$ ,  $3^n$ ,  $2^m \times 3^n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

## **STAT 42000 - Introduction To Time Series**

Credit Hours: 3.00. An introduction to time series analysis suitable for actuarial science, engineering, and sciences. Model building and forecasting with ARMA and ARIMA models. Resampling methods for confidence intervals. Multivariate, state-space, and nonlinear models. Volatility models (ARCH and GARCH). Smoothing in time series. Typically offered Fall Spring.

## **IE 53000 - Quality Control**

Credit Hours: 3.00. Principles and practices of statistical quality control in industry. Control charts for measurements and for attributes. Acceptance sampling by attributes and by measurements. Standard sampling plans. Sequential analysis. Sampling inspection of continuous production. Typically offered Spring Fall Summer.

## **Other Departmental/Program Course Requirements (27-53 credits)**

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Laboratory Science I Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- Computing Option - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience\* - Credit Hours: 0.00 - 4.00
- Great Issues Option - Credit Hours: 3.00

- Multidisciplinary Experience\* (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00  
\*Requirement may be met with a zero credit experiential learning option. See your advisor for more information

## Electives (21-51 credits)

## University Core Requirements

LINK

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

- Calculus I Option - Credit Hours: 4.00 - 5.00 ♦

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00

### **MA 10800 - Mathematics As A Profession And A Discipline**

Credit Hours: 1.00. A "walking tour" of a few topics in mathematics, conducted by a series of guest lecturers. Some talks focus on interesting areas of mathematics, such as chaos theory, fractals, or the mathematics of sending pictures over the Internet. Others focus on where people with degrees in mathematics or statistics work and what they do. This class is open to anyone with an interest in mathematics, regardless of major. Typically offered Fall.

- Free Elective - Credit Hours: 3.00 - 4.00

## 15-17 Credits

### Spring 1st Year

- Calculus II Option - Credit Hours: 4.00 - 5.00
- Computing Option (rec. CS 17700 & meets Teambuilding and Collaboration Experience) - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

## 15-18 Credits

### Fall 2nd Year

- Calculus III Option - Credit Hours: 4.00 - 5.00
- General Education I Option - Credit Hours: 3.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00

### **MA 30100 - An Introduction To Proof Through Real Analysis**

Credit Hours: 3.00. An introduction to abstract reasoning in the context of real analysis. Topics may include axioms for the real numbers, mathematical induction, formal definition of limits, density, decimal representations, convergence of sequences and series, continuity, differentiability, the extreme value, mean value and intermediate value theorems, and cardinality. The emphasis, however, is more on the concept of proof than on any one given topic. Typically offered Fall Spring.

- Free Elective - Credit Hours: 2.00

## 15-17 Credits

### Spring 2nd Year

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Free Elective - Credit Hours: 3.00 - 6.00

15 Credits

Fall 3rd Year

### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and

continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

### **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

- Laboratory Science I Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15-16 Credits

### **Spring 3rd Year**

- Advance Calculus Selective - Credit Hours: 3.00

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

### **STAT 51700 - Statistical Inference**

Credit Hours: 3.00. A basic course in statistical theory covering standard statistical methods and their application. Estimation including unbiased, maximum likelihood and moment estimation; testing hypotheses for standard distributions and contingency tables; confidence intervals and regions; introduction to nonparametric tests and linear regression. Typically offered Fall Spring.

- Laboratory Science II Option - Credit Hours: 3.00 - 4.00

- Great Issues Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## 15-16 Credits

### Fall 4th Year

- Advanced MA Selective - Credit Hours: 3.00

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

- General Education II Option - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 0.00 - 3.00
- Free Elective (Science, Technology & Society Selective Course) - Credit Hours: 3.00 - 6.00

## 15-18 Credits

### Spring 4th Year

### **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

- STAT Selective - Credit Hours: 3.00
- General Education III Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 6.00

## 15 Credits

### Note

Student should earn minimum of a B- see advisor for further details.

Students must earn a 2.0 average in MATH/STAT/IE courses required for major.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Mathematics Minor

### Pre-requisite Courses for Math Minor

To complete the required courses for the Mathematics minor, you will need to first complete the following pre-requisite courses [by completing the course or establishing credit]. These courses are not part of the Mathematics minor.

#### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

#### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

## **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

## **Requirements for the Minor**

The Mathematics Minor provides a strong background in mathematics for students majoring in some other discipline. To qualify for the minor, the following classes must be completed with a C- or better.

ALL COURSES FOR THIS MINOR LISTED BELOW MUST BE TAKEN AT PURDUE UNIVERSITY

To obtain a minor in Mathematics, the following courses must be completed.

No substitutions are allowed. A course can only be used in one area.

3 credits from AREA 1

3 credits from AREA 2

6-7 credits from AREA 3

The three courses used for Areas 2 and 3 cannot all be from the same group.

TOTAL CREDITS FOR MINOR: 12-13 credits

### **Area 1**

CHOOSE ONE COURSE

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **MA 51100 - Linear Algebra With Applications**

Credit Hours: 3.00. Real and complex vector spaces; linear transformations; Gram-Schmidt process and projections; least squares; QR and LU factorization; diagonalization, real and complex spectral theorem; Schur triangular form; Jordan canonical form; quadratic forms. Typically offered Summer.

### **MA 26500 - Linear Algebra**

Credit Hours: 3.00. Introduction to linear algebra. Systems of linear equations, matrix algebra, vector spaces, determinants, eigenvalues and eigenvectors, diagonalization of matrices, applications. Not open to students with credit in MA 26200, 27200, 35000 or MA 35100. Typically offered Fall Spring Summer.

### **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

## **Area 2**

CHOOSE ONE COURSE

### **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

### **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

## **Area 3**

### **CHOOSE TWO COURSES**

Area 3 Choices: in addition to courses listed below, approved mathematics selective courses can also be used:  
<http://www.math.purdue.edu/academic/undergrad/selectives>

## **Group**

## **Analysis**

### **MA 30100 - An Introduction To Proof Through Real Analysis**

Credit Hours: 3.00. An introduction to abstract reasoning in the context of real analysis. Topics may include axioms for the real numbers, mathematical induction, formal definition of limits, density, decimal representations, convergence of sequences and series, continuity, differentiability, the extreme value, mean value and intermediate value theorems, and cardinality. The emphasis, however, is more on the concept of proof than on any one given topic. Typically offered Fall Spring.

### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

### **MA 36200 - Topics In Vector Calculus**

Credit Hours: 3.00. Multivariate calculus; partial differentiation; implicit function theorems and transformations; line and surface integrals; vector fields; theorems of Gauss, Green, and Stokes. Credit granted for only one of MA 36200 and MA 51000. Typically offered Fall Spring.

### **MA 51000 - Vector Calculus**

Credit Hours: 3.00. Calculus of functions of several variables and of vector fields in orthogonal coordinate systems. Optimization problems, implicit function theorem, Green's theorem, Stokes' theorem, divergence theorems. Applications to engineering and the physical sciences. Not open to students with credit in MA 36200 or MA 41000. Typically offered Fall Spring Summer.

## **MA 42500 - Elements Of Complex Analysis**

Credit Hours: 3.00. Complex numbers and complex-valued functions; differentiation of complex functions; power series, uniform convergence; integration, contour integrals; elementary conformal mapping. Typically offered Spring.

## **Probability**

[only one]

## **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

## **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

## **MA 51600 - Advanced Probability And Options With Numerical Methods**

Credit Hours: 3.00. Stochastic interest rate models. American options from the probabilistic and PDE points of view. Numerical methods for European and American options, including binomial, trinomial, and Monte-Carlo methods. Typically offered Fall.

## **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

## **MA 51900 - Introduction To Probability**

Credit Hours: 3.00. (STAT 51900) Algebra of sets, sample spaces, combinatorial problems, independence, random variables, distribution functions, moment generating functions, special continuous and discrete distributions, distribution of a function of a random variable, limit theorems. Typically offered Spring Fall.

## **STAT 51900 - Introduction To Probability**

Credit Hours: 3.00. (MA 51900) Algebra of sets, sample spaces, combinatorial problems, independence, random variables, distribution functions, moment generating functions, special continuous and discrete distributions, distribution of a function of a random variable, limit theorems. Typically offered Fall Spring.

Algebra

## **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

## **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

Linear Algebra

## **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

Differential Equations

[only one]

### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

### **MA 30300 - Differential Equations and Partial Differential Equations for Engineering and the Sciences**

Credit Hours: 3.00. This is a methods course for juniors in any branch of engineering and science, designed to follow MA 26200. Basic techniques for solving systems of linear ordinary differential equations. Series solutions for second order equations, including Bessel functions, Laplace transform, Fourier series, numerical methods, separation of variables for partial differential equations and Sturm-Liouville theory. Not open to students with credit in MA 30400. Typically offered Fall Spring Summer.

### **MA 30400 - Differential Equations And Analysis Of Nonlinear Systems For Engineering And The Sciences**

Credit Hours: 3.00. This is a differential equations course designed to follow MA 26500-MA 26600. Same description as MA 30300 except that material on the qualitative behavior of solutions to nonlinear systems is substituted for material on Laplace transforms. Not open to students with credit in MA 30300. Typically offered Summer Fall Spring.

### **Note**

\*For many students, MA 26500 may not be adequate preparation for upper division mathematics classes. Students planning a Mathematics Minor should consider taking MA 35100 instead. Only students with a very firm grasp of the MA 26500 material [and a grade of B- or better] should contemplate taking MA 35300 without MA 35100

\*\* MA 26600 with at least a "B-" can be used in place of MA 36600 [only one of MA 26600/MA 36600/MA 30300/or MA 30400 can be used in Area 3]. MA 26200 will not be accepted for the minor.

## **Department of Physics and Astronomy**

### **Overview**

The Department of Physics and Astronomy serves the citizens of Indiana, the United States and the world through discovery that expands knowledge in the field of physics and closely related sciences, through conveyance of this knowledge to our students in an excellent learning environment, and through engagement in which we share our skills, knowledge, and enthusiasm with diverse communities beyond the University.

At present we have 58 faculty members, 62 postdocs and research scientists, 146 graduate students, and 196 undergraduate physics majors. These individuals conduct research across a broad spectrum of physics:

Accelerator mass spectrometry  
Applied physics, experimental  
Astrophysics, experimental and theoretical  
Atomic, molecular, and optical (AMO) physics, experimental and theoretical  
Biophysics, experimental and theoretical  
Condensed matter physics, experimental and theoretical  
Geophysics, experimental  
High energy nuclear physics, experimental and theoretical  
High energy particle physics, experimental and theoretical  
Physics education  
Planetary physics

Our faculty members are recognized as world leaders in their respective fields. Included in our ranks are a member of the National Academy of Sciences, a winner of the Hamburg Prize for Theoretical Physics, the immediate past president of the National Association for Research in Science Teaching, 3 AAAS fellows, and 10 APS fellows.

On campus, the department occupies two buildings, the "Physics Building" (originally named the Charles Benedict Stuart Laboratory of Applied Physics) and an attached two-story subterranean laboratory complex containing offices, work rooms, and laboratories dedicated to accelerator mass spectrometry, the Purdue Rare Isotope Measurement Laboratory (PRIME Lab). We also make use of campus facilities in Purdue's Discover Park, particularly the Birck Nanotechnology Center and the Bindley Bioscience Center. Off campus, we participate in research that occurs at the Large Hadron Collider at CERN, Argonne National Laboratory, Brookhaven National Laboratory, Fermilab, the Stanford Linear Accelerator, and several observatories around the globe.

Our department has undergraduate programs in Physics, Honors Physics, Applied Physics, Applied Honors Physics, and Physics Teaching. We also have undergraduate minors in both Astronomy and Physics. Our graduate program offers both M.S. and PH.D. degrees with a wide variety of specializations.

All physics major students must complete the majority of upper level (300 level and above) physics courses in residence at Purdue. Students can use transfer credits for no more than 50 percent of the upper level physics courses in order to receive a Physics and Astronomy B.S. Degree.

Through our outreach programs we bring our love of physics to thousands of elementary and high school students and their teachers every year. Classroom visits are complete with demonstrations hands-on learning activities. Teachers receive high-quality, content-based professional development in our workshops and through summer research opportunities.

## Faculty

<http://www.physics.purdue.edu/people/index.php?type=facultyonly>

## Contact Information

### Mailing Address

Department of Physics and Astronomy  
525 Northwestern Avenue  
West Lafayette, IN 47907-2036

### Telephone and Fax

(765) 494-3000 (main office)

(765) 494-2970 (undergraduate office)  
(765) 494-0706 (fax)

Department directory

**General questions**  
physcontacts@purdue.edu

## Graduate Information

For Graduate Information please see Physics and Astronomy Graduate Program Information.

## Applied Physics Honors, BS

### About the Program

Purdue physics is an internationally recognized department for excellence in forefront research and undergraduate and graduate education. Our undergraduate classes for physics majors average 30 or fewer students and are taught by professors actively engaged in forefront research. Undergraduate research is strongly encouraged and opportunities exist as early as the second semester to work in a research group. These groups include experimental and theoretical condensed matter physics, high energy physics, nano-physics, nuclear physics, astrophysics, biological physics, geophysics, relativity, and interdisciplinary areas of material science, engineering, or computational science.

The department also helps undergraduates with external internships, particularly for the summers. Upon graduation our students are accepted for graduate programs at many of the top universities and are also sought after for positions in industry, particularly high-tech positions. Our graduates have an exceptional record of career accomplishment in a wide variety of settings, including academia and major industrial and government labs.

The specialties under the applied physics curriculum can range from different areas. Individually tailored specialties may be chosen by the student in consultation with an advisor. Currently available specialties include:

- Geophysics and Atmospheric Sciences
- Astrophysics
- Computational Physics
- Nuclear Physics
- Material Science & Engineering
- Chemical Engineering
- Aeronautical & Astronautical Engineering
- Industrial Engineering
- Electrical and Computer Engineering
- Mechanical Engineering
- Medical Physics

In addition, many physics majors manage to complete dual or multiple major programs within the College of Science. This is possible because of a considerable overlap of the College of Science requirements. Popular dual majors with physics are: mathematics, computer science and chemistry.

**The following stipulations need to be met in order to be in, stay in and graduate in the Honors or Applied Honors Program:**

- No D+ or worse grade is allowed in any course for a student to stay in the Honors Programs.
- No more than one C range grade is allowed in all physics courses taken for a student to graduate with Honor. Note that a course can be re-taken for the purpose of satisfying this guideline.
- Both the physics AND overall GPAs of 3.0 or better are required for a student to graduate with Honor.
- All the core courses (PHYS 17200, 27200, 30600, 30700, 34400, 34000, and 42200) be complete with a B or better.
- Students need to petition to Undergraduate Committee for exceptions or requests.

Physics Website

### **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Applied Physics Honors include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

Physics - BS

APHO

≥120 Credits for graduation Credits

## **Applied Physics Honors Major Courses (68-69 credits)**

### **Required Major Courses (44-45 credits)**

#### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

#### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

Calculus III Option - Select from:

#### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals.

Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

### **PHYS 30600 - Mathematical Methods Of Physics I**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include one-and multi-variable calculus, complex numbers and functions of a complex variable, and vector calculus. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 30700 - Mathematical Methods Of Physics II**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include vectors, matrices and normal modes as well as ordinary and partial differential equations. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 34000 - Modern Physics Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany PHYS 34200 or PHYS 34400. Typically offered Fall Spring.

### **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure; elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

### **PHYS 41000 - Physical Mechanics I Honors**

Credit Hours: 3.00. Newtonian, Lagrangian, and Hamiltonian mechanics. Emphasis on point mass mechanics. Free, driven, and damped harmonic motion, central force problem. Typically offered Fall.

## **PHYS 41600 - Thermal And Statistical Physics Honors**

Credit Hours: 4.00. Thermal equilibrium; first, second, and third laws; entropy; probability and statistics; canonical ensembles; chemical potential and Grand Canonical Ensemble; classical and quantum ideal gases; chemical reactions; phase equilibria; critical phenomena. Typically offered Fall.

## **PHYS 42200 - Waves And Oscillations**

Credit Hours: 3.00. Physics of waves and oscillations including sound, elastic waves, and electromagnetic waves such as light. Topics range from the theory of simple harmonic oscillators, transverse modes of a continuous string, and physical optics including interference, Fresnel and Fraunhofer diffraction, and resolution, to diffraction of X-rays and electrons by crystals. Optionally includes topics such as nonlinear waves and surface waves. Typically offered Fall Spring.

## **PHYS 43000 - Electricity And Magnetism I Honors**

Credit Hours: 3.00. Electrostatics, solutions of Poisson's equation in spherical and cylindrical coordinates, macroscopic and microscopic theory of dielectrics, electrostatic energy, conduction; magnetostatics, electromagnetic induction, and magnetic properties of matter. Typically offered Fall.

## **PHYS 45000 - Intermediate Laboratory**

Credit Hours: 2.00. Laboratory primarily intended for junior year physics majors. Assorted experiments in optics and other fields using lasers, photodiodes, computers, and other modern technology. Typically offered Fall Spring.

## **PHYS 46000 - Quantum Mechanics I Honors**

Credit Hours: 3.00. Limits of classical physics, wave packets. Bohr model, atomic systems, Schrodinger equation, eigenfunctions, one-dimensional potentials, wave mechanics general structure, multiparticle systems, Pauli principle, operator methods. Typically offered Spring.

## **PHYS 59300 - Independent Research**

Credit Hours: 1.00 to 4.00. Research in some area of modern physics (spectroscopy, nuclear physics, solid state physics, elementary particle physics, biophysics, geophysics, etc.) with student receiving individualized supervision and guidance from staff member. This course may be used to satisfy the independent project or 500-level elective requirement of the undergraduate majors in Honors and Applied Physics Honors Programs. Permission of instructor required. Typically offered Fall Spring Summer.

Major Selective\* - (24 credits - in chosen applied area(s) approved by the Physics and Astronomy Department)

## Other Departmental/Program Course Requirements (37-66 credits)

- First Year Composition Option (satisfies Written Communication and Information Literacy for core) - Credit Hours: 3.00 - 4.00
- Technical Writing Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 0.00 - 3.00
- Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 0.00 - 3.00
- Teambuilding and Collaboration Experience - Credit Hours: 0.00 - 4.00
- Language I Option - Credit Hours: 0.00 - 4.00
- Language II Option - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Great Issues Option (satisfies one of the Science/Engineering requirements for Physics Selective) - Credit Hours: 3.00
- Multidisciplinary Experience (Select courses could satisfy Science, Technology & Society Selective for core) - Credit Hours: 0.00 - 3.00

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

- Statistics Option - Credit Hours: 3.00
- Computing Option - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses could satisfy Humanities Behavioral/Social Science for core) - Credit Hours: 3.00

### **Calculus I Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **Calculus II Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

### **Free Electives (1-15 credits)**

### **University Core Requirements**

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication

- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

#### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

#### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

- Calculus I Option - Credit Hours: 4.00 - 5.00 \*
- First Year Composition Option - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience - Credit Hours: 0.00

### 15-17 Credits

### Spring 1st Year

#### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

#### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

- Calculus II Option - Credit Hours: 4.00 - 5.00 \*
- Language I Option - Credit Hours: 3.00 - 4.00

15-17 Credits

Fall 2nd Year

### **PHYS 30600 - Mathematical Methods Of Physics I**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include one-and multi-variable calculus, complex numbers and functions of a complex variable, and vector calculus. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 34000 - Modern Physics Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany PHYS 34200 or PHYS 34400. Typically offered Fall Spring.

### **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure; elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

- Calculus III Option - Credit Hours: 4.00 - 5.00
- Language II Option - Credit Hours: 3.00 - 4.00

15-17 Credits

Spring 2nd Year

### **PHYS 30700 - Mathematical Methods Of Physics II**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include vectors, matrices and normal modes as well as ordinary and partial differential equations. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

## **PHYS 42200 - Waves And Oscillations**

Credit Hours: 3.00. Physics of waves and oscillations including sound, elastic waves, and electromagnetic waves such as light. Topics range from the theory of simple harmonic oscillators, transverse modes of a continuous string, and physical optics including interference, Fresnel and Fraunhofer diffraction, and resolution, to diffraction of X-rays and electrons by crystals. Optionally includes topics such as nonlinear waves and surface waves. Typically offered Fall Spring.

- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- Statistics Option - Credit Hours: 3.00
- General Education I Option (Humanities) - Credit Hours: 3.00 \*
- Free Elective (PHYS 23500) - Credit Hours: 1.00

16-17 Credits

Fall 3rd Year

## **PHYS 41000 - Physical Mechanics I Honors**

Credit Hours: 3.00. Newtonian, Lagrangian, and Hamiltonian mechanics. Emphasis on point mass mechanics. Free, driven, and damped harmonic motion, central force problem. Typically offered Fall.

## **PHYS 46000 - Quantum Mechanics I Honors**

Credit Hours: 3.00. Limits of classical physics, wave packets. Bohr model, atomic systems, Schrodinger equation, eigenfunctions, one-dimensional potentials, wave mechanics general structure, multiparticle systems, Pauli principle, operator methods. Typically offered Spring.

## **PHYS 45000 - Intermediate Laboratory**

Credit Hours: 2.00. Laboratory primarily intended for junior year physics majors. Assorted experiments in optics and other fields using lasers, photodiodes, computers, and other modern technology. Typically offered Fall Spring.

- Technical Writing Option and Technical Presenting Option (COM 21700\*) - Credit Hours: 3.00 - 6.00
- Computing Option (CS 15800) - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 1.00

15-19 Credits

Spring 3rd Year

### **PHYS 43000 - Electricity And Magnetism I Honors**

Credit Hours: 3.00. Electrostatics, solutions of Poisson's equation in spherical and cylindrical coordinates, macroscopic and microscopic theory of dielectrics, electrostatic energy, conduction; magnetostatics, electromagnetic induction, and magnetic properties of matter. Typically offered Fall.

- Major Selective - Credit Hours: 3.00
- Major Selective - Credit Hours: 3.00
- Major Selective - Credit Hours: 3.00
- General Education II Option (Humanities) - Credit Hours: 3.00 \*

15 Credits

Fall 4th Year

### **PHYS 41600 - Thermal And Statistical Physics Honors**

Credit Hours: 4.00. Thermal equilibrium; first, second, and third laws; entropy; probability and statistics; canonical ensembles; chemical potential and Grand Canonical Ensemble; classical and quantum ideal gases; chemical reactions; phase equilibria; critical phenomena. Typically offered Fall.

### **PHYS 59300 - Independent Research**

Credit Hours: 1.00 to 4.00. Research in some area of modern physics (spectroscopy, nuclear physics, solid state physics, elementary particle physics, biophysics, geophysics, etc.) with student receiving individualized supervision and guidance from staff member. This course may be used to satisfy the independent project or 500-level elective requirement of the undergraduate majors in Honors and Applied Physics Honors Programs. Permission of instructor required. Typically offered Fall Spring Summer.

- Major Selective - Credit Hours: 3.00
- Major Selective - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00

16 Credits

## Spring 4th Year

- Major Selective - Credit Hours: 3.00
- Major Selective - Credit Hours: 3.00
- Major Selective - Credit Hours: 3.00
- General Education III Option (Behav./Social Science ) - Credit Hours: 3.00 \*
- Multidisciplinary Experience (STS) - Credit Hours: 1.00 - 3.00 \*
- Free Elective - Credit Hours: 2.00

## 15-17 Credits

## Note

\*Satisfies a University Core Requirement

120 semester credits required for Bachelor of Science degree.

3.0 Graduation GPA required for Bachelor of Science degree.

3.0 average in PHYS/ASTR classes required to graduate.

No more than one C grade (i.e., C+, C, or C-) is allowed in all physics courses taken

No grade of D+ or worse is allowed in any course.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Applied Physics, BS

# About the Program

Purdue physics is an internationally recognized department for excellence in forefront research and undergraduate and graduate education. Our undergraduate classes for physics majors average 30 or fewer students and are taught by professors actively engaged in forefront research. Undergraduate research is strongly encouraged and opportunities exist as early as the second semester to work in a research group. These groups include experimental and theoretical condensed matter physics, high energy physics, nano-physics, nuclear physics, astrophysics, biological physics, geophysics, relativity, and interdisciplinary areas of material science, engineering, or computational science.

The department also helps undergraduates with external internships, particularly for the summers. Upon graduation our students are accepted for graduate programs at many of the top universities and are also sought after for positions in industry, particularly high-tech positions. Our graduates have an exceptional record of career accomplishment in a wide variety of settings, including academia and major industrial and government labs.

The specialties under the applied physics curriculum can range from different areas. Individually tailored specialties may be chosen by the student in consultation with an advisor. Currently available specialties include:

- Geophysics and Atmospheric Sciences
- Astrophysics
- Computational Physics
- Nuclear Physics
- Material Science & Engineering
- Chemical Engineering
- Aeronautical & Astronautical Engineering
- Industrial Engineering
- Electrical and Computer Engineering
- Mechanical Engineering
- Medical Physics

In addition, many physics majors manage to complete dual or multiple major programs within the College of Science. This is possible because of a considerable overlap of the College of Science requirements. Popular dual majors with physics are: mathematics, computer science and chemistry.

Physics Website

## Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Applied Physics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

Physics - BS

APPH

120 Credits for graduation Credits

## Applied Physics Major Courses (65 - 66 credits)

## Required Major Courses (41-42 credits)

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

Calculus III Option - Select from:

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

### **PHYS 30600 - Mathematical Methods Of Physics I**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include one-and multi-variable calculus, complex numbers and functions of a complex variable, and vector calculus. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 30700 - Mathematical Methods Of Physics II**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include vectors, matrices and normal modes as well as ordinary and partial differential equations. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 31000 - Intermediate Mechanics**

Credit Hours: 4.00. For students familiar with calculus. Elements of vector algebra; statics of particles and rigid bodies; theory of couples; principle of virtual work; kinematics; dynamics of particles and rigid bodies; work, power, and energy. Typically offered Fall.

### **PHYS 33000 - Intermediate Electricity And Magnetism**

Credit Hours: 3.00. Electrostatics; electric currents; magnetostatics; electromagnetic induction; Maxwell's equation; electromagnetic waves. Typically offered Fall Spring.

### **PHYS 34000 - Modern Physics Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany PHYS 34200 or PHYS 34400. Typically offered Fall Spring.

### **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure; elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

### **PHYS 36000 - Quantum Mechanics**

Credit Hours: 3.00. Historical development of quantum mechanics, wave packets, uncertainty principle, Schrodinger equation, operators, the hydrogen atom, electron spin, angular momentum, perturbation theory, and other selected topics. Typically offered Spring.

### **PHYS 42200 - Waves And Oscillations**

Credit Hours: 3.00. Physics of waves and oscillations including sound, elastic waves, and electromagnetic waves such as light. Topics range from the theory of simple harmonic oscillators, transverse modes of a continuous string, and physical optics including interference, Fresnel and Fraunhofer diffraction, and resolution, to diffraction of X-rays and electrons by crystals. Optionally includes topics such as nonlinear waves and surface waves. Typically offered Fall Spring.

## **PHYS 45000 - Intermediate Laboratory**

Credit Hours: 2.00. Laboratory primarily intended for junior year physics majors. Assorted experiments in optics and other fields using lasers, photodiodes, computers, and other modern technology. Typically offered Fall Spring.

## **PHYS 51500 - Thermal And Statistical Physics**

Credit Hours: 3.00. Equilibrium states, the concept of heat, and the laws of thermodynamics; the existence and properties of the entropy; different thermodynamic potentials and their uses; phase diagrams; introduction to statistical mechanics and its relation to thermodynamics; treatment of ideal gases. Typically offered Fall Spring.

**Major Selective\* - (24 credits - in chosen applied area(s) approved by the Physics and Astronomy Department)**

## **Other Departmental/Program Course Requirements (37-66 credits)**

- First Year Composition Option (satisfies Written Communication and Information Literacy for core) - Credit Hours: 3.00 - 4.00
- Technical Writing Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 0.00 - 3.00
- Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 0.00 - 3.00
- Teambuilding and Collaboration Experience - Credit Hours: 0.00 - 4.00
- Language I Option - Credit Hours: 0.00 - 4.00
- Language II Option - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Great Issues Option (satisfies one of the Science/Engineering requirements for Physics Selective) - Credit Hours: 3.00
- Multidisciplinary Experience (Select courses could satisfy Science, Technology & Society Selective for core) - Credit Hours: 0.00 - 3.00

## **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

## **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory

thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

- Statistics Option - Credit Hours: 3.00
- Computing Option - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses could satisfy Humanities Behavioral/Social Science for core) - Credit Hours: 3.00

## Calculus I Option - Select from (4-5 credits)

(satisfies Quantitative Reasoning for core)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## Calculus II Option - Select from (4-5 credits)

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series,

polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.  
CTL:IMA 1603 Calculus - Long II

## Electives (1-18 credits)

## University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

#### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

#### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

- Calculus I Option - Credit Hours: 4.00 - 5.00 \*
- First Year Composition Option - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience - Credit Hours: 0.00

### 15-17 Credits

## Spring 1st Year

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

- Calculus II Option - Credit Hours: 4.00 - 5.00 \*
- Language I Option - Credit Hours: 3.00 - 4.00

15-17 Credits

## Fall 2nd Year

### **PHYS 30600 - Mathematical Methods Of Physics I**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include one-and multi-variable calculus, complex numbers and functions of a complex variable, and vector calculus. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 34000 - Modern Physics Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany PHYS 34200 or PHYS 34400. Typically offered Fall Spring.

### **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure;

elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

- Calculus III Option - Credit Hours: 4.00 - 5.00 \*
- Language II Option - Credit Hours: 3.00 - 4.00

15-17 Credits

Spring 2nd Year

### **PHYS 30700 - Mathematical Methods Of Physics II**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include vectors, matrices and normal modes as well as ordinary and partial differential equations. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 42200 - Waves And Oscillations**

Credit Hours: 3.00. Physics of waves and oscillations including sound, elastic waves, and electromagnetic waves such as light. Topics range from the theory of simple harmonic oscillators, transverse modes of a continuous string, and physical optics including interference, Fresnel and Fraunhofer diffraction, and resolution, to diffraction of X-rays and electrons by crystals. Optionally includes topics such as nonlinear waves and surface waves. Typically offered Fall Spring.

- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- Statistics Option - Credit Hours: 3.00
- General Education I Option (Humanities) - Credit Hours: 3.00 \*
- Free Elective (PHYS 23500) - Credit Hours: 1.00

16-17 Credits

Fall 3rd Year

### **PHYS 31000 - Intermediate Mechanics**

Credit Hours: 4.00. For students familiar with calculus. Elements of vector algebra; statics of particles and rigid bodies; theory of couples; principle of virtual work; kinematics; dynamics of particles and rigid bodies; work, power, and energy. Typically offered Fall.

### **PHYS 33000 - Intermediate Electricity And Magnetism**

Credit Hours: 3.00. Electrostatics; electric currents; magnetostatics; electromagnetic induction; Maxwell's equation; electromagnetic waves. Typically offered Fall Spring.

### **PHYS 45000 - Intermediate Laboratory**

Credit Hours: 2.00. Laboratory primarily intended for junior year physics majors. Assorted experiments in optics and other fields using lasers, photodiodes, computers, and other modern technology. Typically offered Fall Spring.

- Technical Writing Option and Technical Presenting Option (COM 21700\*) - Credit Hours: 3.00 - 6.00
- Computing Option (CS 15800) - Credit Hours: 3.00 - 4.00

15-19 Credits

Spring 3rd Year

### **PHYS 36000 - Quantum Mechanics**

Credit Hours: 3.00. Historical development of quantum mechanics, wave packets, uncertainty principle, Schrodinger equation, operators, the hydrogen atom, electron spin, angular momentum, perturbation theory, and other selected topics. Typically offered Spring.

### **PHYS 51500 - Thermal And Statistical Physics**

Credit Hours: 3.00. Equilibrium states, the concept of heat, and the laws of thermodynamics; the existence and properties of the entropy; different thermodynamic potentials and their uses; phase diagrams; introduction to statistical mechanics and its relation to thermodynamics; treatment of ideal gases. Typically offered Fall Spring.

- Major Selective - Credit Hours: 3.00
- Major Selective - Credit Hours: 3.00
- General Education II Option (Humanities) - Credit Hours: 3.00 \*

15 Credits

Fall 4th Year

- Major Selective - Credit Hours: 3.00
- Major Selective - Credit Hours: 3.00
- Major Selective - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00
- Free Electives - Credit Hours: 3.00

## 15 Credits

### Spring 4th Year

- Major Selective - Credit Hours: 3.00
- Major Selective - Credit Hours: 3.00
- Major Selective - Credit Hours: 3.00
- General Education III Option (Behav./Social Science ) - Credit Hours: 3.00 \*
- Multidisciplinary Experience (STS) - Credit Hours: 1.00 - 3.00 \*
- Free Electives - Credit Hours: 2.00

## 15-17 Credits

### Note

\*Satisfies a University Core Requirement

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

2.0 average in PHYS/ASTR classes required to graduate.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Physics Honors, BS

# About the Program

Purdue physics is an internationally recognized department for excellence in forefront research and undergraduate and graduate education. Our undergraduate classes for physics majors average 30 or fewer students and are taught by professors actively engaged in forefront research. Undergraduate research is strongly encouraged and opportunities exist as early as the second semester to work in a research group. These groups include experimental and theoretical condensed matter physics, high energy physics, nano-physics, nuclear physics, astrophysics, biological physics, geophysics, relativity, and interdisciplinary areas of material science, engineering, or computational science.

The department also helps undergraduates with external internships, particularly for the summers. Upon graduation our students are accepted for graduate programs at many of the top universities and are also sought after for positions in industry, particularly high-tech positions. Our graduates have an exceptional record of career accomplishment in a wide variety of settings, including academia and major industrial and government labs.

The honors program offers an intensive concentration in physics that provides a solid foundation for advanced studies. Successful graduates of this challenging program are recognized for both the depth and breadth of their physics education, and they have gone on to the premier graduate schools in the country and, ultimately, to many different career choices.

The honors program provides a solid theoretical and experimental background in mechanics, electromagnetism, waves and oscillations, thermal physics, quantum mechanics, and the micro-structure of matter.

A very important feature of this plan is a senior research project (PHYS 59300) with a written report in some area of modern physics, such as condensed matter physics, nuclear physics, elementary particle physics, biophysics, geophysics, etc. Students receive individual supervision and guidance from a faculty member whose specialty matches the area of their research project. PHYS 593 introduces students to the type of research atmosphere they later might encounter as professional physicists, and it promotes self-motivation and independence in their work.

The Honors Program in the Department of Physics and Astronomy begins in the Junior Year. All physics majors typically start by taking PHYS 172H and 272H as freshmen. Students from other majors who have taken PHYS 172/272 may switch into the Honors Physics major. Admission to, and continuation in, the honors program requires that all the core courses (PHYS 17200, 27200, 30600, 30700, 34400, 34000, and 42200) be complete with a B or better, or special permission from the Physics Undergraduate Committee.

## **The following stipulations need to be met in order to be in, stay in and graduate in the Honors or Applied Honors Program:**

- No D+ or worse grade is allowed in any course for a student to stay in the Honors Programs.
- No more than one C range grade is allowed in all physics courses taken for a student to graduate with Honor. Note that a course can be re-taken for the purpose of satisfying this guideline.
- Both the physics AND overall GPAs of 3.0 or better are required for a student to graduate with Honor.
- All the core courses (PHYS 17200, 27200, 30600, 30700, 34400, 34000, and 42200) be complete with a B or better.
- Students need to petition to Undergraduate Committee for exceptions or requests.

Physics Website

## **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Physics Honors include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

Physics - BS  
PHHO  
120 Credits for graduation Credits

## Physics Honors Major Courses (66-68 credits)

### Required Major Courses (51-52 credits)

#### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

#### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

#### **PHYS 30600 - Mathematical Methods Of Physics I**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include one- and multi-variable calculus, complex numbers and functions of a complex variable, and vector calculus. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

#### **PHYS 30700 - Mathematical Methods Of Physics II**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include vectors, matrices and normal modes as well as ordinary and partial differential equations. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

#### **PHYS 34000 - Modern Physics Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany PHYS 34200 or PHYS 34400. Typically offered Fall Spring.

### **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure; elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

### **PHYS 41000 - Physical Mechanics I Honors**

Credit Hours: 3.00. Newtonian, Lagrangian, and Hamiltonian mechanics. Emphasis on point mass mechanics. Free, driven, and damped harmonic motion, central force problem. Typically offered Fall.

### **PHYS 41100 - Physical Mechanics II Honors**

Credit Hours: 2.00. Continuation of mechanics in PHYS 41000. Coupled systems, general theory of small oscillations, the vibrating string, perturbation theory. Rigid body motion. Motion of charged particles in electromagnetic fields. Elements of continuum mechanics. Typically offered Fall Spring.

### **PHYS 41600 - Thermal And Statistical Physics Honors**

Credit Hours: 4.00. Thermal equilibrium; first, second, and third laws; entropy; probability and statistics; canonical ensembles; chemical potential and Grand Canonical Ensemble; classical and quantum ideal gases; chemical reactions; phase equilibria; critical phenomena. Typically offered Fall.

### **PHYS 42200 - Waves And Oscillations**

Credit Hours: 3.00. Physics of waves and oscillations including sound, elastic waves, and electromagnetic waves such as light. Topics range from the theory of simple harmonic oscillators, transverse modes of a continuous string, and physical optics including interference, Fresnel and Fraunhofer diffraction, and resolution, to diffraction of X-rays and electrons by crystals. Optionally includes topics such as nonlinear waves and surface waves. Typically offered Fall Spring.

### **PHYS 43000 - Electricity And Magnetism I Honors**

Credit Hours: 3.00. Electrostatics, solutions of Poisson's equation in spherical and cylindrical coordinates, macroscopic and microscopic theory of dielectrics, electrostatic energy, conduction; magnetostatics, electromagnetic induction, and magnetic properties of matter. Typically offered Fall.

## **PHYS 43100 - Electricity And Magnetism II Honors**

Credit Hours: 2.00. A continuation of PHYS 43000. Magnetic energy; applications of Maxwell's equations to a.c. circuits, filters, transmission lines, waveguides, and antennae; Lienard-Wiechert potentials. Typically offered Fall Spring.

## **PHYS 45000 - Intermediate Laboratory**

Credit Hours: 2.00. Laboratory primarily intended for junior year physics majors. Assorted experiments in optics and other fields using lasers, photodiodes, computers, and other modern technology. Typically offered Fall Spring.

## **PHYS 46000 - Quantum Mechanics I Honors**

Credit Hours: 3.00. Limits of classical physics, wave packets. Bohr model, atomic systems, Schrodinger equation, eigenfunctions, one-dimensional potentials, wave mechanics general structure, multiparticle systems, Pauli principle, operator methods. Typically offered Spring.

## **PHYS 46100 - Quantum Mechanics II Honors**

Credit Hours: 3.00. Angular momenta, radial equation, operators, matrices, spin, time-independent perturbation theory, electron-electromagnetic field interaction, hydrogen atom, structure of atoms, molecules, radiation; selected topics in radiative transitions, collision theory, solids, nuclei, elementary particles and their symmetries. Typically offered Fall Spring.

## **PHYS 59300 - Independent Research**

Credit Hours: 1.00 to 4.00. Research in some area of modern physics (spectroscopy, nuclear physics, solid state physics, elementary particle physics, biophysics, geophysics, etc.) with student receiving individualized supervision and guidance from staff member. This course may be used to satisfy the independent project or 500-level elective requirement of the undergraduate majors in Honors and Applied Physics Honors Programs. Permission of instructor required. Typically offered Fall Spring Summer.

## **Calculus III Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

## **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

## **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

## **Major Selective\* (15-16 credits)**

- PHYS/ASTR Selective  $\geq$  500 level - Credit Hours: 3.00
- PHYS/ASTR Selective  $\geq$  500 level - Credit Hours: 3.00

## **PHYS 53600 - Electronic Techniques For Research**

Credit Hours: 4.00. A summary of principles of modern electronics currently used in research. Coursework will include broad coverage of the field and selected topics in electronics instrumentation. Typically offered Spring.

## **PHYS 57000 - Selected Topics In Physics**

Credit Hours: 3.00. Specialized topics in physics selected from time to time. Permission of instructor required. Typically offered Fall Spring Summer.

## **PHYS 58000 - Computational Physics**

Credit Hours: 3.00. Introduction to computationally based problem solving in physics, emphasis on understanding and applying various numerical algorithms to different types of physics problems. Topics will include chaos in mechanical systems, stochastic systems including percolation and fractal structures, molecular dynamics and the properties of simple fluids, Monte Carlo methods and phase transitions, and time dependent as well as time dependent problems in quantum mechanics. Typically offered Fall.

- Science/Engineering Selective  $\geq$  300 level ( could be met by CoS statistics requirement) - Credit Hours: 3.00
- Science/Engineering Selective  $\geq$  300 level (could be met by CoS Great Issues requirement) - Credit Hours: 3.00

## **Other Departmental/Program Course Requirements (37-66 credits)**

- First Year Composition Option (satisfies Written Communication and Information Literacy for core) - Credit Hours: 3.00 - 4.00
- Technical Writing Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 0.00 - 3.00
- Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 0.00 - 3.00
- Teambuilding and Collaboration Experience - Credit Hours: 0.00 - 4.00
- Language I Option - Credit Hours: 0.00 - 4.00
- Language II Option - Credit Hours: 0.00 - 4.00

- Language III/Culture/Diversity Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Great Issues Option (satisfies one of the Science/Engineering requirements for Physics Selective) - Credit Hours: 3.00
- Multidisciplinary Experience (Select courses could satisfy Science, Technology & Society Selective for core) - Credit Hours: 0.00 - 3.00

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

- Statistics Option - Credit Hours: 3.00
- Computing Option - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses could satisfy Humanities Behavioral/Social Science for core) - Credit Hours: 3.00

### **Calculus I Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602 Calculus - Long I

## Calculus II Option - Select from (4-5 credits)

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.  
CTL:IMA 1603 Calculus - Long II

## Free Electives (1-17 credits)

## University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in

mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

- Calculus I Option\* - Credit Hours: 4.00 - 5.00

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

- First Year Composition Option - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience - Credit Hours: 0.00

15-17 Credits

Spring 1st Year

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

- Calculus II Option\* - Credit Hours: 4.00 - 5.00
- Language I Option - Credit Hours: 3.00 - 4.00

15-17 Credits

Fall 2nd Year

### **PHYS 30600 - Mathematical Methods Of Physics I**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include one-and multi-variable calculus, complex numbers and functions of a complex variable, and vector calculus. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 34000 - Modern Physics Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany PHYS 34200 or PHYS 34400. Typically offered Fall Spring.

### **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure; elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

- Calculus III Option - Credit Hours: 4.00 - 5.00
- Language II Option - Credit Hours: 3.00 - 4.00

15-17 Credits

Spring 2nd Year

### **PHYS 30700 - Mathematical Methods Of Physics II**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include vectors, matrices and normal modes as well as ordinary and partial differential equations. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 42200 - Waves And Oscillations**

Credit Hours: 3.00. Physics of waves and oscillations including sound, elastic waves, and electromagnetic waves such as light. Topics range from the theory of simple harmonic oscillators, transverse modes of a continuous string, and physical optics including interference, Fresnel and Fraunhofer diffraction, and resolution, to diffraction of X-rays and electrons by crystals. Optionally includes topics such as nonlinear waves and surface waves. Typically offered Fall Spring.

- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- Statistics Option - Credit Hours: 3.00
- Science/Engineering Selective  $\geq 300$  - Credit Hours: 3.00
- Free Elective PHYS 23500

16-17 Credits

Fall 3rd Year

**PHYS 41000 - Physical Mechanics I Honors**

Credit Hours: 3.00. Newtonian, Lagrangian, and Hamiltonian mechanics. Emphasis on point mass mechanics. Free, driven, and damped harmonic motion, central force problem. Typically offered Fall.

**PHYS 46000 - Quantum Mechanics I Honors**

Credit Hours: 3.00. Limits of classical physics, wave packets. Bohr model, atomic systems, Schrodinger equation, eigenfunctions, one-dimensional potentials, wave mechanics general structure, multiparticle systems, Pauli principle, operator methods. Typically offered Spring.

**PHYS 45000 - Intermediate Laboratory**

Credit Hours: 2.00. Laboratory primarily intended for junior year physics majors. Assorted experiments in optics and other fields using lasers, photodiodes, computers, and other modern technology. Typically offered Fall Spring.

- Technical Writing Option and Technical Presenting Option COM 21700\* - Credit Hours: 3.00 - 6.00
- General Education I Option (Humanities)\* - Credit Hours: 3.00
- Free Elective - Credit Hours: 1.00

15-18 Credits

Spring 3rd Year

**PHYS 41100 - Physical Mechanics II Honors**

Credit Hours: 2.00. Continuation of mechanics in PHYS 41000. Coupled systems, general theory of small oscillations, the vibrating string, perturbation theory. Rigid body motion. Motion of charged particles in electromagnetic fields. Elements of continuum mechanics. Typically offered Fall Spring.

**PHYS 46100 - Quantum Mechanics II Honors**

Credit Hours: 3.00. Angular momenta, radial equation, operators, matrices, spin, time-independent perturbation theory, electron-electromagnetic field interaction, hydrogen atom, structure of atoms, molecules, radiation; selected topics in radiative transitions, collision theory, solids, nuclei, elementary particles and their symmetries. Typically offered Fall Spring.

### **PHYS 43000 - Electricity And Magnetism I Honors**

Credit Hours: 3.00. Electrostatics, solutions of Poisson's equation in spherical and cylindrical coordinates, macroscopic and microscopic theory of dielectrics, electrostatic energy, conduction; magnetostatics, electromagnetic induction, and magnetic properties of matter. Typically offered Fall.

- General Education II Option (Humanities)\* - Credit Hours: 3.00
- Computing Option CS 15800 - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 1.00

15-16 Credits

Fall 4th Year

### **PHYS 41600 - Thermal And Statistical Physics Honors**

Credit Hours: 4.00. Thermal equilibrium; first, second, and third laws; entropy; probability and statistics; canonical ensembles; chemical potential and Grand Canonical Ensemble; classical and quantum ideal gases; chemical reactions; phase equilibria; critical phenomena. Typically offered Fall.

### **PHYS 43100 - Electricity And Magnetism II Honors**

Credit Hours: 2.00. A continuation of PHYS 43000. Magnetic energy; applications of Maxwell's equations to a.c. circuits, filters, transmission lines, waveguides, and antennae; Lienard-Wiechert potentials. Typically offered Fall Spring.

### **PHYS 59300 - Independent Research**

Credit Hours: 1.00 to 4.00. Research in some area of modern physics (spectroscopy, nuclear physics, solid state physics, elementary particle physics, biophysics, geophysics, etc.) with student receiving individualized supervision and guidance from staff member. This course may be used to satisfy the independent project or 500-level elective requirement of the undergraduate majors in Honors and Applied Physics Honors Programs. Permission of instructor required. Typically offered Fall Spring Summer.

- Science/Engineering Selective  $\geq 300$  - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00

## 15 Credits

### Spring 4th Year

- Adv. Lab Option - Credit Hours: 3.00 - 4.00
- PHYS/ASTR Selective  $\geq 500$  - Credit Hours: 3.00
- PHYS/ASTR Selective  $\geq 500$  - Credit Hours: 3.00
- General Education III Option (Behav./Social Science)\* - Credit Hours: 3.00
- Multidisciplinary Experience (STS)\* - Credit Hours: 2.00
- Free Elective - Credit Hours: 1.00

## 15-16 Credits

### Note

\*Satisfies a University Core Requirement

120 semester credits required for Bachelor of Science degree.

3.0 Graduation GPA required for Bachelor of Science degree.

3.0 average in PHYS/ASTR classes required to graduate.

No more than one C grade (i.e., C+, C, or C-) is allowed in all physics courses taken

No grade of D+ or worse is allowed in any course.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

# Physics, BS

## About the Program

Purdue physics is an internationally recognized department for excellence in forefront research and undergraduate and graduate education. Our undergraduate classes for physics majors average 30 or fewer students and are taught by professors actively engaged in forefront research. Undergraduate research is strongly encouraged and opportunities exist as early as the second semester to work in a research group. These groups include experimental and theoretical condensed matter physics, high energy physics, nano-physics, nuclear physics, astrophysics, biological physics, geophysics, relativity, and interdisciplinary areas of material science, engineering, or computational science.

The department also helps undergraduates with external internships, particularly for the summers. Upon graduation our students are accepted for graduate programs at many of the top universities and are also sought after for positions in industry, particularly high-tech positions. Our graduates have an exceptional record of career accomplishment in a wide variety of settings, including academia and major industrial and government labs.

This program offers a specialization in physics as the core of a broad general education. The core courses provide a solid foundation in Classical Mechanics, Electricity and Magnetism, Waves and Oscillations, Quantum Mechanics, Thermal and Statistical Physics, Modern Physics, Relativity, Electronics, and Computational Physics.

By using free electives in the program, a student can include concentrations in condensed matter physics (PHYS 54500), nuclear physics (PHYS 55600), astrophysics (PHYS 56000), particle physics (PHYS 56400), and other areas. Students also are encouraged to participate in one or two semesters of individual research projects with a selected faculty member (PHYS 39000, 49000, or 59000).

Opportunities for employment in fields related to physics will also be enhanced by taking free-electives in additional science courses such as biological sciences, chemistry, computer science, geosciences, meteorology, and in various branches of engineering. With assistance from an advisor, a student can prepare an individualized program suited to career plans by selecting electives from these areas or from any other area within the University. Normally, students take such electives as juniors and seniors.

Physics Website

### **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Physics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

Physics - BS

PHYS

120 Credits for graduation Credits

### **Physics Major Courses (53-55 credits)**

### **Required Major Courses (41-42 credits)**

## **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

## **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **PHYS 30600 - Mathematical Methods Of Physics I**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include one- and multi-variable calculus, complex numbers and functions of a complex variable, and vector calculus. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

## **PHYS 30700 - Mathematical Methods Of Physics II**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include vectors, matrices and normal modes as well as ordinary and partial differential equations. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

## **PHYS 31000 - Intermediate Mechanics**

Credit Hours: 4.00. For students familiar with calculus. Elements of vector algebra; statics of particles and rigid bodies; theory of couples; principle of virtual work; kinematics; dynamics of particles and rigid bodies; work, power, and energy. Typically offered Fall.

## **PHYS 33000 - Intermediate Electricity And Magnetism**

Credit Hours: 3.00. Electrostatics; electric currents; magnetostatics; electromagnetic induction; Maxwell's equation; electromagnetic waves. Typically offered Fall Spring.

## **PHYS 34000 - Modern Physics Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany PHYS 34200 or PHYS 34400. Typically offered Fall Spring.

## **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure; elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

## **PHYS 36000 - Quantum Mechanics**

Credit Hours: 3.00. Historical development of quantum mechanics, wave packets, uncertainty principle, Schrodinger equation, operators, the hydrogen atom, electron spin, angular momentum, perturbation theory, and other selected topics. Typically offered Spring.

## **PHYS 42200 - Waves And Oscillations**

Credit Hours: 3.00. Physics of waves and oscillations including sound, elastic waves, and electromagnetic waves such as light. Topics range from the theory of simple harmonic oscillators, transverse modes of a continuous string, and physical optics including interference, Fresnel and Fraunhofer diffraction, and resolution, to diffraction of X-rays and electrons by crystals. Optionally includes topics such as nonlinear waves and surface waves. Typically offered Fall Spring.

## **PHYS 45000 - Intermediate Laboratory**

Credit Hours: 2.00. Laboratory primarily intended for junior year physics majors. Assorted experiments in optics and other fields using lasers, photodiodes, computers, and other modern technology. Typically offered Fall Spring.

## **PHYS 51500 - Thermal And Statistical Physics**

Credit Hours: 3.00. Equilibrium states, the concept of heat, and the laws of thermodynamics; the existence and properties of the entropy; different thermodynamic potentials and their uses; phase diagrams; introduction to statistical mechanics and its relation to thermodynamics; treatment of ideal gases. Typically offered Fall Spring.

## **Calculus III Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

## **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

## **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

## **Major Selective\* - (12-13 credits)**

- PHYS/ASTR  $\geq$  300 level - Credit Hours: 3.00

## **PHYS 53600 - Electronic Techniques For Research**

Credit Hours: 4.00. A summary of principles of modern electronics currently used in research. Coursework will include broad coverage of the field and selected topics in electronics instrumentation. Typically offered Spring.

## **PHYS 57000 - Selected Topics In Physics**

Credit Hours: 3.00. Specialized topics in physics selected from time to time. Permission of instructor required. Typically offered Fall Spring Summer.

## **PHYS 58000 - Computational Physics**

Credit Hours: 3.00. Introduction to computationally based problem solving in physics, emphasis on understanding and applying various numerical algorithms to different types of physics problems. Topics will include chaos in mechanical systems, stochastic systems including percolation and fractal structures, molecular dynamics and the properties of simple fluids, Monte Carlo methods and phase transitions, and time dependent as well as time dependent problems in quantum mechanics. Typically offered Fall.

- Science/Engineering Elective  $\geq$  300 level (could be met by CoS statistics requirement) - Credit Hours: 3.00
- Science/Engineering Elective  $\geq$  300 level (could be met by CoS Great Issues requirement) - Credit Hours: 3.00

## **Other Departmental/Program Course Requirements (37-66) credits)**

- First Year Composition Option (satisfies Written Communication and Information Literacy for core) - Credit Hours: 3.00 - 4.00

- Technical Writing Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 0.00 - 3.00
- Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 0.00 - 3.00
- Teambuilding and Collaboration Experience - Credit Hours: 0.00 - 4.00
- Language I Option - Credit Hours: 0.00 - 4.00
- Language II Option - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Great Issues Option (satisfies one of the Science/Engineering requirements for Physics Selective) - Credit Hours: 3.00
- Multidisciplinary Experience (Select courses could satisfy Science, Technology & Society Selective for core) - Credit Hours: 0.00 - 3.00

### **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

### **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

- Statistics Option - Credit Hours: 3.00
- Computing Option - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses could satisfy Human Cultures Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses could satisfy Humanities Behavioral/Social Science for core) - Credit Hours: 3.00

### **Calculus I Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## Calculus II Option - Select from (4-5 credits)

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

## Free Electives (1-30 credits)

## University Core Requirements

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

## **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

- Calculus I Option\* - Credit Hours: 4.00 - 5.00

## **CHM 11500 - General Chemistry**

Credit Hours: 4.00. Stoichiometry; atomic structure; periodic properties; ionic and covalent bonding; molecular geometry; gases, liquids, and solids; crystal structure; thermochemistry; descriptive chemistry of metals and non-metals. Required of students majoring in science and students in engineering who are not in CHM 12300. One year of high school chemistry or one semester of college chemistry required. Typically offered Fall Spring Summer. CTL:IPS 1721 General Chemistry I w/lab

- First Year Composition Option - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience - Credit Hours: 0.00

15-17 Credits

Spring 1st Year

## **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **CHM 11600 - General Chemistry**

Credit Hours: 4.00. A continuation of CHM 11500. Solutions; quantitative equilibria in aqueous solution; introductory thermodynamics; oxidation-reduction and electrochemistry; chemical kinetics; qualitative analysis; further descriptive chemistry of metals and nonmetals. Typically offered Fall Spring Summer. CTL:IPS 1722 General Chemistry II w/lab

- Calculus II Option\* - Credit Hours: 4.00 - 5.00
- Language I Option - Credit Hours: 3.00 - 4.00

15-17 Credits

## Fall 2nd Year

### **PHYS 30600 - Mathematical Methods Of Physics I**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include one-and multi-variable calculus, complex numbers and functions of a complex variable, and vector calculus. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 34000 - Modern Physics Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany PHYS 34200 or PHYS 34400. Typically offered Fall Spring.

### **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure; elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

- Calculus III Option\* - Credit Hours: 4.00 - 5.00
- Language II Option - Credit Hours: 3.00 - 4.00

15-17 Credits

## Spring 2nd Year

### **PHYS 30700 - Mathematical Methods Of Physics II**

Credit Hours: 3.00. Discussion of wide-ranging physics problems from mechanics, E&M, thermal, and modern physics with emphasis on reviews and introductions of mathematical methods and techniques that are essential in such discussion. Relevant mathematical methods include vectors, matrices and normal modes as well as ordinary and partial differential equations. Intended primarily for sophomore physics majors. Typically offered Fall Spring.

### **PHYS 42200 - Waves And Oscillations**

Credit Hours: 3.00. Physics of waves and oscillations including sound, elastic waves, and electromagnetic waves such as light.

Topics range from the theory of simple harmonic oscillators, transverse modes of a continuous string, and physical optics including interference, Fresnel and Fraunhofer diffraction, and resolution, to diffraction of X-rays and electrons by crystals. Optionally includes topics such as nonlinear waves and surface waves. Typically offered Fall Spring.

- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- Statistics Option - Credit Hours: 3.00
- Free Elective PHYS 23500
- Free Elective - Credit Hours: 2.00

15-16 Credits

Fall 3rd Year

### **PHYS 31000 - Intermediate Mechanics**

Credit Hours: 4.00. For students familiar with calculus. Elements of vector algebra; statics of particles and rigid bodies; theory of couples; principle of virtual work; kinematics; dynamics of particles and rigid bodies; work, power, and energy. Typically offered Fall.

### **PHYS 33000 - Intermediate Electricity And Magnetism**

Credit Hours: 3.00. Electrostatics; electric currents; magnetostatics; electromagnetic induction; Maxwell's equation; electromagnetic waves. Typically offered Fall Spring.

### **PHYS 45000 - Intermediate Laboratory**

Credit Hours: 2.00. Laboratory primarily intended for junior year physics majors. Assorted experiments in optics and other fields using lasers, photodiodes, computers, and other modern technology. Typically offered Fall Spring.

- Technical Writing Option and Technical Presenting Option COM 21700\* - Credit Hours: 3.00 - 6.00
- General Education I Option (Humanities)\* - Credit Hours: 3.00

15-18 Credits

Spring 3rd Year

### **PHYS 36000 - Quantum Mechanics**

Credit Hours: 3.00. Historical development of quantum mechanics, wave packets, uncertainty principle, Schrodinger equation,

operators, the hydrogen atom, electron spin, angular momentum, perturbation theory, and other selected topics. Typically offered Spring.

## **PHYS 51500 - Thermal And Statistical Physics**

Credit Hours: 3.00. Equilibrium states, the concept of heat, and the laws of thermodynamics; the existence and properties of the entropy; different thermodynamic potentials and their uses; phase diagrams; introduction to statistical mechanics and its relation to thermodynamics; treatment of ideal gases. Typically offered Fall Spring.

- Computing Option CS 15800 - Credit Hours: 3.00 - 4.00
- General Education II Option (Humanities)\* - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## **15-16 Credits**

### **Fall 4th Year**

- PHYS/ASTR Selective  $\geq 300$  level - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00
- General Education III Option (Behav./Social Science)\* - Credit Hours: 3.00 \*
- Science/Engineering Selective  $\geq 300$  - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

## **15 Credits**

### **Spring 4th Year**

- Adv. Lab Option - Credit Hours: 3.00 - 4.00
- Multidisciplinary Experience (STS)\* - Credit Hours: 1.00 - 3.00
- Science/Engineering Selective  $\geq 300$  - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

## **15-18 Credits**

## **Note**

\* Satisfies a University Core Requirement

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

2.0 average in PHYS/ASTR classes required to graduate.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Astronomy Minor

The following courses describe the minimum coursework necessary to earn a minor in astronomy. In addition, GPA over all PHYS and ASTR courses must be 2.0 or higher. (These requirements apply to students who matriculate at Purdue in or after Fall 2011.)

ALL REQUIRED COURSES FOR THIS MINOR MUST BE TAKEN AT PURDUE UNIVERSITY

## Minor Prerequisites

To complete the required courses listed below, the following prerequisite courses must be completed.

### **PHYS 15200 - Mechanics**

Credit Hours: 4.00. (West Lafayette, Calumet, North Central, IUPUI) 5.00 (Fort Wayne) Statics, uniform and accelerated motion; Newton's laws; circular motion; energy, momentum, and conservation principles; dynamics of rotation; gravitation and planetary motion; hydrostatics and hydrodynamics; simple harmonic motion; wave motion and sound. Typically offered Fall Spring Summer.

### **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

### **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

### **PHYS 26100 - Electricity And Optics**

Credit Hours: 4.00. Electricity and magnetism with emphasis on fields; geometrical and physical optics. Typically offered Fall Spring Summer.

### **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **Requirements for the Minor**

To obtain a minor in Astronomy, the following courses must be completed.

### **PHYS 34200 - Modern Physics**

Credit Hours: 3.00. A survey of basic concepts and phenomena in atomic, nuclear, and solid-state physics. Typically offered Fall.

### **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure; elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

### **ASTR 36300 - The Solar System**

Credit Hours: 3.00. This course is intended for students in science or engineering. The components of the course consist of an overview of solar system objects and an overview of the physical processes that control the evolution of solar system objects since formation. The overview of solar system includes observations of the Sun, planets, asteroids and Kuiper-belt objects, comets, and interplanetary dust. Specific processes that are discussed include hydrostatic equilibrium, orbital dynamics,

radioactive decay, and heat flow. The role of these processes in shaping planetary surfaces and atmosphere is explored. Typically offered Fall.

### **ASTR 36400 - Stars And Galaxies**

Credit Hours: 3.00. This course is intended for students in Science or Engineering. This is the second of a two-semester introductory sequence on astronomy and astrophysics, although it is designed to be a standalone course. It is intended mainly for Science and Engineering majors who are comfortable with calculus-based contents. The course provides an overview on the formation and evolution of stars, galaxies, and clusters of galaxies. Selected topics that are covered in more detail include stellar structure and atmosphere, properties of black holes, neutron stars, and white dwarfs, galactic dynamics, and dark matter in galaxies and clusters of galaxies. Typically offered Spring.

### **ASTR 37000 - Cosmology**

Credit Hours: 3.00. Intended for science and engineering majors. Basic physics and math knowledge will be assumed. The picture of how the Universe came to be and how it has evolved has recently come into sharp focus. This progress is the result of improved observational techniques that have resulted in high resolution images of very distant galaxies, a more accurate mapping of the Large Scale Structure of the Universe or the high resolution picture of the young universe provided by Cosmic Microwave Background observations. We will present a historical perspective of how ideas and data have shaped Cosmology through the centuries. In addition, we will review the theoretical models that are in agreement with the current observations. Our goal will be to provide the students with a broad overview of the current research in Cosmology with an eye toward stimulating the students curiosity about the many questions still awaiting answers in this field. Typically offered Fall.

**And Choose 3 additional credit hours from the following courses**

### **PHYS 56000 - Stellar Evolution**

Credit Hours: 3.00. (ASTR 56000) Observational basis of astrophysics; formation of galaxies and stars; evolution of stars; white dwarfs, supernovae and neutron stars, pulsars, quasars, black holes; cosmic rays, their origin and acceleration; radio astronomy, radio galaxies; the H-21 cm line and the 3mK blackbody radiation; gravitational radiation; X-ray and g-ray astronomy; cosmology; space physics, magnetosphere, and solar wind. Typically offered Spring.

### **ASTR 56000 - Stellar Evolution**

Credit Hours: 3.00. (PHYS 56000) Observational basis of astrophysics; formation of galaxies and stars; evolution of stars; white dwarfs, supernovae and neutron stars, pulsars, quasars, black holes; cosmic rays, their origin and acceleration; radio astronomy, radio galaxies; the H-21 cm line and the 3mK blackbody radiation; gravitational radiation; X-ray and g-ray astronomy; cosmology; space physics, magnetosphere, and solar wind. Typically offered Spring.

### **PHYS 56100 - Galaxies And Large Scale Structure**

Credit Hours: 3.00. (ASTR 56100) Covers basic observed properties and models of galactic structure, dynamics of stars, physics of interstellar medium, formation of galaxies, properties of clusters of galaxies, and dark matter. Typically offered Fall Spring.

### **ASTR 56100 - Galaxies And Large Scale Structure**

Credit Hours: 3.00. (PHYS 56100) Covers basic observed properties and models of galactic structure, dynamics of stars, physics of interstellar medium, formation of galaxies, properties of clusters of galaxies, and dark matter. Typically offered Fall Spring.

### **PHYS 56200 - Introduction To High Energy Astrophysics**

Credit Hours: 3.00. (ASTR 56200) An overview of important physical processes in a variety of astronomical settings and of the experimental techniques employed in the field of high energy astrophysics. Covered in more detail are individual systems that include black holes, neutron stars, white dwarfs, supernova remnants, active galactic nuclei, clusters of galaxies, gamma-ray bursts, and cosmic rays, with special emphasis on several research frontiers. Typically offered Fall Spring.

### **ASTR 56200 - Introduction To High Energy Astrophysics**

Credit Hours: 3.00. (PHYS 56200) An overview of important physical processes in a variety of astronomical settings and of the experimental techniques employed in the field of high energy astrophysics. Covered in more detail are individual systems that include black holes, neutron stars, white dwarfs, supernova remnants, active galactic nuclei, clusters of galaxies, gamma-ray bursts, and cosmic rays, with special emphasis on several research frontiers. Typically offered Fall Spring.

### **PHYS 56300 - Astroparticle Physics**

Credit Hours: 3.00. (ASTR 56300) An overview of an emerging research frontier in modern physics that lies at the interface of particle physics and astrophysics. Emphasis is on topics that are particularly relevant to both fields, including cosmology, cosmic ray physics, very-high-energy gamma ray astrophysics, neutrino astrophysics, and gravitational wave physics. Typically offered Fall Spring.

### **ASTR 56300 - Astroparticle Physics**

Credit Hours: 3.00. (PHYS 56300) An overview of an emerging research frontier in modern physics that lies at the interface of particle physics and astrophysics. Emphasis is on topics that are particularly relevant to both fields, including cosmology, cosmic ray physics, very-high-energy gamma ray astrophysics, neutrino astrophysics, and gravitational wave physics. Typically offered Fall Spring.

- PHYS/ASTR - Approved PHYS/ASTR at or above 400 level - Credit Hours: 3.00

## **Physics Minor**

The following courses describe the minimum coursework necessary to earn a minor in Physics. In addition, GPA over all PHYS courses must be 2.0 or higher. (These requirements apply to students who matriculate at Purdue in or after Fall 2011.)

## Minor Prerequisites

To complete the required courses listed below, the following prerequisite courses must be completed.

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

or

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602 Calculus - Long I

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603 Calculus - Long II

### **PHYS 15200 - Mechanics**

Credit Hours: 4.00. (West Lafayette, Calumet, North Central, IUPUI) 5.00 (Fort Wayne) Statics, uniform and accelerated motion; Newton's laws; circular motion; energy, momentum, and conservation principles; dynamics of rotation; gravitation and planetary motion; hydrostatics and hydrodynamics; simple harmonic motion; wave motion and sound. Typically offered Fall Spring Summer.

## **PHYS 24200 - Introduction To Heat And Thermal Physics**

Credit Hours: 1.00. A general introduction to thermodynamics for students in science and engineering who have a basic calculus and mechanics background. Typically offered Summer Fall Spring.

or

## **PHYS 17200 - Modern Mechanics**

Credit Hours: 4.00. Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered Summer Fall Spring. CTL:IPS 1753 Calculus-based Physics I

## **PHYS 24100 - Electricity And Optics**

Credit Hours: 3.00. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Electromagnetic waves, geometrical and physical optics. Typically offered Summer Fall Spring.

## **PHYS 25200 - Electricity And Optics Laboratory**

Credit Hours: 1.00. Selected experiments in electric fields, magnetic fields, steady-state and transient d.c. circuits, thermodynamics, and optics. Typically offered Fall Spring Summer.

or

## **PHYS 27200 - Electric And Magnetic Interactions**

Credit Hours: 4.00. Calculus-based physics course using concepts of electric and magnetic fields and an atomic description of matter to describe polarization, fields produced by charge distributions, potential, electrical circuits, magnetic forces, induction, and related topics, leading to Maxwell's equations and electromagnetic radiation and an introduction to waves and interference. 3-D graphical simulations and numerical problem solving by computer are employed throughout. Typically offered Fall Spring.

## **Requirements for the Minor**

To obtain a minor in Physics, the following courses must be completed.

ALL REQUIRED COURSES BELOW MUST BE TAKEN AT PURDUE UNIVERSITY

## **PHYS 34200 - Modern Physics**

Credit Hours: 3.00. A survey of basic concepts and phenomena in atomic, nuclear, and solid-state physics. Typically offered Fall.

### **PHYS 34400 - Modern Physics**

Credit Hours: 4.00. Survey of modern physics primarily intended for physics majors. Special relativity; particle properties of electromagnetic radiation; wave properties of particles; uncertainty principle; atomic spectra and X-rays; nuclear structure; elementary particles; statistical distribution laws; physics of atoms, molecules and condensed matter such as solids. Typically offered Fall Spring.

### **PHYS 34000 - Modern Physics Laboratory**

Credit Hours: 1.00. Laboratory experiments to accompany PHYS 34200 or PHYS 34400. Typically offered Fall Spring.

Choose 6 additional credit hours at or above 300 level in Physics (PHYS)

\*Except PHYS 31700, PHYS 39000, 49000, or 59000.

## **Department of Statistics**

### **Overview**

The Department of Statistics is housed in Haas Hall and the Mathematical Sciences Building. The main office, the graduate office, and some of the department's faculty, staff, and student offices are located on the first and second floors of HAAS. The rest of the faculty, staff, and graduate students are located on the fifth, second, and ground floors of the MATH building. The Department's Graduate program is ranked in the top 10 by U.S. News and World Report, April 2008.

There are 39 tenured and tenure-track professors, 3 emeriti faculty, 5 adjunct faculty members, 7 visiting professors and 17 lecturers who form the Department of Statistics faculty. Visiting Scholars from all over the world enrich the group.

The Department of Statistics has about 433 undergraduate students majoring in statistics and/or actuarial science (a joint major with the Department of Mathematics).

The Department of Statistics has 114 graduate students, 70 are Ph.D. Students and 44 are M.S. students.

### **Faculty**

<http://www.stat.purdue.edu/people/faculty/index.php>

### **Contact Information**

**Department of Statistics**

Purdue University  
250 N. University Street  
West Lafayette, IN 47907-2066  
USA

Phone:1-765-494-6030

Fax:1-765-494-0558

**Administrative Contacts**

**Department Head:** Hao Zhang zhanghao@purdue.edu

**Associate Head:** Tom Sellke tsellke@purdue.edu

**Assistant to the Head:** Linda Foster foster2@purdue.edu

## Graduate Information

For Graduate Information please see Statistics Graduate Program Information.

## Applied Statistics, BS

## About the Program

Statistics at Purdue University is one of the largest (students and faculty) in the United States. It is consistently rated by U.S. News and World Report as one of the top departments in the country. It offers courses in fundamental statistics and probability, and also courses that focus on statistical computation to train students as future data scientists. Students enjoy a great deal of interaction with faculty as well as small classes. The department offers a master's program in which a student can earn both a bachelor's degree and a master's degree in five years.

The statistics major consists of two options:

- Applied statistics
- Mathematical statistics (Mathematical statistics usually leads to a double major in mathematics and statistics.)

Statistics - Applied Statistics Website

**Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Applied Statistics include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

STAT-BS

Code-STAP

120 Credits

## Departmental/Program Major Courses (63-93 credits)

## Required Major Courses (36-40 credits)

Average GPA in courses must be 2.00 excluding Calculus I, II, and III

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **MA 36200 - Topics In Vector Calculus**

Credit Hours: 3.00. Multivariate calculus; partial differentiation; implicit function theorems and transformations; line and surface integrals; vector fields; theorems of Gauss, Green, and Stokes. Credit granted for only one of MA 36200 and MA 51000. Typically offered Fall Spring.

### **STAT 42000 - Introduction To Time Series**

Credit Hours: 3.00. An introduction to time series analysis suitable for actuarial science, engineering, and sciences. Model building and forecasting with ARMA and ARIMA models. Resampling methods for confidence intervals. Multivariate, state-space, and nonlinear models. Volatility models (ARCH and GARCH). Smoothing in time series. Typically offered Fall Spring.

### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

### **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

### **STAT 51700 - Statistical Inference**

Credit Hours: 3.00. A basic course in statistical theory covering standard statistical methods and their application. Estimation including unbiased, maximum likelihood and moment estimation; testing hypotheses for standard distributions and contingency tables; confidence intervals and regions; introduction to nonparametric tests and linear regression. Typically offered Fall Spring.

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

### **Calculus I Option (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **Calculus II Option (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

### **Calculus III Option (4-5 credits)**

(satisfies Quantitative Reasoning for core) **Grade of C or better required.**

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100. Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

## Applied STAT Selective (6-7 credits)

(Check with advisor for additional approved courses.)

### **STAT 51300 - Statistical Quality Control**

Credit Hours: 3.00. A strong background in control charts including adaptations, acceptance sampling for attributes and variables data, standard acceptance plans, sequential analysis, statistics of combinations, moments and probability distributions, applications. Offered in alternate years. Typically offered Fall Spring.

### **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2n$ ,  $3n$ ,  $2m \times 3n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

### **STAT 42000 - Introduction To Time Series**

Credit Hours: 3.00. An introduction to time series analysis suitable for actuarial science, engineering, and sciences. Model building and forecasting with ARMA and ARIMA models. Resampling methods for confidence intervals. Multivariate, state-space, and nonlinear models. Volatility models (ARCH and GARCH). Smoothing in time series. Typically offered Fall Spring.

### **STAT 47201 - Actuarial Models- Life Contingencies**

Credit Hours: 4.00. Mathematical foundation of actuarial science, emphasizing probability models for life contingencies as the basis for analyzing life insurance and life annuities and determining premiums and reserves. This course provides the background for Course MLC of the Society of Actuaries and Course 3L of the Casualty Actuarial Society. Typically offered Fall.

### **STAT 47301 - Introduction To Arbitrage-Free Pricing Of Financial Derivatives**

Credit Hours: 3.00. This course exposes students to a number of financial economics concepts related to arbitrage-free option pricing in the binomial market model and the Black-Scholes model. Specific models include: (1) Options and parity relationship between options (2) Option Pricing under the Binomial model (3) Option Pricing under the Black-Scholes model (4) Option hedging and the market maker's overnight profit (5) Black Scholes theory with Brownian motion and Ito calculus (6) Risk-neutral option pricing and Monte Carlo valuation (7) Stochastic interest rates and Stochastic Volatility. This course provides the

background for Course MFE of the Society of Actuaries and Course 3F of the Casualty Actuarial Society. Typically offered Fall Spring.

## **STAT 50600 - Statistical Programming And Data Management**

Credit Hours: 3.00. Use of the SAS software system for managing statistical data. The SAS environment. Data description. Data access and management. SAS macro language and application development. Prerequisite: STAT 51200 and coursework in computer programming. Typically offered Fall Spring.

## **STAT 52200 - Sampling And Survey Techniques**

Credit Hours: 3.00. Survey designs; simple random, stratified, and systematic samples; systems of sampling; methods of estimation; costs. Offered in alternate years. Typically offered Spring.

## **Other Departmental/Program Course Requirements (27-53 credits)**

\* Requirement may be met with a zero credit experiential learning option. See your advisor for more information

## **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option \* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option \* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option \* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Laboratory Science I Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education III Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00

- Computing Option - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience \* - Credit Hours: 0.00 - 4.00
- Multidisciplinary Experience (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00
- Great Issues Option - Credit Hours: 3.00

## Electives (27-57 credits)

## University Core Requirements

LINK

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

- Calculus I Selective - Credit Hours: 4.00 - 5.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 1.00 (STAT 19000 Recommended)
- Free Elective - Credit Hours: 4.00

## 15-18 Credits

### Spring 1st Year

- Calculus II Option - Credit Hours: 4.00 - 5.00
- Computing Option (CS 17700 Recommended) - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

## 15-18 Credits

### Fall 2nd Year

- Calculus III Option - Credit Hours: 4.00 - 5.00 ♦
- General Education Option - Credit Hours: 3.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 5.00

## 15-17 Credits

### Spring 2nd Year

#### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

#### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

## **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Free Elective - Credit Hours: 3.00 - 6.00

15 Credits

Fall 3rd Year

## **MA 36200 - Topics In Vector Calculus**

Credit Hours: 3.00. Multivariate calculus; partial differentiation; implicit function theorems and transformations; line and surface integrals; vector fields; theorems of Gauss, Green, and Stokes. Credit granted for only one of MA 36200 and MA 51000. Typically offered Fall Spring.

## **STAT 42000 - Introduction To Time Series**

Credit Hours: 3.00. An introduction to time series analysis suitable for actuarial science, engineering, and sciences. Model building and forecasting with ARMA and ARIMA models. Resampling methods for confidence intervals. Multivariate, state-space, and nonlinear models. Volatility models (ARCH and GARCH). Smoothing in time series. Typically offered Fall Spring.

## **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

## **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

- Laboratory Science Option I - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00

- Free Elective - Credit Hours: 3.00

15-16 Credits

Spring 3rd Year

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

- Applied STAT Selective - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 6.00

15-17 Credits

Fall 4th Year

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

- General Education II Option - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 3.00
- Free Elective/Science, Technology & Society Selective Course - Credit Hours: 6.00 - 9.00

15-18 Credits

Spring 4th Year

- Applied STAT Selective - Credit Hours: 3.00
- General Education III Option - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00

- Free Elective - Credit Hours: 6.00

## 15 Credits

## Note

Student should earn minimum of a C.

Students must earn a 2.0 average in MATH/STAT courses required for major. Calculus I, II, and III must have a grade of C or higher.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Statistics - Math Emphasis, BS

## About the Program

Statistics at Purdue University is one of the largest (students and faculty) in the United States. It is consistently rated by *U.S. News and World Report* as one of the top departments in the country. It offers courses in fundamental statistics and probability, and also courses that focus on statistical computation to train students as future data scientists. Students enjoy a great deal of interaction with faculty as well as small classes. The department offers a master's program in which a student can earn both a bachelor's degree and a master's degree in five years.

The statistics major consists of two options:

- Applied statistics

- Mathematical statistics (Mathematical statistics usually leads to a double major in mathematics and statistics.)  
Statistics - Applied Statistics Website

### **Degree Requirements and Supplemental Information**

The full Program Requirements for 2016-17 Statistics/Math Emphasis include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

STAT-BS  
Code-STMA  
120 Credits

## **Departmental/Program Major Courses (69-99 credits)**

### **Required Major Courses (42-46 credits)**

Average GPA in courses must be 2.00 excluding Calculus I, II and III

#### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

#### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

#### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

#### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

### **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

### **STAT 51700 - Statistical Inference**

Credit Hours: 3.00. A basic course in statistical theory covering standard statistical methods and their application. Estimation including unbiased, maximum likelihood and moment estimation; testing hypotheses for standard distributions and contingency tables; confidence intervals and regions; introduction to nonparametric tests and linear regression. Typically offered Fall Spring.

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

### **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

### **Calculus I Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **Calculus II Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

## **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring.  
CTL:IMA 1603 Calculus - Long II

## **Calculus III Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core) Grade of C or Better Required

## **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100 . Typically offered Fall Spring Summer.

## **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

## **Advance Calculus Selective (3 credits)**

## **MA 36200 - Topics In Vector Calculus**

Credit Hours: 3.00. Multivariate calculus; partial differentiation; implicit function theorems and transformations; line and surface integrals; vector fields; theorems of Gauss, Green, and Stokes. Credit granted for only one of MA 36200 and MA 51000. Typically offered Fall Spring.

## **MA 44200 - Multivariate Analysis I Honors**

Credit Hours: 3.00. Topics covered may include a unified modern treatment of functions of several variables. Topics covered include the topology of Euclidean spaces, mappings of Euclidean spaces, exterior algebra, Lebesgue integration, and integration on manifolds. Typically offered Spring.

## **MA 51000 - Vector Calculus**

Credit Hours: 3.00. Calculus of functions of several variables and of vector fields in orthogonal coordinate systems. Optimization problems, implicit function theorem, Green's theorem, Stokes' theorem, divergence theorems. Applications to engineering and the physical sciences. Not open to students with credit in MA 36200 or MA 41000. Typically offered Fall Spring Summer.

## Advanced MA Selective (3-4 credits)

### **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

### **MA 37500 - Introduction To Discrete Mathematics**

Credit Hours: 3.00. Induction, permutations, combinations, finite probability, relations, graphs, trees, graph algorithms, recurrence relations, generating functions. Problem solving in all these areas. Credit granted for only one of MA 27600 and 37500. Typically offered Fall Spring.

### **MA 42100 - Linear Programming And Optimization Techniques**

Credit Hours: 3.00. Solution of linear programming problems by the simplex method, duality theory, transportation problems, assignment problems, network analysis, dynamic programming. Typically offered Fall Spring.

### **MA 42500 - Elements Of Complex Analysis**

Credit Hours: 3.00. Complex numbers and complex-valued functions; differentiation of complex functions; power series, uniform convergence; integration, contour integrals; elementary conformal mapping. Typically offered Spring.

### **MA 42800 - Introduction To Fourier Analysis**

Credit Hours: 3.00. Topics include: Fourier series, convolutions, kernels, summation methods, Fourier transforms, applications to the wave, heat, and Laplace equations. Prerequisites: Vector calculus and linear algebra. Typically offered Fall Spring.

### **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

## **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

## **STAT Selective (3 credits)**

### **STAT 51300 - Statistical Quality Control**

Credit Hours: 3.00. A strong background in control charts including adaptations, acceptance sampling for attributes and variables data, standard acceptance plans, sequential analysis, statistics of combinations, moments and probability distributions, applications. Offered in alternate years. Typically offered Fall Spring.

### **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2n$ ,  $3n$ ,  $2m \times 3n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

### **STAT 42000 - Introduction To Time Series**

Credit Hours: 3.00. An introduction to time series analysis suitable for actuarial science, engineering, and sciences. Model building and forecasting with ARMA and ARIMA models. Resampling methods for confidence intervals. Multivariate, state-space, and nonlinear models. Volatility models (ARCH and GARCH). Smoothing in time series. Typically offered Fall Spring.

### **IE 53000 - Quality Control**

Credit Hours: 3.00. Principles and practices of statistical quality control in industry. Control charts for measurements and for attributes. Acceptance sampling by attributes and by measurements. Standard sampling plans. Sequential analysis. Sampling inspection of continuous production. Typically offered Spring Fall Summer.

## **Other Departmental/Program Course Requirements (27-53 credits)**

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

## **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Laboratory Science I Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science for core) - Credit Hours: 3.00
- Computing Option - Credit Hours: 3.00 - 4.00
- Teambuilding and Collaboration Experience\* - Credit Hours: 0.00 - 4.00
- Great Issues Option - Credit Hours: 3.00
- Multidisciplinary Experience\* (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00

\* Requirement may be met with a zero credit experiential learning option. See your advisor for more information.

## **Electives (21-51 credits)**

## **University Core Requirements**

LINK

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

# Program Requirements

## Fall 1st Year

- Calculus I Option - Credit Hours: 4.00 - 5.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00
- Free Elective (STAT 19000 - Topics In Statistics For Undergraduates)
- Free Elective - Credit Hours: 3.00 - 4.00

## 15-18 Credits

## Spring 1st Year

- Calculus II Option - Credit Hours: 4.00 - 5.00
- Computing Option (rec. CS 17700 & meets Teambuilding and Collaboration Experience) - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

## 15-18 Credits

## Fall 2nd Year

- Calculus III Option - Credit Hours: 4.00 - 5.00 ♦
- General Education I Option - Credit Hours: 3.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00

### **MA 30100 - An Introduction To Proof Through Real Analysis**

Credit Hours: 3.00. An introduction to abstract reasoning in the context of real analysis. Topics may include axioms for the real numbers, mathematical induction, formal definition of limits, density, decimal representations, convergence of sequences and series, continuity, differentiability, the extreme value, mean value and intermediate value theorems, and cardinality. The emphasis, however, is more on the concept of proof than on any one given topic. Typically offered Fall Spring.

- Free Elective - Credit Hours: 2.00

15-17 Credits

Spring 2nd Year

### **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Free Elective - Credit Hours: 3.00 - 6.00

15 Credits

Fall 3rd Year

### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

- Laboratory Science I Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15-16 Credits

Spring 3rd Year

### **MA 36200 - Topics In Vector Calculus**

Credit Hours: 3.00. Multivariate calculus; partial differentiation; implicit function theorems and transformations; line and surface integrals; vector fields; theorems of Gauss, Green, and Stokes. Credit granted for only one of MA 36200 and MA 51000. Typically offered Fall Spring.

### **MA 44200 - Multivariate Analysis I Honors**

Credit Hours: 3.00. Topics covered may include a unified modern treatment of functions of several variables. Topics covered include the topology of Euclidean spaces, mappings of Euclidean spaces, exterior algebra, Lebesgue integration, and integration on manifolds. Typically offered Spring.

### **MA 51000 - Vector Calculus**

Credit Hours: 3.00. Calculus of functions of several variables and of vector fields in orthogonal coordinate systems. Optimization problems, implicit function theorem, Green's theorem, Stokes' theorem, divergence theorems. Applications to engineering and the physical sciences. Not open to students with credit in MA 36200 or MA 41000. Typically offered Fall Spring Summer.

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

### **STAT 51700 - Statistical Inference**

Credit Hours: 3.00. A basic course in statistical theory covering standard statistical methods and their application. Estimation including unbiased, maximum likelihood and moment estimation; testing hypotheses for standard distributions and contingency tables; confidence intervals and regions; introduction to nonparametric tests and linear regression. Typically offered Fall Spring.

- Laboratory Science II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credits Hours: 6.00

## **15-16 Credits**

### **Fall 4th Year**

- Advanced MA Selective - Credit Hours: 3.00

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

- General Education II Option - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 0.00 - 3.00
- Free Elective (Science, Technology & Society Selective Course) - Credit Hours: 3.00 - 6.00

15-18 Credits

Spring 4th Year

### **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

- STAT Selective - Credit Hours: 3.00
- General Education III Option - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15 Credits

### **Note**

Student should earn minimum of a C.

Students must earn a 2.0 average in MATH/STAT/IE courses required for major.

Calculus I, II, III and MA 35100 must have a grade of C or higher.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

### **Degree Requirements**

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

### **Foreign Language Courses**

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

### **Critical Course**

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Statistics Honors, BS

### About the Program

Statistics at Purdue University is the only doctorate-granting program in statistics in Indiana and is one of the largest (students and faculty) in the United States. It is consistently rated by *U.S. News and World Report* as one of the top departments in the country. Students enjoy a great deal of interaction with faculty as well as small classes. For students with excellent preparation in high school, the department offers a master's program in which a student can earn both a bachelor's degree and a master's degree in five years.

The statistics major consists of two options:

- Applied statistics
- Mathematical statistics (Mathematical statistics usually leads to a double major in mathematics and statistics.)

Statistics - Applied Statistics Website

#### Degree Requirements and Supplemental Information

The full Program Requirements for 2016-17 Statistics Honors include all Supplemental Information and selective lists of those categories which a student must fulfill in order to earn their degree. These are intended to be printer-friendly, but include less descriptive course detail.

Please see below for program requirements and the necessary degree fulfillments.

STAT-BS  
Code-STHO  
120 Credits

#### Departmental/Program Major Courses (69-99 credits)

#### Required Major Courses (42-46 credits)

Average GPA in courses must be 2.00 excluding Calculus I, II, and III. An Average GPA in MA 44000, MA 44200, MA 45000, STAT 51600, or STAT 51700 must be 3.5 or higher - must take **three** of these five courses\*.

#### MA 35100 - Elementary Linear Algebra

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

#### STAT 35000 - Introduction To Statistics

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

### **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

## **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

## **STAT 51700 - Statistical Inference**

Credit Hours: 3.00. A basic course in statistical theory covering standard statistical methods and their application. Estimation including unbiased, maximum likelihood and moment estimation; testing hypotheses for standard distributions and contingency tables; confidence intervals and regions; introduction to nonparametric tests and linear regression. Typically offered Fall Spring.

## **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

## **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

## **Calculus I Option - Select from (4-5 credits)**

(satisfies Quantitative Reasoning for core)

## **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

## **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

## Calculus II Option - Select from (4-5 credits)

(satisfies Quantitative Reasoning for core)

### **MA 16200 - Plane Analytic Geometry And Calculus II**

Credit Hours: 5.00. Continuation of MA 16100. Vectors in two and three dimensions, techniques of integration, infinite series, conic sections, polar coordinates, surfaces in three dimensions. Some schools or departments may allow only 4 credit hours toward graduation for this course. Typically offered Fall Spring Summer.

### **MA 16600 - Analytic Geometry And Calculus II**

Credit Hours: 4.00. Continuation of MA 16500. Vectors in two and three dimensions. Techniques of integration, infinite series, polar coordinates, surfaces in three dimensions. Not open to students with credit in MA 16200. Typically offered Fall Spring. CTL:IMA 1603  
Calculus - Long II

## Calculus III Option - Select from (4-5 credits)

(satisfies Quantitative Reasoning for core) Grade of C or Better Required

### **MA 26100 - Multivariate Calculus**

Credit Hours: 4.00. Planes, lines, and curves in three dimensions. Differential calculus of several variables; multiple integrals. Introduction to vector calculus. Not open to students with credit in MA 17400 or MA 27100. Typically offered Fall Spring Summer.

### **MA 27101 - Honors Multivariate Calculus**

Credit Hours: 5.00. This course is the Honors version of MA 26100, Multivariate Calculus; it will also include a review of infinite series. The course is intended for first-year students who have credit for Calculus I and II. There will be a significant emphasis on conceptual explanation, but not on formal proof. Permission of department is required. Typically offered Fall.

## Advance Calculus Selective (3 credits)

## **MA 36200 - Topics In Vector Calculus**

Credit Hours: 3.00. Multivariate calculus; partial differentiation; implicit function theorems and transformations; line and surface integrals; vector fields; theorems of Gauss, Green, and Stokes. Credit granted for only one of MA 36200 and MA 51000. Typically offered Fall Spring.

## **MA 44200 - Multivariate Analysis I Honors**

Credit Hours: 3.00. Topics covered may include a unified modern treatment of functions of several variables. Topics covered include the topology of Euclidean spaces, mappings of Euclidean spaces, exterior algebra, Lebesgue integration, and integration on manifolds. Typically offered Spring.

## **MA 51000 - Vector Calculus**

Credit Hours: 3.00. Calculus of functions of several variables and of vector fields in orthogonal coordinate systems. Optimization problems, implicit function theorem, Green's theorem, Stokes' theorem, divergence theorems. Applications to engineering and the physical sciences. Not open to students with credit in MA 36200 or MA 41000. Typically offered Fall Spring Summer.

## **Advanced MA Selective (3-4 credits)**

## **MA 36600 - Ordinary Differential Equations**

Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject. Typically offered Spring Fall.

## **MA 37500 - Introduction To Discrete Mathematics**

Credit Hours: 3.00. Induction, permutations, combinations, finite probability, relations, graphs, trees, graph algorithms, recurrence relations, generating functions. Problem solving in all these areas. Credit granted for only one of MA 27600 and 37500. Typically offered Fall Spring.

## **MA 42100 - Linear Programming And Optimization Techniques**

Credit Hours: 3.00. Solution of linear programming problems by the simplex method, duality theory, transportation problems, assignment problems, network analysis, dynamic programming. Typically offered Fall Spring.

## **MA 42500 - Elements Of Complex Analysis**

Credit Hours: 3.00. Complex numbers and complex-valued functions; differentiation of complex functions; power series, uniform convergence; integration, contour integrals; elementary conformal mapping. Typically offered Spring.

## **MA 42800 - Introduction To Fourier Analysis**

Credit Hours: 3.00. Topics include: Fourier series, convolutions, kernels, summation methods, Fourier transforms, applications to the wave, heat, and Laplace equations. Prerequisites: Vector calculus and linear algebra. Typically offered Fall Spring.

## **MA 45300 - Elements Of Algebra I**

Credit Hours: 3.00. Fundamental properties of integers, polynomials, groups, rings, and fields, with emphasis on problem solving and applications. Not open to students with credit in MA 45000. Typically offered Fall Spring.

## **MA 45000 - Algebra Honors**

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

## **MA 52000 - Boundary Value Problems Of Differential Equations**

Credit Hours: 3.00. Separation of variables; Fourier series; boundary value problems; Fourier transforms; Bessel functions; Legendre polynomials. Typically offered Fall Spring Summer.  
(check with advisor for additional approved courses)

STAT Selective (3 credits)

## **STAT 51300 - Statistical Quality Control**

Credit Hours: 3.00. A strong background in control charts including adaptations, acceptance sampling for attributes and variables data, standard acceptance plans, sequential analysis, statistics of combinations, moments and probability distributions, applications. Offered in alternate years. Typically offered Fall Spring.

## **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2n$ ,  $3n$ ,  $2m \times 3n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

### **STAT 42000 - Introduction To Time Series**

Credit Hours: 3.00. An introduction to time series analysis suitable for actuarial science, engineering, and sciences. Model building and forecasting with ARMA and ARIMA models. Resampling methods for confidence intervals. Multivariate, state-space, and nonlinear models. Volatility models (ARCH and GARCH). Smoothing in time series. Typically offered Fall Spring.

### **IE 53000 - Quality Control**

Credit Hours: 3.00. Principles and practices of statistical quality control in industry. Control charts for measurements and for attributes. Acceptance sampling by attributes and by measurements. Standard sampling plans. Sequential analysis. Sampling inspection of continuous production. Typically offered Spring Fall Summer.

## **Other Departmental/Program Course Requirements (27-53 credits)**

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language II Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Language III/Culture/Diversity Option\* (Select courses COULD satisfy Human Cultures Humanities for core) - Credit Hours: 0.00 - 4.00
- Technical Writing Option and Technical Presenting Option (Select courses COULD satisfy Oral Communication for core) - Credit Hours: 3.00 - 6.00
- Laboratory Science I Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- Laboratory Science II Option (satisfies Science Selective for core) - Credit Hours: 3.00 - 4.00
- General Education I Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00

- General Education II Option (Select courses COULD satisfy Human Culture Behavioral/Social Science or Humanities for core) - Credit Hours: 3.00
  - Computing Option - Credit Hours: 3.00 - 4.00
  - Teambuilding and Collaboration Experience\* - Credit Hours: 0.00 - 4.00
  - Great Issues Optione - Credit Hours: 3.00
  - Multidisciplinary Experience\* (Select courses COULD satisfies Science, Technology, and Society Selective for core) - Credit Hours: 0.00 - 3.00
- \*Requirement may be met with a zero credit experiential learning option. See your advisor for more information.

## Electives (21-51 credits)

## University Core Requirements

LINK

- Human Cultures Humanities
- Human Cultures Behavioral/Social Science
- Information Literacy
- Science #1
- Science #2
- Science, Technology & Society Selective
- Written Communication
- Oral Communication
- Quantitative Reasoning

## Program Requirements

### Fall 1st Year

- Calculus I Option - Credit Hours: 4.00 - 5.00

### **ENGL 10600 - First-Year Composition**

Credit Hours: 4.00. Extensive practice in writing clear and effective prose. Instruction in organization, audience, style, and research-based writing. Typically offered Fall Spring Summer. NOTE: Concurrent registration is not permitted for ENGL 10600 and COM 11400.

### **ENGL 10800 - Accelerated First-Year Composition**

Credit Hours: 3.00. An accelerated composition course that substitutes for ENGL 10600 for students showing superior writing ability. Typically offered Summer Fall Spring.

- Language I Option - Credit Hours: 3.00 - 4.00

## **STAT 19000 - Topics In Statistics For Undergraduates**

Credit Hours: 1.00 to 5.00. Supervised reading course or special topics course at the freshman level for undergraduates are given under this number. Permission of instructor required. Typically offered Summer Fall Spring.

- Free Elective - Credit Hours: 4.00

15-18 Credits

### Spring 1st Year

- Calculus II Option - Credit Hours: 4.00 - 5.00
- Computing Option (rec. CS 17700 & meets Teambuilding and Collaborating Experience) - Credit Hours: 3.00 - 4.00
- Language II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 2.00

15-18 Credits

### Fall 2nd Year

- Calculus III Option - Credit Hours: 4.00 - 5.00 ♦
- General Education I Option - Credit Hours: 3.00
- Language III/Culture/Diversity Option - Credit Hours: 3.00 - 4.00

## **MA 30100 - An Introduction To Proof Through Real Analysis**

Credit Hours: 3.00. An introduction to abstract reasoning in the context of real analysis. Topics may include axioms for the real numbers, mathematical induction, formal definition of limits, density, decimal representations, convergence of sequences and series, continuity, differentiability, the extreme value, mean value and intermediate value theorems, and cardinality. The emphasis, however, is more on the concept of proof than on any one given topic. Typically offered Fall Spring.

- Free Elective - Credit Hours: 2.00

15-17 Credits

### Spring 2nd Year

## **MA 35100 - Elementary Linear Algebra**

Credit Hours: 3.00. Systems of linear equations, finite dimensional vector spaces, matrices, determinants, eigenvalues and eigenvector applications to analytical geometry. Not open to students with credit in MA 26500. Typically offered Fall Spring.

### **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **COM 21700 - Science Writing And Presentation**

Credit Hours: 3.00. Students learn to effectively communicate scientific and technical information both verbally and in writing to a variety of audiences. Typically offered Fall Spring.

- Free Elective - Credit Hours: 0.00 - 3.00
- Free Elective - Credit Hours: 3.00

15 Credits

Fall 3rd Year

### **MA 34100 - Foundations Of Analysis**

Credit Hours: 3.00. An introductory course in rigorous analysis, covering real numbers, sequences, series, continuous functions, differentiation, and Riemann integration. MA 30100 is helpful but not required. Typically offered Fall Spring.

### **MA 44000 - Real Analysis Honors**

Credit Hours: 3.00. Basic real analysis, limits, continuity, differentiation, and integration. Typically offered Fall.

### **MA 41600 - Probability**

Credit Hours: 3.00. (STAT 41600) An introduction to mathematical probability suitable as a preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and

continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Typically offered Fall Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

### **STAT 51600 - Basic Probability And Applications**

Credit Hours: 3.00. A first course in probability, intended to serve as a background for statistics and other applications. Sample spaces and axioms of probability, discrete and continuous random variables, conditional probability and Bayes' theorem, joint and conditional probability distributions, expectations, moments and moment generating functions, law of large numbers, and central limit theorem. (The probability material in course one of the Society of Actuaries and the Casualty Actuarial Society is covered by this course.) Typically offered Fall Spring.

- Laboratory Science I Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15-16 Credits

Spring 3rd Year

### **MA 36200 - Topics In Vector Calculus**

Credit Hours: 3.00. Multivariate calculus; partial differentiation; implicit function theorems and transformations; line and surface integrals; vector fields; theorems of Gauss, Green, and Stokes. Credit granted for only one of MA 36200 and MA 51000. Typically offered Fall Spring.

### **MA 44200 - Multivariate Analysis I Honors**

Credit Hours: 3.00. Topics covered may include a unified modern treatment of functions of several variables. Topics covered include the topology of Euclidean spaces, mappings of Euclidean spaces, exterior algebra, Lebesgue integration, and integration on manifolds. Typically offered Spring.

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

## **STAT 51700 - Statistical Inference**

Credit Hours: 3.00. A basic course in statistical theory covering standard statistical methods and their application. Estimation including unbiased, maximum likelihood and moment estimation; testing hypotheses for standard distributions and contingency tables; confidence intervals and regions; introduction to nonparametric tests and linear regression. Typically offered Fall Spring.

- Laboratory Science II Option - Credit Hours: 3.00 - 4.00
- Free Elective - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00

15-16 Credits

Fall 4th Year

## **MA 35300 - Linear Algebra II With Applications**

Credit Hours: 3.00. Factoring matrices, orthogonal projections (with application to least squares estimation), diagonalization and Jordan canonical form (with applications to Markov chains and systems of differential equations), Hermitian matrices, convexity (with application to linear programming). Emphasis on problem solving and applications from science, engineering, economics, or business. Not open to students with credit in MA 51100. Typically offered Fall Spring.

## **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

- General Education II Option - Credit Hours: 3.00
- Multidisciplinary Experience - Credit Hours: 0.00 - 3.00
- Free Elective (Science, Technology & Society Selective Course) - Credit Hours: 3.00 - 6.00

15-18 Credits

Spring 4th Year

## MA 45000 - Algebra Honors

Credit Hours: 3.00. This course, which is essentially the first half of MA 55300, is recommended for students wanting a more substantial background in algebra than is afforded by MA 45300, in particular students intending to do graduate work in science or engineering. Topics include the elements of number theory and group theory; unique factorization in polynomial rings and in principal ideal domains. Typically offered Fall.

- STAT Selective - Credit Hours: 3.00
- General Education III Option - Credit Hours: 3.00
- Free Elective - Credit Hours: 3.00
- Great Issues Option - Credit Hours: 3.00

## 15-16 Credits

### Note

Student should earn minimum of a C.

Students must earn a 2.0 average in MATH/STAT/IE courses required for major AND Average GPA in MA 44000, MA 44200, MA 45000, STAT 51600, or STAT 41700 must be 3.5 or higher - must take **three** of these five courses\*. Calculus I, II, III and MA 35100 must have a grade of C or higher.

120 semester credits required for Bachelor of Science degree.

2.0 Graduation GPA required for Bachelor of Science degree.

## Degree Requirements

The student is ultimately responsible for knowing and completing all degree requirements.

(Degree Works) MyPurduePlan is knowledge source for specific requirements and completion.

## Foreign Language Courses

Foreign Language proficiency requirements vary by program. For acceptable languages and proficiency levels, see your advisor:

American Sign Language, Arabic, Chinese, French, German, (ancient) Greek, Hebrew, Italian, Japanese, Latin, Portuguese, Russian, Spanish

## Critical Course

The ♦ course is considered critical. A Critical Course is one that a student must be able to pass to persist and succeed in a particular major.

## Statistics Minor

The following courses describe the minimum coursework necessary to earn a minor in Statistics.

ALL COURSES FOR THIS MINOR MUST BE TAKEN AT PURDUE UNIVERSITY

Students Majoring in Actuarial Science, Applied Statistics, Mathematical Statistics, and/or Statistics with Math cannot complete this minor.

## Pre-requisite Courses for Stat Minor

To complete the required courses for the Statistics minor, you will need to first complete the following pre-requisite courses [by completing the course or establishing credit]. These courses are not part of the Statistics minor.

### **MA 16500 - Analytic Geometry And Calculus I**

Credit Hours: 4.00. Introduction to differential and integral calculus of one variable, with applications. Conic sections. Designed for students who have had at least a one-semester calculus course in high school, with a grade of "A" or "B", but are not qualified to enter MA 16200 or MA 16600, or the advanced placement courses MA 17300 or MA 27100, or the honors calculus course MA 18100. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring. CTL:IMA 1602  
Calculus - Long I

### **MA 16100 - Plane Analytic Geometry And Calculus I**

Credit Hours: 5.00. Introduction to differential and integral calculus of one variable, with applications. Some schools or departments may allow only 4 credit hours toward graduation for this course. Designed for students who have not had at least a one-semester calculus course in high school, with a grade of "A" or "B". Not open to students with credit in MA 16500. Demonstrated competence in college algebra and trigonometry. Typically offered Fall Spring Summer.

### **MA 16010 - Applied Calculus I**

Credit Hours: 3.00. Topics include trigonometric and exponential functions; limits and differentiation, rules of differentiation, maxima, minima and optimization; curve sketching, integration, anti-derivatives, fundamental theorem of calculus. Properties of definite integrals and numerical methods. Applications to life, managerial and social sciences. Typically offered Fall Spring Summer.

## Minor Requirements

To obtain a minor in Statistics, the following courses must be completed. A course can only be used in one area.

3 credits from AREA 1, 3 credits from AREA 2, 3 credits from AREA 3, 6 credits from AREA 4 = 15 TOTAL Credits

### Area 1

CHOOSE ONE COURSE

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

## **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

## **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

## **MGMT 30500 - Business Statistics**

Credit Hours: 3.00. Introduction to business statistics as related to facilitating managerial decision making. Topics include descriptive statistics, probability models, estimation, hypothesis testing, and regression analysis. Students use software to do their own analyses. Typically offered Summer Fall Spring.

## **IE 33000 - Probability And Statistics In Engineering II**

Credit Hours: 3.00. Continuation of IE 23000. Introduction to statistical inference and experimental design. Correlation, regression, single and multi-factor ANOVA, non-parametric methods. Applications to statistical quality control. Typically offered Fall Spring.

## **Area 2**

CHOOSE ONE COURSE

## **STAT 22500 - Introduction To Probability Models**

Credit Hours: 3.00. An introduction to basic probability. Emphasis is placed on formulation of models and applications. Probability calculus, standard distributions, random variables, and moments. Credit cannot be given for more than one of STAT 22500, STAT 31100, or STAT 41600. Typically offered Summer Fall Spring.

## **STAT 31100 - Introductory Probability**

Credit Hours: 3.00. Formulation of probability problems, discrete and continuous random variables, expectation, standard distributions, applications to statistical problems, and problems in the physical sciences. Credit cannot be given for more than one of STAT 22500, 31100, or STAT 41600. Prerequisite: two semesters of college calculus. Typically offered Spring.

## **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

## **IE 23000 - Probability And Statistics In Engineering I**

Credit Hours: 3.00. An introduction to probability and statistics. Probability and probability distributions. Mathematical expectation. Functions of random variables. Estimation. Applications oriented to engineering problems. Typically offered Fall Spring.

## **Area 3**

## **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

## **Area 4**

CHOOSE TWO COURSES

## **STAT 51300 - Statistical Quality Control**

Credit Hours: 3.00. A strong background in control charts including adaptations, acceptance sampling for attributes and variables data, standard acceptance plans, sequential analysis, statistics of combinations, moments and probability distributions, applications. Offered in alternate years. Typically offered Fall Spring.

## **IE 53000 - Quality Control**

Credit Hours: 3.00. Principles and practices of statistical quality control in industry. Control charts for measurements and for attributes. Acceptance sampling by attributes and by measurements. Standard sampling plans. Sequential analysis. Sampling inspection of continuous production. Typically offered Spring Fall Summer.

## **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2n$ ,  $3n$ ,  $2m \times 3n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

## **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

## **IE 33600 - Operations Research - Stochastic Models**

Credit Hours: 3.00. Introduction to probabilistic models in operations research. Emphasis on Markov chains, Poisson processes, and their application to queueing systems. Typically offered Fall Spring.

## **Note**

AT LEAST 9 credits of the 15 credit hour minor must be STAT courses.

IE 53000 is considered a STAT course due to cross-listing

**Due to Minor Requirements and Pre-requisites, Below are the Suggested Pathways for Specific Majors**

## Krannert Students

### **STAT 22500 - Introduction To Probability Models**

Credit Hours: 3.00. An introduction to basic probability. Emphasis is placed on formulation of models and applications. Probability calculus, standard distributions, random variables, and moments. Credit cannot be given for more than one of STAT 22500, STAT 31100, or STAT 41600. Typically offered Summer Fall Spring.

### **MGMT 30500 - Business Statistics**

Credit Hours: 3.00. Introduction to business statistics as related to facilitating managerial decision making. Topics include descriptive statistics, probability models, estimation, hypothesis testing, and regression analysis. Students use software to do their own analyses. Typically offered Summer Fall Spring.

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

### **STAT 51300 - Statistical Quality Control**

Credit Hours: 3.00. A strong background in control charts including adaptations, acceptance sampling for attributes and variables data, standard acceptance plans, sequential analysis, statistics of combinations, moments and probability distributions, applications. Offered in alternate years. Typically offered Fall Spring.

### **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2^n$ ,  $3^n$ ,  $2^m \times 3^n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

## IE Majors

### **IE 23000 - Probability And Statistics In Engineering I**

Credit Hours: 3.00. An introduction to probability and statistics. Probability and probability distributions. Mathematical expectation. Functions of random variables. Estimation. Applications oriented to engineering problems. Typically offered Fall Spring.

### **IE 33000 - Probability And Statistics In Engineering II**

Credit Hours: 3.00. Continuation of IE 23000. Introduction to statistical inference and experimental design. Correlation, regression, single and multi-factor ANOVA, non-parametric methods. Applications to statistical quality control. Typically offered Fall Spring.

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

### **STAT 51300 - Statistical Quality Control**

Credit Hours: 3.00. A strong background in control charts including adaptations, acceptance sampling for attributes and variables data, standard acceptance plans, sequential analysis, statistics of combinations, moments and probability distributions, applications. Offered in alternate years. Typically offered Fall Spring.

### **IE 53000 - Quality Control**

Credit Hours: 3.00. Principles and practices of statistical quality control in industry. Control charts for measurements and for attributes. Acceptance sampling by attributes and by measurements. Standard sampling plans. Sequential analysis. Sampling inspection of continuous production. Typically offered Spring Fall Summer.

### **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2^n$ ,  $3^n$ ,  $2^m \times 3^n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

Pharmacy, Nursing, Biology, Agriculture Majors

## **STAT 50300 - Statistical Methods For Biology**

Credit Hours: 3.00. Introductory statistical methods, with emphasis on applications in biology. Topics include descriptive statistics, binomial and normal distributions, confidence interval estimation, hypothesis testing, analysis of variance, introduction to nonparametric testing, linear regression and correlation, goodness-of-fit tests, and contingency tables. Open only to majors related to the life sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Typically offered Fall Spring Summer.

## **STAT 22500 - Introduction To Probability Models**

Credit Hours: 3.00. An introduction to basic probability. Emphasis is placed on formulation of models and applications. Probability calculus, standard distributions, random variables, and moments. Credit cannot be given for more than one of STAT 22500, STAT 31100, or STAT 41600. Typically offered Summer Fall Spring.

## **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

## **STAT 51300 - Statistical Quality Control**

Credit Hours: 3.00. A strong background in control charts including adaptations, acceptance sampling for attributes and variables data, standard acceptance plans, sequential analysis, statistics of combinations, moments and probability distributions, applications. Offered in alternate years. Typically offered Fall Spring.

## **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2n$ ,  $3n$ ,  $2m \times 3n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

## **MATH Majors**

## **STAT 35000 - Introduction To Statistics**

Credit Hours: 3.00. A data-oriented introduction to the fundamental concepts and methods of applied statistics. Exploratory analysis of data. Sample design and experimental design. Probability distributions and simulation. Sampling distributions. The reasoning of statistical inference. Confidence intervals and tests for one and two samples. Inference for contingency tables, regression, and correlation. Introduction to regression with several explanatory variables. Essential use is made of statistical software throughout. Intended primarily for students majoring in the mathematical sciences. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, 35000, 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: two semesters of college calculus. Typically offered Fall Spring.

### **STAT 41600 - Probability**

Credit Hours: 3.00. (MA 41600) An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability and Bayes theorem, discrete and continuous random variables, moments and moment generating functions, joint and conditional distributions, standard discrete and continuous distributions and their properties, law of large numbers and central limit theorem. Credit cannot be given for more than one of STAT 22500, STAT 31100, or 41600. Prerequisite: multivariate calculus. Typically offered Fall Spring.

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

### **STAT 41700 - Statistical Theory**

Credit Hours: 3.00. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions. Typically offered Fall Spring.

### **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2^n$ ,  $3^n$ ,  $2^m \times 3^n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

## Science

### **STAT 51100 - Statistical Methods**

Credit Hours: 3.00. Descriptive statistics; elementary probability; sampling distributions; inference, testing hypotheses, and estimation; normal, binomial, Poisson, hypergeometric distributions; one-way analysis of variance; contingency tables; regression. For statistics majors and minors, credit should be allowed in no more than one of STAT 30100, STAT 35000, STAT 50100, and in no more than one of STAT 50300 and STAT 51100. Prerequisite: Two semesters of college calculus. Typically offered Fall Spring.

### **STAT 22500 - Introduction To Probability Models**

Credit Hours: 3.00. An introduction to basic probability. Emphasis is placed on formulation of models and applications. Probability calculus, standard distributions, random variables, and moments. Credit cannot be given for more than one of STAT 22500, STAT 31100, or STAT 41600. Typically offered Summer Fall Spring.

### **STAT 51200 - Applied Regression Analysis**

Credit Hours: 3.00. Inference in simple and multiple linear regression, residual analysis, transformations, polynomial regression, model building with real data, nonlinear regression. One-way and two-way analysis of variance, multiple comparisons, fixed and random factors, analysis of covariance. Use of existing statistical computer programs. Prerequisite: Coursework in Statistical Methods with a calculus prerequisite. Typically offered Fall Spring Summer.

### **STAT 51300 - Statistical Quality Control**

Credit Hours: 3.00. A strong background in control charts including adaptations, acceptance sampling for attributes and variables data, standard acceptance plans, sequential analysis, statistics of combinations, moments and probability distributions, applications. Offered in alternate years. Typically offered Fall Spring.

### **STAT 51400 - Design Of Experiments**

Credit Hours: 3.00. Fundamentals, completely randomized design; randomized complete blocks; latin square; multi-classification; factorial; nested factorial; incomplete block and fractional replications for  $2n$ ,  $3n$ ,  $2m \times 3n$ ; confounding; lattice designs; general mixed factorials; split plot; analysis of variance in regression models; optimum design. Use of existing statistical programs. Typically offered Fall Spring.

## **Note**

Courses that do not require calculus, such as PSY 20100 and SOC 38200, are not equivalent to the courses listed.

Credit for the STAT minor is not allowed for more than one course in each group (per Course Catalog descriptions):

- STAT 22500, STAT 31100, STAT 41600 or MA 41600
- STAT 30100, STAT 35000, STAT 50100
- STAT 50300 and STAT 51100.