PHYSICS

PHY 110 Energy, Environment and Climate (4 Credits)
Earth's reliance on carbon-based, non-renewable energy sources comes at a severe environmental, economic and political cost. Are there alternatives? This course offers a hands-on exploration of renewable energy technologies with an emphasis on understanding the underlying scientific principles. Students assess worldwide energy demand; study the limits to improved energy efficiency; explore the science and technology of solar, wind and hydropower; understand the science behind global warming; investigate climate models; and evaluate strategies for a sustainable future. This course also includes in-class experiments and field trips. {N}
Fall, Spring, Variable

PHY 111 Living Physics I (4 Credits)
First semester of an algebra-based introductory physics course with an emphasis on biological and chemical systems. Topics include: the modeling of physical interactions in terms of mechanical and electrical forces; random motion and diffusion; mechanical properties of cells; fluid flow, viscosity and surface tension; energy transfers due to mechanical movement; the formation and breaking of chemical bonds; and temperature gradients. This course includes a full lab component, integrated into the regular class meeting times, as well as in-class review of all necessary mathematics with a focus on the use of math to represent information in the physical world (physical modeling). Enrollment limited to 28. (E) {N}
Fall

PHY 112 Mathematics of Living Physics I (1 Credit)
This course is an optional supplement to PHY 111. It is designed for students requiring a calculus-based course to meet major or professional school requirements as well as anyone interested in exploring the subject in more depth mathematically. The two foci of this course are: (1) the use of calculus in mathematical modeling of the physics underlying common biological and chemical processes considered in PHY 111 and (2) the physical insights that can be gained through this analysis. Previous coursework in calculus is required, but the course includes in-class review of all necessary mathematics. S/U only. Corequisite: PHY 111. (E) {N}
Fall

PHY 113 Living Physics II (4 Credits)
Second semester of an algebra-based introductory physics course with an emphasis on the physics of biological and chemical systems. Topics include: thermal energy, enthalpy and Gibbs free energy; probability and the Boltzmann distribution; electric fields, capacitance and potential differences across cell membranes; electric currents and charge flow, including electrical properties of nerve cells; oscillations and waves, including biochemical oscillations and feedback; the ray model of light and its applications to the eye and microscope; the wave model of light and the electromagnetic spectrum; the photon model of light, including optical fluorescence; and magnetism, including magnetic resonance and magnetic imaging. Prerequisite: PHY 111. Enrollment limited to 28. (E) {N}
Spring

PHY 114 Mathematics of Living Physics II (1 Credit)
This course is an optional supplement to PHY 113. It is designed for students requiring a calculus-based course to meet major or professional school requirements as well as anyone interested in exploring the subject in more depth mathematically. The two foci of this course are: (1) the use of calculus in mathematical modeling of the physics underlying common biological and chemical processes considered in PHY 113 and (2) the physical insights that can be gained through this analysis. The course includes in-class review of all necessary mathematics. S/U only. Corequisite: PHY 113. PHY 112 recommended. (E)
Spring

PHY 115 Quantitative Approaches to Physics (1 Credit)
Science blends physical knowledge with mathematical knowledge. This blending changes the meaning attached to math and even the way mathematical equations are interpreted. Learning to think about physics with math involves a number of scientific thinking skills that are rarely taught in introductory classes. Students in this course explicitly learn and practice these skills through individual and group work in a small class setting. Students are recommended for this course on the basis of a short placement test available before registration and again at the start of classes. Successful completion of PHY 115 or the placement test is required to enter any PHY courses with a PHY 117 prerequisite. S/U only. Prerequisite: PHY 117 or PHY 118 must be taken concurrently. Instructor permission required. (E)
Fall, Spring

PHY 117 Introductory Physics I (5 Credits)
The concepts and relations (force, energy and momentum) describing physical interactions and the changes in motion they produce, along with applications to the physical and life sciences. Lab experiments, lectures and problem-solving activities are interwoven into each class. In-class discussion sections offer additional help with mathematics, data analysis and problem solving. This course satisfies medical school and engineering requirements for an introductory physics I course with a lab. Prerequisite: MTH 111 or equivalent. Restrictions: Not open to students who have taken PHY 119. Enrollment limited to 28. {N}
Fall, Spring

PHY 118 Introductory Physics II (5 Credits)
The concepts and relations (force fields, energy fields and potentials) underlying electrical, magnetic and gravitational interactions, as well as an exploration of simple harmonic motion, oscillations and waves. Lab experiments are integrated into the in-class lectures, discussions and problem solving activities. Satisfies medical school and engineering requirements for an introductory physics II course with lab. Prerequisite: PHY 117 or equivalent. Restrictions: Not open to students who have taken PHY 119. Enrollment limited to 28. {N}
Fall, Spring

PHY 119 Advanced Introductory Physics (5 Credits)
This course is designed for incoming students who have significant prior calculus-based experience with the topics covered in PHY 117 (Newtonian mechanics) and PHY 118 (electricity and magnetism), but who nevertheless would benefit from a course in introductory physics at the college level. Students develop their problem-solving, experimental-design, data-analysis, scientific- computing and communication skills on a variety of more advanced applications of the standard introductory physics topics related to mechanics and E & M. Specific applications may include the physics of the solar system(s), numerical solution of F=ma, the atomic theory of matter, the laws of thermodynamics, electric circuits and electromagnetic waves. Prerequisite: MTH 111 or equivalent. Restrictions: Not open to students who have taken PHY 117 or PHY 118. Enrollment limited to 28. Instructor permission required. {N}
Fall

PHY 210 Mathematical Methods of Physical Sciences and Engineering (4 Credits)
This course covers a variety of math topics of particular use to physics and engineering students. Topics investigated in class include ordinary differential equations, linear algebra, Fourier analysis, partial differential equations and a review of multivariate calculus, with particular focus on physical interpretation and application. A working knowledge of differential and integral calculus, Taylor series expansions, complex numbers, and partial derivatives is assumed. Students can arrange to work independently with the instructor in a review of these prerequisites if needed. Prerequisites: MTH 212 and (PHY 111, PHY 117 or PHY 119) or equivalent. Enrollment limited to 30. {M}{N}
Fall, Spring

PHY 211 Computational Methods in the Physical Sciences (4 Credits)
This course provides an overview of commonly used computational methods and their applications to physics problems. Using the Python programming language, students begin with learning how programs send instructions to computers, move on to simple data visualization, error analysis and uncertainty in computational calculations, and then progress to numerical integration and differentiation, machine learning and stochastic methods. In each case, students examine the method's applications to relevant physics scenarios. This course is project-based, with multiple short projects throughout the semester intended to build the skills and generate a set of modules that can be used as part of a final project applying a computational method to an appropriate physics problem of the student's choice. Prerequisites: (PHY 113 and PHY 114) or PHY 118 or PHY 119; and MTH 112. Enrollment limited to 30. {M}{N}
Fall

PHY 215 Light, Relativity, and Quantum Physics (4 Credits)
The special theory of relativity, the wave equation and mathematics of waves, optical phenomena of interference and diffraction, particle and wave models of matter and radiation, Bohr model of atomic structure, introduction to fundamental principles and problems in quantum mechanics, and introduction to nuclear physics. Prerequisite: MTH 112 and (PHY 113 and PHY 114) or PHY 118 or PHY 119. {N}
Spring

PHY 240 Electronics (4 Credits)
A semester of experiments in electronics, with emphasis on designing, building and trouble-shooting circuits. Discrete electronic components: physics and applications of diodes and transistors. Analog and digital IC circuits: logic gates, operational amplifiers, timers, counters and displays. Final individual design project. Prerequisite: (PHY 113 and PHY 114) or PHY 118 or PHY 119, or equivalent. Priority given to physics majors and minors, and students planning to major or minor in Physics. Enrollment limited to 18. Instructor permission required. {N}
Fall

PHY 242 Research in High Precision Spectroscopy (3 Credits)
This course gives students a practical introduction to experimental atomic physics by having students do real, publishable research. While this course-based research program is focused on high precision spectroscopy, students gain skills that can be generally applied to investigational science in experimental design, experimental iteration and systematic error analysis, data analysis and writing scientific papers for publication. In addition, students learn about basic atomic physics and quantum mechanics, atom and light interactions, and optics, and they gain a basic understanding in how experiment and theory interact to further the knowledge of nature. Corequisite: PHY 242L. Enrollment limited to 12. (E) {N}
Fall, Spring, Variable

PHY 242L Laboratory in High Precision Spectroscopy (1 Credit)
This lab course gives students a practical introduction to experimental atomic physics by having students do real, publishable research. While this course-based research program is focused on high precision spectroscopy, students gain skills that can be generally applied to investigational science in experimental design, experimental iteration and systematic error analysis, data analysis and writing scientific papers for publication. In addition, students learn about basic atomic physics and quantum mechanics, atom and light interactions, and optics, and they gain a basic understanding in how experiment and theory interact to further the knowledge of nature. Corequisite: PHY 242. Enrollment limited to 4. (E) {N}
Fall, Spring, Variable

PHY 300 Physics Pedagogy: Theory (2 Credits)
A course emphasizing the pedagogy in physics based on Physics Education Research (PER). Readings and discussion emphasize the research literature and strategies for implementing successful and effective methods of teaching physics at the introductory level in the classroom. May be repeated once for credit. Prerequisites: (PHY 111 and PHY 112) or (PHY 113 and PHY 114) or PHY 117, PHY 118 or PHY 119. Instructor permission required. {N}
Fall, Spring

PHY 301 Physics Pedagogy: Practicum (2 Credits)
A practicum course involving actual classroom experience in implementing methods of teaching based on Physics Education Research (PER). Students have direct interaction with learners in the classroom during group activities, laboratory exercises and problem-solving. May be repeated once for credit. Corequisite: PHY 300. Prerequisites: (PHY 111 and PHY 112) or (PHY 113 and PHY 114) or PHY 117, PHY 118 or PHY 119. Instructor permission required. {N}
Fall, Spring

PHY 317 Classical Mechanics (4 Credits)
Newtonian and Lagrangian dynamics of particles and rigid bodies, oscillations and planetary orbits. Prerequisite: PHY 210 and PHY 215, or equivalent. {N}
Fall

PHY 318 Electricity and Magnetism (4 Credits)
Introduction to (relativistic) local field theory. Electrostatic and magnetostatic fields in vacuum and in matter, Maxwell's equations of electrodynamics and electromagnetic waves. Prerequisite: PHY 210 and PHY 215, or equivalent. {N}
Fall, Spring, Alternate Years

PHY 319 Thermal Physics (4 Credits)
Introduction to statistical mechanics and thermodynamics. Prerequisites: PHY 210 and PHY 215, or equivalent. {N}
Fall, Spring, Alternate Years

PHY 327 Quantum Mechanics (4 Credits)
The formal structure of nonrelativistic quantum mechanics, including operator methods. Wave packets; quantum mechanical scattering and tunneling; central potentials; matrix mechanics of spin, addition of angular momenta; corrections to the hydrogen spectrum; identical particles and exchange symmetry; EPR paradox, Bell's Theorem and the interpretation of quantum mechanics. Prerequisites: PHY 210 and PHY 215, or equivalent. PHY 317 recommended. {N}
Spring

PHY 350 Experimental Physics (4 Credits)
An advanced laboratory course for juniors and seniors in which students learn and make use of advanced signal recovery methods to design and perform laboratory experiments drawn from a wide range of topics in modern and contemporary physics. Students planning on special studies or honors work in experimental physics as seniors should take PHY 350 during their junior year. Prerequisites: PHY 210, PHY 215 and PHY 240, or equivalent. Enrollment limited to 12. {N}
Spring

PHY 360gr Advanced Topics in Physics-General Relativity (4 Credits)
This course covers the basics of general relativity. The class discusses tensors and metric spaces and re-frames special relativity in those terms. Students then generalize the rules of special relativity to non-inertial frames and use the equivalence principle to extend those ideas to spaces with gravitational fields. The class explores "Einstein's equation" relating matter and geometry. Finally, students discuss basic applications, including black holes, gravitational waves and cosmology. Prerequisites: PHY 210 and PHY 215, or equivalent. {N}
Fall, Spring, Variable

PHY 360op Advanced Topics in Physics-Optics (4 Credits)
Electromagnetic waves; polarization and polarizing devices; reflection and refraction at interfaces; optical properties of dielectrics and metals; birefringent materials and devices; multiple beam interference and interferometers; diffraction and optical resolution; lasers. Prerequisite: PHY 210. {N}
Fall, Spring, Variable

PHY 399 Current PhysicsLiterature (2 Credits)
For this course we read articles and attend talks on diverse topics in physics; attendance at bi-weekly Physics Seminars is required. The emphasis is put on oral presentation and discussion of the new phenomena using knowledge from other physics courses. Prerequisite: PHY 215, or equivalent. Restrictions: Juniors and seniors only. Enrollment limited to 8. {N}
Fall, Spring, Variable

PHY 400 Special Studies (1-4 Credits)
Instructor permission required.
Fall, Spring

PHY 410 Capstone Physics (1 Credit)
This course is intended to give students an opportunity to synthesize bodies of knowledge from the different sub-disciplines of physics. Administering of GRE practice exams is used as an assessment tool of this understanding and of relevant analytical skills needed for problem-solving. {N}
Fall, Spring, Variable

PHY 430D Honors Project (4 Credits)
Department permission required.
Fall, Spring

PHY 432D Honors Project (6 Credits)
This is a full-year course. Department permission required.
Fall, Spring