Physics Courses (PHYSICS)

Courses

Basic laws and concepts of physics introduced and demonstrated through operation of everyday devices and systems. Emphasis on understanding physical principles behind working of modern technologies and interplay between science and technology. Prerequisite(s): student must have satisfied university entrance requirements in English and Mathematics. (Fall and Spring)

PHYSICS 1010. Physics in Everyday Life Laboratory — 1 hr.
Laboratory activities involving energy, temperature and heat, waves and sound, electricity and magnetism, light and color; and the atomic and nuclear structure of matter. Emphasis on observation, interpretation, and conceptual understanding of physical phenomena. Lab, 2 periods. Prerequisite(s) or corequisite(s): PHYSICS 1000 (880:012) or consent of department head. (Fall and Spring)

PHYSICS 1100. First-Year Projects in Physics — 1 hr.
An introduction to the basic elements of physics research and applications. Students will complete a series of projects designed to integrate theory, measurement and computation to create instruments and devices that interact with the physical world. In doing so, students will learn how to create and control electro-mechanical devices and gain experience in techniques used in both industry and research. Prerequisite(s) or corequisite(s): PHYSICS 1701 (880:130), Physics I for Science and Engineering, or the consent of the department head. (Fall)

PHYSICS 1511 (880:054). General Physics I — 4 hrs.
Algebra-based introductory course covering Newtonian mechanics, gravitation, and thermal physics. Emphasis on conceptual understanding of physical principles through group investigations and lab activities. Discussion/lab, 5 periods. Prerequisite(s): MATH 1130 (880:044) or MATH 1140 (800:048) or MATH 1150 (800:048) or MATH 1420 (800:060) or equivalent, or a satisfactory ALEKS score. (Fall and Spring)

Algebra-based introductory course covering electricity, magnetism, optics, and modern physics. Emphasis on conceptual understanding of physical principles through group investigations and lab activities. Discussion/lab, 5 periods. Prerequisite(s): PHYSICS 1511 (880:054) or PHYSICS 1701 (880:130). (Fall and Spring)

Calculus-based introductory course covering Newtonian mechanics, gravitation, and thermal physics. Lab activities. Discussion/lab, 5 periods. Prerequisite(s): one year of high school physics or equivalent. Prerequisite(s) or corequisite(s): MATH 1420 (800:060). (Fall)

Calculus-based introductory course covering electricity, magnetism, and optics. Lab activities. Discussion/lab, 5 periods. Prerequisite(s): PHYSICS 1511 (880:054) (minimum grade of B) or PHYSICS 1701 (880:130). Prerequisite(s) or corequisite(s): MATH 1421 (800:061). (Spring)

Calculus-based course covering the more advanced topics in introductory physics. Emphasis on developing analytical and computational skills needed to study physics at a more advanced level. Topics include Newtonian mechanics and applications, Maxwell's equations and applications. Prerequisite(s): PHYSICS 1702 (880:131). (Fall)

PHYSICS 2700. Mathematical Methods of Physics — 3 hrs.
Introduction to the mathematical methods used in upper-level Physics courses, illustrated with applications from all areas of Physics. Applications will illustrate electrodynamics, thermodynamics, classical mechanics and quantum mechanics. Prerequisite(s): MATH 1420 (800:060); MATH 1421 (800:061); MATH 2422 (800:062); PHYSICS 1701 (880:130); PHYSICS 1702 (880:131); PHYSICS 2300 (880:132). (Spring)

PHYSICS 3000 (880:180). Undergraduate Research in Physics — 1-6 hrs.
Research activities under direct supervision of sponsoring staff members or at a national laboratory. Should normally be taken after the first year of the major. Successful completion of the research experience requires both a written and oral report. Prerequisite(s): minimum overall 2.50 GPA; consent of department. (Fall and Spring)

PHYSICS 3500. Robotics and Sensors — 3 hrs.
Students will build their own autonomous robot. Students will learn and apply basic electronics, programming, physics concepts to develop their robot and create an interactive presentation on their creation. These robotics concepts will also be applied to important issues for industry and sustainability in the areas of automation, energy, and transportation. Lecture 1 period, Lab, 3 periods. Prerequisite(s): PHYSICS 1511 (880:054) and PHYSICS 1512 (880:056), or PHYSICS 1701 (880:130) and PHYSICS 1702 (880:131), or TECH 1037 (330:037) or CS 1510 (810:051). Other interested students with some experience in coding and/or electronics experience are encouraged to contact the instructor. (Same as TECH TEE 3050) (Variable)

PHYSICS 3179 (880:179). Cooperative Education.
Applied physics internship under PHYSICS 3179 (880:179) should be taken during the junior or senior year. If unable to do so, the internship may be done under PHYSICS 3500 (880:184) with consent of department. Successful completion of either PHYSICS 3179 (880:179) or PHYSICS 3500 (880:184) requires both a written and an oral report. Offered on credit/no credit basis only. (Fall and Spring)

Departmentally approved work in applied physics (at an industrial, medical, or government laboratory) followed by oral and written reports given on completed work. Offered on credit/no credit basis only. Prerequisite(s): minimum overall 2.50 GPA; consent of department. (Fall and Spring)

Seminar course covering aspects important for life after graduation. Participation in physics colloquia; oral report on research topic or internship, drafting resume/CV, interview, perform job and graduate school search. Prerequisite(s): PHYSICS 4100/5100 (880:137g). (Fall)
PHYSICS 4050/5050 (880:140g). Optical Science — 3 hrs.
An introduction to optics and applied optics. Topics include: geometric
optics, wave optics, quantum optics, and introductions to lasers
and optical spectroscopy. Discussion, 2 periods; lab, 2 periods.
Prerequisite(s): PHYSICS 1512 (880:056) or PHYSICS 1702
(880:131); junior standing or consent of department head. (Even Falls)

PHYSICS 4080/5080. Resources for Teaching Physics — 2 hrs.
A physics course that focuses on topics recommended for high
school physics programs, with an emphasis on various physics
education resources in the context of science education initiatives.
This course is designed for both current science teachers and
science education undergraduates. Prerequisite(s): PHYSICS 1511
(880:054) or PHYSICS 1701 (880:130); PHYSICS 1512 (880:056) or
PHYSICS 1702 (880:131); junior standing. (Spring)

PHYSICS 4100/5100 (880:137g). Modern Physics — 4 hrs.
Special relativity; quantum phenomena; wave-particle duality; atomic
and nuclear structure; properties of solids, interaction of radiation
with matter; and elementary particles. Prerequisite(s): PHYSICS 1702
(880:131); junior standing. (Spring)

PHYSICS 4110/5110 (880:138g). Modern Physics Laboratory — 2 hrs.
Experiments on interactions of photons and electrons; mass and
charge of electrons; atomic spectroscopy; nuclear detection and
spectroscopy; spin resonance; and properties of solids. Requires
detailed lab reports, including error analysis. Prerequisite(s): junior
standing. Prerequisite(s) or corequisite(s): PHYSICS 4100/5100
(880:137g). (Spring)

PHYSICS 4160/5160. Data Visualization, Modeling and
Simulation — 3 hrs.
This course focuses on the theory and practice of designing effective
visualizations of various data sets, processing images, modeling and
finding patterns in these data sets. The course covers visualization
tools, scientific visualization, medical visualization, and information
visualization. Topics include image processing techniques and
the associated toolboxes, methods to visualize and analyze the evolution
of data sets including images, and finding predictive models and
simulation methods that can generate and explain data. Prerequisite(s):
CS 1510 (810:051); junior standing. (Spring)

PHYSICS 4200/5200 (880:144g). Nanoscience — 3 hrs.
Study of nanoscale materials and processes, with emphasis on the
preparation and characterization of materials with nanometer scale
dimensions; investigation of how nanoscale dimensions produce
unique chemical and physical properties; nanoscale microscopy
and spectroscopic methods of investigation. Prerequisite(s):
CHEM 1110 (860:044) and CHEM 1120 (860:048) or (CHEM 1130
(860:070)); PHYSICS 1511 (880:054) or PHYSICS 1701 (880:130);
PHYSICS 1512 (880:056) or PHYSICS 1702 (880:131); junior standing. [Same as CHEM 4200/5200 (860:144g)] (Fall)

PHYSICS 4210/5210 (880:148g). Nanotechnology — 3 hrs.
Study of nanoscale materials and processes, with emphasis on the
current and potential future applications of materials with distinctive
properties due to their nanometer scale dimensions; nanoporous
materials; discussion of the broader implications of nanotechnology
in areas such as government policy, occupational safety and
medical technology. Prerequisite(s): CHEM 1110 (860:044) and
CHEM 1120 (860:048) or (CHEM 1130 (860:070)); PHYSICS 1511
(880:054) or PHYSICS 1701 (880:130); PHYSICS 1512
(880:056) or PHYSICS 1702 (880:131); junior standing. [Same as CHEM 4210/5210 (860:148g)] (Odd Springs)

PHYSICS 4290/5290. Project Lead The Way: Digital Electronics
— 3 hrs.
Introduction to the theory and applications of analog and digital
electronics utilizing the Digital Electronics curriculum from the
nationally certified Project Lead The Way (PLTW) curriculum.
Especially intended for science and technology K-12 education majors
to become certified PLTW teachers of this course. Prerequisite(s):
PHYSICS 1511 (880:054) or PHYSICS 1400 or PHYSICS 1701
(880:130); junior standing. (Same as TECH 4290/5290) (Spring)

PHYSICS 4300/5300 (880:152g). Introduction to Electronics — 4 hrs.
Introduction to DC and AC circuits; electrical measurements, circuit
theory and circuit simulation; analog and digital circuits; energy
generation and efficiency. Discussion, 2 periods; lab, 4 periods.
Prerequisite(s): PHYSICS 1512 (880:056) or PHYSICS 1702
(880:131); MATH 1421 (800:061); junior standing. (Fall)

Introduction to computer interfacing, instrument control, and
data acquisition. Utilization of industry standard software and
microcontrollers to acquire and process data, process signals, and
perform feedback control of physical systems. Prerequisite(s):
PHYSICS 1511 (880:054) and PHYSICS 1512 (880:056), or
PHYSICS 1701 (880:130) and PHYSICS 1702 (880:131); junior standing. (Odd Springs)

PHYSICS 4450/5450 (880:185g). Laboratory Projects — 1-3 hrs.
Experimental activities to meet individual needs and interests not
normally included in other courses. Maximum of 3 hours may be
applied to a physics major or minor. Prerequisite(s): junior standing;
consent of department. (Fall and Spring)

Vectors and kinematics; force and motion; work and energy;
Lagrange's equations; gravity; oscillations; rigid-body motion; and
accelerated reference frames. Prerequisite(s): MATH 1420 (800:060);
MATH 1421 (800:061); PHYSICS 1701 (880:130); PHYSICS 1702
(880:131); PHYSICS 2300 (880:132); PHYSICS 2700; junior standing.
Corequisite(s): MATH 2422 (800:062). (Fall)

PHYSICS 4700/5700 (880:167g). Electrodynamics — 4 hrs.
Vector calculus. Electrostatic fields and dielectrics; magnetic fields,
permanent magnets, and magnetic materials; Maxwell's equations and
electromagnetic waves. Prerequisite(s): MATH 2422 (800:062);
PHYSICS 2300 (880:132); PHYSICS 2700; junior standing.
Prerequisite(s) or corequisite(s): PHYSICS 4600/5600 (880:166g).
(Odd Falls)

Structural, thermal, and electronic properties of materials;
applications to modern devices. Discussion, 2 periods; lab,
2 periods. Prerequisite(s): PHYSICS 4100/5100 (880:137g);
PHYSICS 4110/5110 (880:138g); junior standing. (Odd Falls)

PHYSICS 4800/5800 (880:172g). Quantum Mechanics — 4 hrs.
Solution of Schrodinger equation for several systems: spin and
angular momentum; identical particles; perturbation theory; WKB
approximation; and scattering. Prerequisite(s): PHYSICS 2700;
PHYSICS 4100/5100 (880:137g); PHYSICS 4600/5600 (880:166g);
junior standing. (Even Springs)

PHYSICS 4860/5860 (880:150g). Computational Physics — 3 hrs.
Computer simulations and numerical solutions of behaviors of
important physical systems, emphasizing those that are very
difficult or impossible to analyze by traditional means, for example,
nonlinear oscillators or phase transitions in the Ising Model.
Discussion, 2 periods; lab, 2 periods. Prerequisite(s): PHYSICS 2300
(880:132); PHYSICS 2700; PHYSICS 4100/5100 (880:137g);
PHYSICS 4600/5600 (880:166g); junior standing. (Spring)

PHYSICS 4900/5900 (880:136g). Thermodynamics and Statistical
Mechanics — 4 hrs.
General principles of classical thermodynamics and applications
(e.g., to first-order phase transitions); general principles of statistical
mechanics and applications (e.g., to the classical ideal gas).
Prerequisite(s): PHYSICS 2300 (880:132); PHYSICS 2700;
PHYSICS 4100/5100 (880:137g); junior standing. (Spring)

PHYSICS 4950/5950 (880:189g). Readings in Physics — 1-3 hrs.
Readings/problems in areas of physics (or related interdisciplinary
areas) not normally covered in other courses. Maximum of 3 hours
may be applied to a physics major or minor. Prerequisite(s): junior
standing; consent of department. (Variable)

PHYSICS 4990. Senior Thesis — 1 hr.
Senior Thesis. Open only to students pursuing the B.S. Physics Honors
Research Emphasis or the B.A. Physics-Teaching Honors Research
Emphasis. Prerequisite(s): consent of the department head. (Fall,
Spring, Summer)

PHYSICS 6100 (880:205). Modeling and Simulation of Physical
Systems — 3 hrs.
Computer simulation and visualization of physical systems.
Students will code, debug, and run basic simulations in C++ as
well as more sophisticated simulations with other tools, including
parallel computing. Prerequisite(s): CS 1160 (810:036) and
PHYSICS 4860/5860 (880:150g), or MATH 3440/5440 (800:176g)
and CS 1160 (810:036), or consent of instructor. (Variable)

PHYSICS 6299 (880:299). Research.
Prerequisite(s): consent of department. (Variable)

PHYSICS 6300 (880:220). Computer Interfacing and Signal
Processing — 3 hrs.
Introduction to computer interfacing, instrument control, and data
acquisition. Discussion of digital signal processing and utilization
of industry-standard software platforms in laboratory activities.
Prerequisite(s): PHYSICS 2300 (880:132); PHYSICS 4300/5300
(880:152g). (Variable)

PHYSICS 6500 (880:250). Special Problems in Physics — 1-6 hrs.
Credit determined at registration. Problems selected according to
needs of students. Prerequisite(s): consent of department. (Variable)