

# PHYSICS (PHYS)

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## PHYS 1201. Introduction to Astronomy. (3 Credits)

Includes discussions of the solar system, stars, galaxies and cosmology. Method of making observations. An investigation of physical phenomena including lenses spectroscopy and refraction. Direct observation through the telescope of celestial objects depending on their position and weather conditions. Astro photography and film development is also available. The lab is intended for the student with little mathematical background. Note that there will be regular night-time observation labs. (No lab fee).

**Attribute:** PSCI.

## PHYS 1203. Environmental Physics. (3 Credits)

An introductory course for non-science majors. Topics include heat engines, energy supply and consumption, nuclear fission and fusion; renewable energy resources, fossil fuels, and acid rain. Emphasis will be on basic physical principles as applied to environmental issues. Course requirements include several laboratory experiments. The laboratory is designed to investigate various physical properties of the environment. Experiments will include water-testing and air quality measurements as well as the rudiments of electronic circuitry and the investigation of radioactivity in the environment. There is no lab fee.

**Attributes:** ENST, ESNS, ESPS, PSCI, SOIN, URST.

## PHYS 1206. Physics of Everyday Life. (3 Credits)

An introductory course for non-science majors. Topics include physical phenomena that one comes across in everyday life. Physical principles will be explained and numerous examples—many from sports—will be presented. There will be multiple laboratory experiments that will give students a better understanding of several physical quantities. The experiments will illustrate aspects of mechanics, wave motion, heat and electricity and magnetism. There is no lab fee.

**Attribute:** CO09.

## PHYS 1207. Physics of Light and Color. (3 Credits)

An introductory course for non-science majors. Topics include laser light and how lasers influence our lives, with examples from telecommunications, compact disk players, laser surgery, and holograms. An investigation of the human eye and the mechanism of color vision. Course requirements include several laboratory experiments. The laboratory is designed to investigate various physical properties of laser light and color. There is no lab fee.

**Attribute:** PSCI.

## PHYS 1242. Science Fiction Physics. (3 Credits)

This course will use science fiction as a way to understand basic ideas in physics. Topics such as energy, momentum, mechanics, special and general relativity, among other areas of physics will be studied in the context of science fiction. We will use these physical ideas to determine in many cases whether or not various ideas (such as faster-than-light travel, teleportation, artificial gravity, and more) in science fiction stories would be viable.

**Attribute:** PSCI.

## PHYS 1350. The Physics of Climate Change. (3 Credits)

Anthropogenic climate change due to increased atmospheric carbon dioxide from fossil fuel burning is having a profound effect on the global community. The consequences range from mild to catastrophic. This course will provide an overview of the physics behind climate change, including how scientists know human activities are responsible for global warming, sea level rise, and ocean acidification.

**Attributes:** ENST, ESPS, PSCI.

## PHYS 1501. General Physics I. (3 Credits)

An introductory course in physics at the noncalculus level. A study of the basic laws of classical and modern physics, including mechanics, heat, sound, electricity and magnetism.

**Attributes:** ENST, ENV5, ESNS, ESPS.

**Corequisite:** PHYS 1503.

## PHYS 1502. General Physics II. (3 Credits)

Continuation of PHYS 1501.

**Corequisite:** PHYS 1504.

## PHYS 1503. General Physics I Recitation. (0 Credits)

Discussion and problem solving on topics to be covered in PHYS 1501 General Physics II.

**Corequisite:** PHYS 1501.

## PHYS 1504. General Physics II Recitation. (0 Credits)

Discussion and problem solving on topics to be covered in PHYS 1502 General Physics II.

**Corequisite:** PHYS 1502.

## PHYS 1511. Physics I Lab. (1 Credit)

Measurements in mechanics, heat, waves, electricity and magnetism, optics and atomic and nuclear physics. Lab fee.

**Attribute:** ENV5.

## PHYS 1512. Physics II Lab. (1 Credit)

Continuation of PHYS 1511. Lab fee.

## PHYS 1601. Introduction to Physics I. (4 Credits)

This is an introductory calculus-based course for physics majors—a study of mechanics, thermodynamics, electricity and magnetism, optics, and atomic physics. Note: Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attributes:** ENST, ESNS, ESPS.

## PHYS 1602. Introduction to Physics II. (4 Credits)

This is a continuation of PHYS 1601, a calculus-based introductory physics course. Note: Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Prerequisite:** PHYS 1601.

**Corequisite:** PHYS 1604.

## PHYS 1603. Introduction to Physics I Recitation. (0 Credits)

Discussion and problem solving on topics to be covered in PHYS 1601 Introductory Physics I.

**Corequisite:** PHYS 1601.

## PHYS 1604. Introduction to Physics II Recitation. (0 Credits)

Discussion and problem solving on topics to be covered in PHYS 1602 Introductory Physics II.

**Prerequisite:** PHYS 1601.

**Corequisite:** PHYS 1602.

## PHYS 1701. Physics I. (3 Credits)

This is an introductory calculus-based physics course for students who have completed one year of college calculus (MT 1206-1207 or equivalent). It provides a study of mechanics, the physics of motion, starting with velocity and ending with harmonic motion.

**Attributes:** ENST, ESNS, ESPS.

**Mutually Exclusive:** NSCI 1701.

**PHYS 1702. Physics II. (3 Credits)**

The course is the second-semester continuation of PHYS 1701. It is a calculus-based physics course that examines waves, sound, optics, electricity, magnetism, and electronics.

**Corequisite:** PHYS 1704.

**Mutually Exclusive:** NSCI 1702.

**PHYS 1703. Physics I Recitation. (0 Credits)**

Discussion and problem solving on topics to be covered in PHYS 1701 Physics I.

**Corequisite:** PHYS 1701.

**PHYS 1704. Physics II Recitation. (0 Credits)**

Discussion and problem solving on topics to be covered in PHYS 1702 Physics II.

**Corequisite:** PHYS 1702.

**PHYS 2005. Introduction to Modern Physics. (4 Credits)**

A survey course of the more important areas of modern physics. Topics include special theory of relativity, introduction to quantum mechanics, atomic physics, molecules and solids, nuclear structure and elementary nuclear physics applications and particle physics. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**Prerequisites:** PHYS 1601 and PHYS 1602.

**PHYS 2010. Lab Methods and Techniques. (1 Credit)**

Topics to be covered are (a) lab safety procedures, (b) machining techniques using Machine Shop equipment and tools, (c) maintenance of equipment, (d) handling of high voltage electrical equipment, (e) trouble shooting and diagnostic tests of electronic equipment, (f) handling of precision instruments, and (g) any other topics deemed necessary to make the lab a safe place to work.

**Prerequisite:** PHYS 1601.

**PHYS 2011. Intermediate Laboratory. (2 Credits)**

Measurements in electricity and magnetism. This course will also include practical machine shop experience. Lab fee.

**Prerequisites:** PHYS 2305 or PHYS 2005.

**PHYS 2101. Engineering Statics and Dynamics. (4 Credits)**

The following topics will be covered: forced system resultants, equilibrium or rigid body, structural analysis, internal forces, friction, center of gravity centroid, moments of inertia, virtual work, impulse and momentum, rigid-body kinematics, relative motion, Coriolis accelerations, and rigid-body kinetics. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**Prerequisites:** PHYS 1601 and PHYS 1602.

**PHYS 2102. Mechanics of Materials. (4 Credits)**

An introduction to the mechanical properties of materials including their response to: stress, strain, torsion, bending and shear. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**PHYS 2111. Introduction to Inventions and Patents. (1 Credit)**

Introduction to the creative process that drives innovation and inventorship. Includes discussions on creative development of ideas, formalizing patent applications, commercialization and technology transfer.

**PHYS 2201. Classical Mechanics I. (4 Credits)**

An introduction to classical mechanics including kinematics and dynamics of particles and rigid bodies. Includes a discussion of D'Alembert's principle, Lagrange's equations and Hamilton's principle. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**Prerequisites:** PHYS 1601 and PHYS 1602 and PHYS 2005.

**PHYS 3001. Electricity and Magnetism I. (4 Credits)**

Electrostatics, dielectric media, direct current circuits, magnetism and magnetic media, transients and alternating currents, electromagnetic induction, Maxwell's equations, electromagnetic waves and wave guides. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**Prerequisites:** PHYS 1601 and PHYS 1602 and MATH 2005.

**PHYS 3013. Experimental Techniques in Engineering and Physics. (3 Credits)**

Experimental Techniques in Engineering and Physics seeks to provide broad overview of engineering and physics concepts and experimental methods through lectures and laboratory experiments. The experiments are designed to demonstrate the physical principles learned in engineering and physics courses. In addition to experimental procedure, focus will be placed on technical writing and presentation.

**Prerequisite:** PHYS 2010.

**PHYS 3100. Math Methods in Physics. (4 Credits)**

Implicit function theorem, Jacobians, curves and line integrals, multiple integrals, surface and volume integrals, divergence theorem, Stokes' theorem, and Green's theorem. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**PHYS 3101. Math Methods in Physics I. (4 Credits)**

Matrices and determinants, series expansion, complex numbers and functions, Fourier series, ordinary differential equations, partial differential equations, and special functions of physics, theory of special relativity. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Prerequisite:** MATH 2005.

**PHYS 3102. Math Methods in Physics II. (4 Credits)**

Continuation of PHYS 3101. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**Prerequisite:** PHYS 3101.

**PHYS 3103. Math Methods in Physics III. (4 Credits)**

Topics to be covered include suffix notation and tensor algebra, theory of complex variables, contour integration, applications of contour integration, Sturm-Liouville Theory, integral equations. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**PHYS 3201. Fluid Mechanics. (4 Credits)**

This course introduces the fundamentals of fluid statics, dimensional analysis and modeling, viscous flow in pipes, channel flows, laminar flow, transition, turbulence; flow past an object, wake, separation, vortices, drag; convection, conduction, transition from periodic to chaotic behavior, compressible flow; transition to turbulence. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**Prerequisite:** PHYS 1601.

**PHYS 3205. Fundamentals of Engineering Thermodynamics. (4 Credits)**

Basic principles and laws of thermodynamics and their relation to pure substances, ideal gases, and real gases. Use of thermodynamic property tables. Development of concepts of reversibility and availability. First and Second Law application to engineering systems; power and refrigeration cycles. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Prerequisites:** PHYS 1601 and PHYS 1602.

**PHYS 3211. Computational Physics and Programming I. (2 Credits)**

An introductory course in the use of computers to numerically solve problems in physics using C++. Topics include numerical solution of non-linear equations, interpolation and extrapolation, numerical differentiation, and integration. No prior knowledge of computer language is required.

**PHYS 3242. Science Fiction Physics for Majors. (4 Credits)**

This course will use science fiction as a way to understand advanced topics in physics. Energy, momentum, mechanics, and special and general relativity, among other areas of physics, will be studied at an upper level in the context of science fiction. Note: Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Prerequisites:** PHYS 3001 and PHYS 3101.

**PHYS 3401. Thermo and Stat Physics. (4 Credits)**

Fundamental principles, first and second laws, thermodynamic functions; a discussion of the kinetic theory of gases and introductory statistical mechanics. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**Prerequisites:** PHYS 1602 and PHYS 2005.

**PHYS 3555. Modeling, Simulation, and Design. (4 Credits)**

This course introduces students to fundamental concepts of mechanical design, solid modeling, and prototype development. Topics to be covered will include industrial design principles, orthographic projections, and assemblies. Students will engage in designing, simulating, and manufacturing mechanical components. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Prerequisites:** PHYS 1601 and PHYS 1602.

**PHYS 3601. Optics. (4 Credits)**

Wave propagation, interference, diffraction, and polarization; electromagnetic theory of light. Note: Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**Prerequisites:** PHYS 2005 and PHYS 3001.

**PHYS 4003. Classical Mechanics II. (4 Credits)**

Lagrange's equations, variational principles, Hamilton's equations, canonical transformations, Hamilton-Jacobi theory, rigid body motion, small oscillations, central forces and Kepler's planetary motion. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**Prerequisites:** PHYS 2201 and PHYS 3101.

**PHYS 4004. Electricity and Magnetism II. (4 Credits)**

Continuation of PHYS 3001. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**Prerequisites:** PHYS 1601 and PHYS 1602 and PHYS 3001.

**PHYS 4005. Quantum Mechanics I. (4 Credits)**

Foundations of quantum mechanics, Schrödinger equation, Hermitian operators, solution of the Schrödinger equation, harmonic oscillator, hydrogen atom, angular momentum operators, variational method, perturbation theory. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**Prerequisites:** PHYS 2005 or PHYS 2305.

**PHYS 4006. Quantum Mechanics II. (4 Credits)**

Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**PHYS 4010. Introduction to Electrical Engineering. (4 Credits)**

Electrical circuit laws and theorems, transient and steady-state response, phasors, frequency response, resonance. Diode and transistor circuits, digital logic devices. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**Prerequisites:** PHYS 2002 or PHYS 3001.

**PHYS 4011. Nuclear and Particle Physics. (4 Credits)**

A survey of nuclear and particle physics for advanced undergraduate students. It explores the common roots and tools of the nuclear (medium energy) and particle (high energy) fields. The primary goal is to understand the basic ideas of the Standard Model of quarks, leptons and the fundamental interactions of the universe. Specific topics include properties and simple models of nuclei, fundamental interactions and their mediators, quarks and leptons, symmetries and tests of conservation laws, physics beyond the Standard Model, and other ideas in theoretical and experimental nuclear and particle physics. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Prerequisites:** PHYS 4005 and (PHYS 2005 or PHYS 2305).

**PHYS 4012. Solid State Physics. (4 Credits)**

An introduction to the elastic, thermal, electromagnetic, and optical properties of solids; energy bands, semiconductors, superconductors, surface and defect structures and device applications. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attribute:** GEAP.

**Prerequisites:** PHYS 1601 and PHYS 1602 and PHYS 2005.

**PHYS 4020. Biomechanics. (4 Credits)**

Engineering principles such as mechanics, rigid body dynamics, fluid dynamics and solid mechanics are applied to the study of biological systems such as ligaments, tendons, bone, muscles, joint, etc. Methods for both rigid body and deformational mechanics are developed in the context of bone, muscle, and connective tissue. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Prerequisite:** PHYS 2102.

**PHYS 4021. Medical Instrument and Imaging. (4 Credits)**

Introduction to the physics and the practical technology associated with such methods as X-ray computed tomography (CT), magnetic resonance imaging (MRI), functional MRI (f-MRI) and spectroscopy, ultrasonics (echocardiography, Doppler flow), PET scans as well as optical methods such as bioluminescence and optical tomography. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**PHYS 4025. Machine Dynamics and Mechanical Design. (4 Credits)**

The principles of dynamics as applied to the analysis of the accelerations and dynamic forces in machines such as linkages, cam systems, gears, belts, chains, couplings, bearings, brakes, clutches, and flexible mechanical elements. Concepts of engineering design, material selection, failure theories, fracture and fatigue. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**PHYS 4192. Rediscovering the New World. (4 Credits)**

This course uses the lenses of literary studies and physics to consider the technologies that enabled the Spanish conquest of Mexico, Central America, and the Caribbean. In particular, it highlights 15th- and 16th century writings of Christopher Columbus, Hernán Cortés, and others on the emergent science of the age of exploration. Concurrently, it examines scientific technologies that have emerged in the last decade and are being used to uncover “lost” pre-Hispanic cultures at sites such as Chichén Itzá, Tulum, and Teotihuacan. Students will hone their critical and analytical skills, and particularly their oral and written expression, in a multidisciplinary context while exploring one of the most dynamic time periods in modern history. Note: Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**Attributes:** ICC, LAHA.

**Mutually Exclusive:** LALS 4192.

**PHYS 4211. Computational Physics II. (3 Credits)**

A continuation of PHYS 3211, this course will cover advanced topics in programming and their applications in physics. Topics can include, but are not limited to, numerical partial differential solvers, parallel computing, and optimization of numerical algorithms.

**Prerequisite:** PHYS 3211.

**PHYS 4401. Undergraduate Research I. (4 Credits)**

Participation of the undergraduate in research under the direction of one of the faculty. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**PHYS 4402. Undergraduate Research II. (4 Credits)**

Participation of the undergraduate in research under the direction of one of the faculty. Four-credit courses that meet for 150 minutes per week require three additional hours of class preparation per week on the part of the student in lieu of an additional hour of formal instruction.

**PHYS 4999. Independent Study. (0 to 4 Credits)**

Independent research and reading with supervision from a faculty member.