PHYSICS

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The major in Physics in the Sciences and Letters Curriculum allows students maximum flexibility to develop scientifically oriented careers in fields requiring a physics background through the Physics Concentration or the Physics Teaching Concentration.

The Physics Concentration is a flexible program for students who plan to pursue technical or professional careers in areas requiring a sound grounding in physical science and mathematics. Students can use the concentration to prepare for employment immediately upon graduation or for continuing on to graduate study in a wide variety of fields.

The Physics Teaching Concentration fulfills state certification requirements to teach both physics and general science.

The LAS Specialized Curriculum in Physics is designed for students who plan to pursue graduate study in physics or a closely allied field. In some cases, however, the greater flexibility of the Science and Letters Curriculum may make it a better choice for graduate school preparation for those who want to pursue a combined major and minor, a double major, or double degrees.

See also Engineering Physics (http://catalog.illinois.edu/undergraduate/engineer/departments/engin-physics) in the College of Engineering. See the Physics Department for additional information.

For the Degree of Bachelor of Science in Liberal Arts and Sciences

Major in Sciences and Letters Curriculum

- Physics Concentration (http://catalog.illinois.edu/undergraduate/las/physics/physics-concentration)
- Physics Teaching Concentration (http://catalog.illinois.edu/undergraduate/las/physics/physics-teaching-concentration)

For the Degree of Bachelor of Science in Physics

- LAS Specialized Curriculum in Physics (http://catalog.illinois.edu/undergraduate/las/physics/las-specialized-curriculum-physics)

PHYS Class Schedule (https://courses.illinois.edu/schedule/DEFAULT/DEFAULT/PHYS)

Courses

PHYS 100 Thinking About Physics credit: 2 Hours.
Conceptual and problem solving skills in preparation for PHYS 211: analysis and mathematical descriptions of physical situations - understanding the meaning of the solutions Prerequisite: Credit or concurrent registration in MATH 220 or MATH 221.

PHYS 101 College Physics: Mech & Heat credit: 5 Hours.
Newton's Laws, work and energy, rotational motion, fluids, thermodynamics, and waves. A noncalculus-based approach for majors in the life sciences, preprofessional health programs, agriculture, and veterinary medicine. Credit is not given for both PHYS 101 and either PHYS 211 or PHYS 213. Prerequisite: Trigonometry. This course satisfies the General Education Criteria for: Nat Sci Tech - Phys SciencesQuantitative Reasoning II

PHYS 102 College Physics: E&M & Modern credit: 5 Hours.
Electric forces and fields, electric potential, electric circuits, magnetic forces and fields, geometrical optics, relativity, and modern physics. A noncalculus-based approach for majors in the life sciences, preprofessional health programs, agriculture, and veterinary medicine. Credit is not given for both PHYS 102 and either PHYS 212 or PHYS 214. Prerequisite: PHYS 101. This course satisfies the General Education Criteria for: Nat Sci Tech - Phys SciencesQuantitative Reasoning II

PHYS 110 Physics Careers credit: 0 Hours.
 Exploration of careers founded on physics undergraduate training. Introduction to the Physics Department, faculty, research and curricula. Outside speaker presentations. Approved for S/U grading only.

PHYS 123 Physics Made Easy credit: 3 Hours.
Inquiry-based, nonmathematical, hands-on study of physics for elementary school teachers. Coverage of most of the National Science Education K-4 Content Standards. Additional fees may apply. See Class Schedule.
This course satisfies the General Education Criteria for: Nat Sci Tech - Phys Sciences

PHYS 140 How Things Work credit: 3 Hours.
Nonmathematical approach underscoring the generality and ubiquity of basic physical laws in understanding commonplace phenomena: musical instruments, photography, electric and electronic circuits, television, motors, engines, etc. Credit is not given to engineering majors.
This course satisfies the General Education Criteria for: Nat Sci Tech - Phys Sciences

PHYS 150 Physics of Societal Issues credit: 3 Hours.
Physics topics and applications relevant in the modern world: energy, quantum mechanics, electricity and magnetism, nuclear physics, waves, light, and outer space. Application to satellites, alternative energy, medical imaging, radiation, nuclear weapons, climate change, and electronics. Emphasis on analytical thinking and the applicability to modern societal issues.
This course satisfies the General Education Criteria for: Nat Sci Tech - Phys Sciences

PHYS 192 Science and Pseudoscience credit: 1 Hour.
Extra-sensory perception, alien abduction, and psychic crime-solving from the standpoint of scientific inquiry and exploration; the scientific method, how science progresses, and the types of argumentative fallacies that pervade the pseudoscientific community; examples of good science and how the scientific method is self-correcting.

PHYS 193 Physics of Music credit: 2 Hours.
Physics of music and musical instruments; acoustical physics, propagation of sound waves, the biological physics of human hearing, and the acoustical physics associated with all types of musical instruments.
PHYS 194  Behavior of Complex Systems  credit: 1 Hour.
Exploration of systems with simple rules that nevertheless exhibit
complex behavior. Lecture demonstrations on fractal growth, chaos,
catastrophes, self-assembly, lightning, turbulence, explosions, and
human rhythms. Simple computer models which exhibit regular, irregular,
symmetric, and self-similar patterns and dynamics. Dynamics of isolated
and coupled complex systems and mathematical tools for quantifying
complex behavior.

PHYS 199  Undergraduate Open Seminar  credit: 0 to 5 Hours.
Approved for letter and S/U grading. May be repeated.

PHYS 211  University Physics: Mechanics  credit: 4 Hours.
Newton's Laws, work and energy, static properties and fluids, oscillations,
transverse waves, systems of particles, and rotations. A calculus-based
approach for majors in engineering, mathematics, physics and chemistry.
Credit is not given for both PHYS 211 and PHYS 101. Prerequisite: Credit
or concurrent registration in MATH 231.
This course satisfies the General Education Criteria for:
Nat Sci Tech - Phys Sciences
Quantitative Reasoning II

PHYS 212  University Physics: Elec & Mag  credit: 4 Hours.
Coulomb's Law, electric fields, Gauss' Law, electric potential, capacitance,
circuits, magnetic forces and fields, Ampere's law, induction,
electromagnetic waves, polarization, and geometrical optics. A calculus-
based approach for majors in engineering, mathematics, physics,
and chemistry. Credit is not given for both PHYS 212 and PHYS 102.
Prerequisite: PHYS 211; credit or concurrent registration in MATH 241.
This course satisfies the General Education Criteria for:
Nat Sci Tech - Phys Sciences
Quantitative Reasoning II

PHYS 213  Univ Physics: Thermal Physics  credit: 2 Hours.
First and second laws of thermodynamics including kinetic theory
of gases, heat capacity, heat engines, introduction to entropy and
statistical mechanics, and introduction to application of free energy and
Boltzmann factor. A calculus-based approach for majors in engineering,
mathematics, physics and chemistry. Credit is not given for both
PHYS 213 and PHYS 101. Prerequisite: PHYS 211; credit or concurrent
registration in MATH 241.
This course satisfies the General Education Criteria for:
Nat Sci Tech - Phys Sciences
Quantitative Reasoning II

PHYS 214  Univ Physics: Quantum Physics  credit: 2 Hours.
Interference and diffraction, photons and matter waves, the Bohr atom,
uncertainty principle, and wave mechanics. A calculus-based course for
majors in engineering, mathematics, physics, and chemistry. Credit is not
given for both PHYS 214 and PHYS 102. Prerequisite: PHYS 212.
This course satisfies the General Education Criteria for:
Nat Sci Tech - Phys Sciences
Quantitative Reasoning II

PHYS 221  Enrichment Mechanics  credit: 1 Hour.
Supplement to PHYS 211 with a collaborative group learning approach to
improving conceptual understanding and problem solving in introductory
calculus-based mechanics. Prerequisite: PHYS 100; concurrent
registration in PHYS 211.

PHYS 222  Enrichment E & M  credit: 1 Hour.
Supplement to PHYS 212 with a collaborative group learning approach to
improving conceptual understanding and problem solving in introductory
calculus-based electricity & magnetism. Prerequisite: PHYS 100;
concurrent registration in PHYS 212.

PHYS 225  Relativity & Math Applications  credit: 2 Hours.
Theory of Special Relativity, with applications to kinematics and
dynamics. Key mathematical methods as they apply to aspects of
electromagnetic theory and classical mechanics, including vector
analysis, series expansions, matrices, Fourier analysis, partial
der differentiation, three-dimensional calculus, and simple differential
equations. Prerequisite: Credit or concurrent registration in PHYS 212.

PHYS 280  Nuclear Weapons & Arms Control  credit: 3 Hours.
Nontechnical analysis of the physics of nuclear weapons, nuclear
weapon effects, delivery systems, and defenses against nuclear attack;
presentation of current issues; basis for making informed judgments
about nuclear armaments and arms control. Same as GLBL 280.
This course satisfies the General Education Criteria for:
Advanced Composition

PHYS 298  Freshmen/Sophomore Special Topics in Physics  credit: 0
to 4 Hours.
Topical offerings of technical interest, skills, and knowledge in physics,
and its practice, intended to augment the existing curriculum at the
introductory level. Approved for Letter and S/U grading. May be repeated
in separate terms up to 12 credit hours if topics vary. Prerequisite:
See Class Schedule or departmental course information for topics and
prerequisites. For students with freshman or sophomore standing.

PHYS 325  Classical Mechanics I  credit: 3 Hours.
Kinematics and dynamics of classical systems, including a review
of Newtonian kinematics and dynamics. Three dimensional motion,
variable mass, and conservation laws; damped and periodically driven
oscillations; gravitational potential of extended objects and motion in
rotating frames of reference; Lagrangian and Hamiltonian mechanics.
Prerequisite: PHYS 225; credit or concurrent registration in MATH 285.

PHYS 326  Classical Mechanics II  credit: 3 Hours.
Continuation of PHYS 325. Central force motion, collisions and
scattering, rotational motion, coupled oscillations, continuous media, and
fluid dynamics. Prerequisite: PHYS 325.

PHYS 329  Atmospheric Dynamics I  credit: 3 Hours.
Same as ATMS 302. See ATMS 302.

PHYS 330  Atmospheric Dynamics II  credit: 3 Hours.
Same as ATMS 312. See ATMS 312.

PHYS 398  Sophomore/Junior Special Topics in Physics  credit: 1 to 4
Hours.
Topical offerings of technical interest, skills, and knowledge in physics,
and its practice, intended to augment the existing curriculum at the
intermediate level. Approved for Letter and S/U grading. May be repeated
in separate terms up to 12 hours if topics vary. Prerequisite:
See Class Schedule or departmental course information for topics and
prerequisites. For students with sophomore or junior standing.

PHYS 401  Classical Physics Lab  credit: 3 Hours.
Experiments and techniques in classical mechanics and
electromagnetism. Dynamics of electrical and mechanical oscillators in
the linear domain. Fourier analysis of system response. Measurements
of electrostatic fields, transmission lines, waves, and radiation.
Electromagnetic phenomena in dielectrics, conductors, and magnetic
materials. Instruction in data analysis and report writing. 3 undergraduate
hours. 3 graduate hours. Prerequisite: Credit or concurrent enrollment in
PHYS 325.
PHYS 402 Light credit: 4 Hours.
Wave kinematics; geometrical optics: basic concepts, ray-tracing and matrix formalism; Gaussian imaging by thick lenses, stops, apertures, and intensity relations; interference; interference spectroscopy and coherence; diffraction: Fresnel-Kirchhoff formulation, Fraunhofer case, Fresnel case, and holography; polarized light. 4 undergraduate hours. 3 or 4 graduate hours. (3 hours without lab). Prerequisite: MATH 285; PHYS 102 or PHYS 214.

PHYS 403 Modern Experimental Physics credit: 4 or 5 Hours.
Techniques and experiments in the physics of atoms, atomic nuclei, molecules, the solid state, and other areas of modern physical research. 5 undergraduate hours. 4 graduate hours. Prerequisite: Credit or concurrent registration in PHYS 486.

PHYS 404 Electronic Circuits credit: 5 Hours.
Physics of semiconductor devices; theory and application of discrete and integrated devices in linear circuits; use of operational amplifiers and feedback; regulation, oscillators, and modulation; emphasizes practical experience. 5 undergraduate hours. 4 graduate hours. Prerequisite: PHYS 325.

PHYS 406 Acoustical Physics of Music credit: 4 Hours.
Acoustical physics associated with music and musical instruments, propagation of sound waves in and from musical instruments, and the biological physics of human hearing. Investigation of topics via advanced laboratory and data acquisition techniques. 4 undergraduate hours. 4 graduate hours. Prerequisite: PHYS 213 and PHYS 214.

PHYS 419 Space, Time, and Matter-ACP credit: 3 or 4 Hours.
Identical to PHYS 420 except for the additional writing component including a final term paper. Same as PHIL 419. 3 undergraduate hours. 4 graduate hours. Credit is not given for both PHYS 419 and PHYS 420. Prerequisite: PHYS 101; PHYS 101 or PHYS 211. This course satisfies the General Education Criteria for: Advanced Composition

PHYS 420 Space, Time, and Matter credit: 2 Hours.
Philosophical examination of some fundamental concepts and theories of the physical world, such as time, matter, space, and geometry; interpretation of quantum theory. Same as PHIL 420. 2 undergraduate hours. 2 graduate hours. Credit is not given for both PHYS 420 and PHYS 419. Prerequisite: PHIL 101; PHYS 101 or PHYS 211.

PHYS 427 Thermal & Statistical Physics credit: 4 Hours.
Equilibrium thermodynamics, statistical mechanics, and kinetic theory of gases. A unified treatment is used in that the principles of heat and thermodynamics are discussed along with statistical postulates and the microscopic approach of introductory quantum mechanics. 4 undergraduate hours. 4 graduate hours. Credit is not given for both PHYS 427 and any of ME 404, CHEM 444, MSE 500. Prerequisite: PHYS 213, PHYS 214, and PHYS 325.

PHYS 435 Electromagnetic Fields I credit: 3 Hours.
Static electric and magnetic fields, their interactions with electric charge and current, and their transformation properties; the effect of special relativity is incorporated. Macroscopic fields in material media are described. 3 undergraduate hours. 3 graduate hours. Prerequisite: MATH 285; credit or concurrent enrollment in PHYS 325.

PHYS 436 Electromagnetic Fields II credit: 3 Hours.
Time-dependent fields. Electromagnetic induction, Maxwell's equations, electromagnetic wave propagation in various media and structures, and electromagnetic radiation from charge and current distributions. Relativistic covariance of Maxwell's equations. Course Information: 3 undergraduate hours. 3 graduate hours. Prerequisite: PHYS 435.

PHYS 460 Condensed Matter Physics credit: 4 Hours.
Bonding and structure of crystals; energy bands in insulators, semiconductors, and metals; electrical conductivity; optical properties; lattice vibrations; elasticity; point defects; dislocations. 4 undergraduate hours. 4 graduate hours. Credit is not given for both PHYS 460 and MSE 304. Prerequisite: PHYS 435; PHYS 485 or PHYS 486.

PHYS 466 Atomic Scale Simulations credit: 3 or 4 Hours.
The nature and properties of nuclei and elementary particles, symmetries, interactions, nuclear models, tools and techniques of experimental subatomic physics, and applications to power generation, astrophysics, chemistry, medicine, and biology. 4 undergraduate hours. 4 graduate hours. Prerequisite: PHYS 485 or PHYS 486.

PHYS 470 Subatomic Physics credit: 4 Hours.
Major concepts of physics inherent to biological systems. Basics of biology, including protein and DNA structure and their organization into cells with a focus on single molecule biophysics. Major experimental techniques including x-ray diffraction, optical and magnetic traps, and fluorescence microscopy, including new super-resolution techniques. Applications to cytoplasmic and nuclear molecular motors, bacterial motion, nerves, and vision. Same as BIOP 401. 3 undergraduate hours. 4 graduate hours. Prerequisite: PHYS 213 and PHYS 214.

PHYS 485 Quantum Physics I credit: 4 Hours.
Basic concepts of quantum theory which underlie modern theories of the properties of materials; elements of atomic and nuclear theory; kinetic theory and statistical mechanics; quantum theory and simple applications; atomic spectra and atomic structure; molecular structure and chemical binding. 3 undergraduate hours. 3 graduate hours. Credit is not given for both PHYS 485 and CHEM 442. Prerequisite: MATH 285 and PHYS 214.

PHYS 486 Quantum Physics II credit: 4 Hours.
Atomic phenomena integrated with an introduction to quantum theory; evidence for the atomic nature of matter and the properties of the Schrodinger equation, single particle solutions in one dimension, the hydrogen atom, perturbation theory, external fields, and atomic spectroscopy of outer electrons. 4 undergraduate hours. 4 graduate hours. Prerequisite: PHYS 213, PHYS 214; credit or concurrent registration in MATH 415.

PHYS 487 Quantum Physics II credit: 4 Hours.
Continuation of PHYS 486. Identical particles, spectral hyperfine structure, magnetic properties of matter, atomic spectroscopy of inner electrons, high-energy photon effects, molecular binding and spectra, emission and absorption of light, and symmetry principles. 4 undergraduate hours. 4 graduate hours. Prerequisite: PHYS 486.

PHYS 496 Intro to Physics Research credit: 3 Hours.
Examination of current research topics through extensive reading, writing, and oral-presentation activities. 3 undergraduate hours. No graduate credit.
This course satisfies the General Education Criteria for: Advanced Composition

PHYS 497 Individual Study credit: 1 to 4 Hours.
Individual study at an advanced level in a subject not covered by course offerings. 1 to 4 undergraduate hours. 1 to 4 graduate hours. May be repeated. Prerequisite: Consent of instructor.
PHYS 498  Special Topics in Physics  credit: 1 to 4 Hours.
Subject offerings of new and developing areas of knowledge in physics intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. 1 to 4 undergraduate hours. 1 to 4 graduate hours. May be repeated in the same or separate terms if topics vary.

PHYS 499  Senior Thesis  credit: 3 Hours.
Faculty-guided writing of a senior thesis involving independent research. Oral presentations of research and outside journal articles, proposal writing and reviewing, poster presentation, preparation of graduate school applications, and discussion of physics frontiers with outside experts. 3 undergraduate hours. No graduate credit. Prerequisite: PHYS 496.