

Physics (PHY)

PHY 301 Mechanics 3 Hours

Designed for students who intend to major in science or mathematics.

PHY 101L Laboratory for Physics 301 1 Hour

PHY 302K General Physics Technical Course: Mechanics, Heat, and Sound 3 Hours

Noncalculus technical course in physics. Completion of high school trigonometry or Mathematics 305G is highly recommended.

PHY 302L General Physics Technical Course: Electricity and Magnetism, Light, Atomic and Nuclear Physics 3 Hours

Noncalculus technical course in physics.

PHY 102M Laboratory for Physics 302K 1 Hour

PHY 102N Laboratory for Physics 302L 1 Hour

PHY 303E Electromagnetic, Quantum, and Semiconductor Physics 3 Hours

Discuss electricity, magnetism, electromagnetic waves, photons, matter waves, atomic physics, band structure, semiconductors, diodes, and transistors.

PHY 303K Engineering Physics I 3 Hours

A general survey of physics; primarily laws of motion, heat, and wave phenomena.

PHY 303L Engineering Physics II 3 Hours

Electricity and magnetism, optics, and atomic phenomena.

PHY 103M Laboratory for Physics 303K 1 Hour

PHY 103N Laboratory for Physics 303L 1 Hour

PHY 104 Introductory Physics Seminar 1 Hour

Discussion of the development of important ideas in physics, with emphasis on their relevance to contemporary research.

PHY 105M Laboratory For Physics 302K, 303K, and 317K 1 Hour

Participate in an introductory mechanics laboratory.

PHY 105N Laboratory For Physics 302L, 303L, and 317L 1 Hour

Participate in an introductory electricity, magnetism, and optics laboratory.

PHY 306 Elementary Physics Methods 3 Hours

Designed for students who have not had high school physics, have weak problem-solving skills, and need preparation for Physics 301 or 303K.

PHY 108 Introduction to Research 1 Hour

Introductory laboratory experience; use of tools and test equipment; beginning apprenticeship in active physics research.

PHY 208F, 308F Introduction to Research 2-3 Hours

Introductory laboratory experience; use of tools and test equipment; beginning apprenticeship in active physics research.

PHY 309K Elementary Physics for Nontechnical Students 3 Hours

Mechanics, heat, and sound. Designed for students who do not intend to do further work in natural sciences, engineering, mathematics, or medicine.

PHY 309L Elementary Physics for Nontechnical Students 3 Hours

Electricity and magnetism, light, atomic and nuclear physics. Designed for students who do not intend to do further work in natural sciences, engineering, mathematics, or medicine.

PHY 110, 210, 310, 410, 510, 610, 710, 810, 910 Topics in Physics 1-9 Hours

PHY 110C Topics in Conference Course 1 Hour

Supervised study of selected topics in physics, by individual arrangement with department and instructor.

PHY 315 Wave Motion and Optics 3 Hours

Study of general properties of waves; examples include sound, electromagnetic, and mechanical waves; special emphasis on light and optics.

PHY 115L Laboratory for Physics 315 1 Hour

PHY 316 Electricity and Magnetism 3 Hours

PHY 116L Laboratory for Physics 316 1 Hour

PHY 317K General Physics I 3 Hours

Mechanics, heat, and sound, with biomedical applications. An introductory course designed and recommended primarily for premedical students and others in the biomedical sciences whose professional or preprofessional training includes an introductory course in calculus. Satisfies most medical and dental school requirements for physics.

PHY 317L General Physics II 3 Hours

Electricity and magnetism, light, atomic and molecular physics, nuclear physics, and their biomedical applications. Designed and recommended primarily for premedical students and others in the biomedical sciences whose professional or preprofessional training includes an introductory course in calculus. Satisfies most medical and dental school requirements for physics.

PHY 117M Laboratory for Physics 317K 1 Hour

PHY 117N Laboratory for Physics 317L 1 Hour

PHY 119S, 219S, 319S, 419S, 519S, 619S, 719S, 819S, 919S Topics in Physics 1-9 Hours

This course is used to record credit the student earns while enrolled at another institution in a program administered by the University's Study Abroad Office. Credit is recorded as assigned by the study abroad adviser in the Department of Physics. University credit is awarded for work in an exchange program; it may be counted as coursework taken in residence. Transfer credit is awarded for work in an affiliated studies program.

PHY 321 Modern Physics: Plan II 3 Hours

Conceptual foundations of modern physics. Examines quantum mechanics, quantum field theory, relativity, and general relativity, including large-scale structure and cosmology; and the development of analytic problem-solving skills, including estimation.

PHY 329 Introduction to Computational Physics 3 Hours

Computational methods for problem solving and research in physics; numerical analysis and computer simulation methods for physics applications using different types of computers.

PHY 129S, 229S, 329S, 429S, 529S, 629S, 729S, 829S, 929S Topics in Physics 1-9 Hours

This course is used to record credit the student earns while enrolled at another institution in a program administered by the University's Study Abroad Office. Credit is recorded as assigned by the study abroad adviser in the Department of Physics. University credit is awarded for work in an exchange program; it may be counted as coursework taken in residence. Transfer credit is awarded for work in an affiliated studies program.

PHY 329W Cooperative Physics 3 Hours

Covers the work period of physics students in the Cooperative Education Program, which provides supervised work experience by arrangement with the employer and the supervising instructor.

PHY 333 Modern Optics 3 Hours

Review of geometrical optics, polarization, interference, and optical instruments. Subjects include Fourier optics, light propagation in fibers, quantum optics, and coherence.

PHY 133L Laboratory for Physics 333 1 Hour

PHY 336K Classical Dynamics 3 Hours

Elementary linear vector algebra, Newtonian mechanics, Lagrangian mechanics, central force motion, dynamics of rigid bodies, and theory of small oscillations.

PHY 336L Fluid Dynamics 3 Hours

Fundamental concepts of fluid mechanics developed and applied to laminar and turbulent flows. Subjects include the Navier-Stokes equations, pipe and channel flow, drag, boundary layers, convection, and rotating fluids.

PHY 338K Electronic Techniques 3 Hours

Elementary circuit theory, amplifiers, feedback, pulse and digital techniques, signal processing, and microprocessors as applied to physics instrumentation.

PHY 239C Physics Cognition and Pedagogy 2 Hours

Investigate physics-specific education literature, and think about how the results of these studies apply to teaching practice. Discuss obstacles to students' academic success such as stereotype threat, identity, implicit bias, and mindset. Reflect on how to make a difference in students' learning as a physics learning assistant.

PHY 341 Selected Topics in Physics 3 Hours

PHY 341.1 Energy Production 3 Hours

The various means that exist or have been suggested for generating energy; comparison in terms of efficiency, safety, and effects on the environment.

PHY 341.3 Musical Acoustics 3 Hours

Study of the production, transmission, and perception of the special kind of sound called music, based on the application of elementary principles of physics.

PHY 341.4 The Nature of Things 3 Hours

A qualitative survey of all of physics, from falling bodies to quarks, making heavy use of classroom demonstrations.

PHY 341.5 Pseudoscience 3 Hours

Study of a variety of ideas treated very seriously by the communications media but having no basis in fact, including astrology, extrasensory perception, and flying saucers; why such areas are not part of science.

PHY 341.6 Writing 3 Hours

PHY 341.7 Research Methods: UTeach 3 Hours

PHY 141T, 241T, 341T, 441T, 541T, 641T, 741T, 841T, 941T Topics in Physics 1-9 Hours

PHY 345 Biophysics 3 Hours

Basic concepts of physics developed and applied to biological systems. Subjects include energy in living systems, entropic interactions, molecular forces and self-assembly, biopolymers, bio-membranes, cell-cell interactions, pattern formation, collective behavior, higher order systems, population dynamics and evolution.

PHY 352K Classical Electrodynamics I 3 Hours

Electrostatic fields, magnetostatic fields, derivation of Green's theorems and functions and of Maxwell's equations.

PHY 352L Classical Electrodynamics II 3 Hours

A continuation of Physics 352K, emphasis is placed on conservation laws, electromagnetic waves, potentials and fields, radiation, and Lorentz invariance. One or more special subjects, such as Rayleigh scattering and energy loss by relativistic charged particles in matter will be developed.

PHY 353L Modern Physics Laboratory 3 Hours

Laboratory experiments investigating the breakdown of classical physics for microscopic phenomena. Includes absorption and emission spectra, the photoelectric effect, blackbody radiation, the Compton effect, X-ray diffraction, and other experiments in modern physics.

PHY 355 Modern Physics and Thermodynamics 3 Hours

Introduction to modern physics and thermodynamics: photons (spectra, photoelectric effect, blackbody radiation, Compton effect), atoms (Rutherford, Bohr), matter waves (Planck, deBroglie, probability interpretation, Schroedinger), nuclei, particles, special relativity, the laws of thermodynamics, and statistical physics.

PHY 362K Quantum Physics II: Atoms and Molecules 3 Hours

The two-electron atom; spin and statistics; coupling schemes for many-electron atoms; atoms and the radiation field; perturbation methods for decay and collisions; thermal, electrical, and magnetic properties of solids; and free-electron metal and band theory. May include subjects such as superconductivity, Josephson tunneling, and others.

PHY 362L Quantum Physics III: Particles and Nuclei 3 Hours

Nuclei and nucleons, their gross properties; the hadrons; symmetries and conservation laws; nuclear stability; electromagnetic, weak, and hadronic interactions; nuclear reactions at low, medium, and high energies; nucleon structure; tools of experimental nuclear physics; models of theoretical nuclear physics; nuclear technology.

PHY 369 Thermodynamics and Statistical Mechanics 3 Hours

Basic concepts of thermal physics; entropy, enthalpy, free energy, phase transitions, equilibrium distribution functions, applications.

PHY 670T Senior Thesis 6 Hours

Individual research with faculty supervision. First half involves preparation of proposal; second involves completion of written thesis.

PHY 371C Individual Study in Physics 3 Hours

Supervised reading or research in physics.

PHY 373 Quantum Physics I: Foundations 3 Hours

Postulates of quantum mechanics, the bound states of the finite square well, the harmonic oscillator, operator-eigenvalue formalism and selected examples, the hydrogen atom, angular momentum, rigid rotor, and spin. May include simple scattering theory.

PHY 474 Advanced Laboratory I 4 Hours

Modern experimental techniques, theory of error, and analysis of experiments; both modern and classical experiments in atomic and nuclear physics, electricity and magnetism, optics and heat.

PHY 375C Cosmology and AstroParticle Physics 3 Hours

Discuss the physics of the expanding universe, Einstein's equations, inflationary expansion, the basics of nuclear physics and big bang nucleosynthesis, and the content of the Universe: the known particles and forces of the standard model of particle physics as well as the unknown dark matter and dark energy.

PHY 375P Introductory Plasma Physics 3 Hours

Orbit theory and drifts, introduction to plasma stability and waves, applications to plasma confinement and heating.

PHY 375R Introduction to Relativity 3 Hours

Overview of the special and general theories of relativity, with emphasis on recent developments in gravitation.

PHY 375S Introductory Solid-State Physics 3 Hours

Crystal structure, classification of solids, cohesion, thermal and electrical properties of solids, magnetic properties of solids, imperfections.

PHY 379H Honors Tutorial Course 3 Hours

PHY 380L Plasma Physics I 3 Hours

Particle drifts, equations for plasmas, magnetohydrodynamics, waves and instabilities in the two-fluid model, Vlasov equation, Landau damping, controlled thermonuclear research, plasma diagnostics.

PHY 380M Plasma Physics II 3 Hours

Plasma containment, stability theory in fluid models, derivation of Vlasov and Fokker-Planck equations, the dielectric tensor, velocity space and gradient instabilities, Nyquist diagrams.

PHY 380N Experimental Physics 3 Hours
Experimental work to provide exposure to physics research techniques.

PHY 180T, 280T, 380T Topics in Advanced Physics 1-3 Hours
Special topics for physics teachers.

PHY 381C Computational Physics 3 Hours
Dynamical and statical descriptions and solutions of many-body, nonlinear physical systems by computation. Theory of computation and applications to various branches of physics.

PHY 381M Methods of Mathematical Physics I 3 Hours
Theory of analytic functions; linear algebra and vector spaces; orthogonal functions; ordinary differential equations; partial differential equations; Green's functions; complex variables.

PHY 381N Methods of Mathematical Physics II 3 Hours
Continuation of Computational Science, Engineering, and Mathematics 385M and Physics 381M. Topology, functional analysis, approximation methods, group theory, differential manifolds.

PHY 382M Fluid Mechanics 3 Hours
Flow of ideal and viscous fluids; introduction to turbulence; boundary layers; sound and shock waves.

PHY 382N Nonlinear Dynamics 3 Hours
Basic concepts of evolution and stability, examples of instabilities, low dimensional dynamical systems, chaos, characterization of temporal chaos, pattern formation, Hamiltonian systems.

PHY 382P Biophysics I 3 Hours
The cell, small molecules and chemical kinetics, forces on the molecular scale, proteins, lipids and membranes, biopolymers, neurons and electrical signal transduction, and complex pattern formation in cells and cell aggregates.

PHY 382Q Biophysics II 3 Hours
Advanced biophysics with emphasis on biologically relevant questions addressed with physical approaches. Biopolymer mechanics, protein-nucleic acid interaction, protein structure and dynamics, membrane dynamics, cytoskeletal dynamics, motor proteins, cell shape and motility, cell communication, tissue mechanics.

PHY 382S Seminar in Nonlinear Dynamics 3 Hours

PHY 385K Classical Mechanics 3 Hours
Classical and relativistic Hamiltonian mechanics; Hamilton-Jacobi theory; Lagrangian mechanics for continuous media; symmetry principles and conservation laws.

PHY 385L Statistical Mechanics 3 Hours
Equilibrium statistical mechanics; introduction to nonequilibrium concepts; ensembles; classical and quantum gases; statistical physics of solids.

PHY 385S Seminar in Statistical Physics 3 Hours
Topics to be announced.

PHY 385T Special Topics in Statistical Physics 3 Hours
Topics to be announced.

PHY 386K Physics of Sensors 3 Hours
Physical principles of acoustic, optical, electromagnetic, radiation, and motion sensors.

PHY 386N Technical Seminar 3 Hours
Physics for applied and industrial purposes.

PHY 386S Seminar in Applied Physics 3 Hours
Topics to be announced.

PHY 387K Electromagnetic Theory I 3 Hours
Electrostatics and magnetostatics; boundary value problems; Maxwell's equations; plane waves; wave guides; diffraction; multipole radiation.

PHY 387L Electromagnetic Theory II 3 Hours
Magnetohydrodynamics and plasmas; relativity; collisions of charged particles; radiation from moving charges; radiation damping.

PHY 387M Relativity Theory I 3 Hours
Explore tensor calculus, differential geometry, special and general relativity, black holes, and gravitational waves.

PHY 387N Relativity Theory II 3 Hours
General relativity theory; gravitational field equations; weak field approximations; Schwarzschild solution, observable consequences; other topics.

PHY 388M Graduate Colloquy 3 Hours
Reviews of current topics in physics research.

PHY 388S Seminar in Teaching Physics 3 Hours
Topics to be announced.

PHY 389K Quantum Mechanics I 3 Hours
Hilbert space and operators; Schroedinger and Heisenberg equations; solutions for systems in one and three dimensions; theory of spin and orbital angular momentum; the effect of symmetries; approximation techniques; elementary scattering theory.

PHY 389L Quantum Mechanics II 3 Hours
Perturbation techniques; systems of identical particles; quantum theory of radiation; emission and absorption of photons; selection rules; life times; scattering theory for light and particles, S-matrix; relativistic corrections to electron motion.

PHY 190, 290, 390, 690, 990 Graduate Research 1,2,3,6,9 Hours

PHY 391M Nonlinear Plasma Theory 3 Hours
Quasi-linear theory, weak turbulence, large amplitude waves, plasma radiation, shock waves, shock structure, computer techniques.

PHY 391S Seminar in Plasma Physics 3 Hours
Topics to be announced.

PHY 391T Special Subjects in Plasma Physics 3 Hours
Subjects to be announced.

PHY 391U Seminar in Plasma Theory 3 Hours
Current topics in plasma theory.

PHY 392K Solid-State Physics I 3 Hours
Lattice vibrations and thermal properties of solids; band theory of solids; transport properties of metals and semiconductors; optical properties; magnetic properties; magnetic relaxation; superconductivity.

PHY 392L Solid-State Physics II 3 Hours
Elementary excitations: phonons, electrons, spin waves; interactions: phonon-phonon, electron-electron, electron-phonon; theory of metals and semiconductors; transport theory; optical properties.

PHY 392N Many-Body Theory 3 Hours
Overview of many-body theory; second quantization; Green's functions and Feynman diagrams; finite-temperature, imaginary-time Green's functions; the disordered metal; path integrals; broken symmetries; and local moments.

PHY 392P Advanced Optical Spectroscopy 3 Hours
Examine the foundational principles and cutting-edge applications of advanced optical spectroscopy methods. Analyze the electrodynamics of solids (metals, insulators, semiconductors), which exhibit complex and rich electromagnetic behavior. Study the key components of a basic optical spectroscopy setup. Explore advanced spectroscopy techniques and current research frontiers in the field.

PHY 392Q Density Functional Theory 3 Hours

Examine the quantum theory of many-electron systems from the point of view of first-principles atomic-scale calculations. Develop the conceptual foundations of density functional theory and its uses in computational materials modeling, design, and discovery. Perform predictive calculations of structural, electronic, optical, vibrational, and magnetic properties of solids using high-performance computing environments.

PHY 392S Seminar in Solid-State Physics 3 Hours

Topics to be announced.

PHY 392T Special Topics in Solid-State Physics 3 Hours

Topics to be announced.

PHY 393S Seminar in Relativity 3 Hours

Topics to be announced.

PHY 393T Special Topics in Relativity 3 Hours

Topics to be announced.

PHY 194U, 294U, 394U Special Topics in Theoretical Physics 1-3 Hours

Topics to be announced.

PHY 195, 295, 395 Topics in Survey of Atomic and Molecular Physics 1-3 Hours

Spectra of atoms and diatomic molecules; quantum electronics; experimental techniques.

PHY 395K Nonlinear Optics and Lasers 3 Hours

Gaussian beam optics, interaction of electromagnetic radiation with matter, semiclassical laser theory, experimental laser systems, nonlinear optical susceptibilities, harmonic generation, wave mixing, electro-optic and acousto-optic effects, coherent transient effects, optical breakdown, laser-plasma interactions.

PHY 395M Laser Physics 3 Hours

Continuation of Physics 395K. Advanced atomic physics of various laser systems, optical coherence and diffraction theory, pulse propagation and dispersion effects, advanced laser oscillator and amplifier physics, laser amplifier chain design, and chirped-pulse amplification.

PHY 395S Seminar in Atomic and Molecular Physics 3 Hours

Topics to be announced.

PHY 395T Special Topics in Atomic and Molecular Physics 3 Hours

Topics to be announced.

PHY 396G Cosmology 3 Hours

Explore inflationary cosmology, the formation of element abundances during Big Bang nucleosynthesis, cosmological perturbations and structure formation, the cosmic microwave background, and the content of the universe (including dark matter and dark energy). Examine unresolved problems in cosmology (such as the origin of the matter/antimatter asymmetry), the possibility of extra dimensions, what happened before the Big Bang, "big data" in cosmology, observational probes of dark energy, and inflation models and tests.

PHY 396J Introduction to Elementary Particle Physics 3 Hours

Historical introduction to elementary particles, elementary particle dynamics, relativistic kinematics, symmetries, bound states, the Feynman calculus, quantum electrodynamics, electrodynamics of quarks and hadrons, quantum chromodynamics, weak interactions, gauge theories.

PHY 396K Quantum Field Theory I 3 Hours

Quantization of the Klein-Gordon, Dirac, and electromagnetic field theories; theory of interacting fields, perturbation theory, and renormalization.

PHY 396L Quantum Field Theory II 3 Hours

Path-integral formalism, massless particles, electrodynamics, nonperturbative methods, one-loop calculations in quantum electrodynamics, general renormalization theory, soft photons, bound states in quantum electrodynamics.

PHY 396P String Theory I 3 Hours

Introduction to string theory and conformal field theory. The free string, conformal invariance and conformal field theory, supersymmetry and string interactions.

PHY 396Q String Theory II 3 Hours

Advanced conformal field theory, perturbative string theory and compactification. Introduction to nonperturbative aspects of string theory.

PHY 196S, 296S, 396S Topics in Particle Physics: Seminar 1-3 Hours

Topics to be announced.

PHY 396T Special Topics in Particle Physics 3 Hours

Topics to be announced.

PHY 396V High Energy and Astroparticle Physics 3 Hours

Review quantum field theory, aspects of the standard model and beyond, the naturalness problem, dark matter, early universe cosmology, and other selected subjects.

PHY 397K Nuclear Physics 3 Hours

Systematics of stable nuclei; nuclear structure; decay of the nucleus; cross sections and reaction mechanisms; the elementary particles.

PHY 397S Seminar in Nuclear Physics 3 Hours

Topics to be announced.

PHY 397T Special Topics in Nuclear Physics 3 Hours

Topics to be announced.

PHY 197U Graduate Seminar in Nanoscience 1 Hour

Various seminar topics in nanoscience.

PHY 698 Thesis 6 Hours

PHY 398R Master's Report 3 Hours

Prepare a report to fulfill the requirement for the master's degree under the report option.

PHY 398S Seminar in High Energy Theory 3 Hours

PHY 398T Supervised Teaching in Physics 3 Hours

A review of physics teaching strategies, administrative procedures, and classroom responsibilities. Includes a review and critique of each participant's classroom teaching.

PHY 399W, 699W, 999W Dissertation 3,6,9 Hours