PHYSICS • PHYS

Prerequisites • All prerequisites in physics courses should be rigorously observed.

Corequisites • A student may not continue in a course after dropping a corequisite course prior to the last day of the midsemester examination period.

Of the 7000-level courses, those numbered in the 7200s, as well as 7343, 7363, 7383, 7398, and 7411 are offered every year; 7353 and 7373 every other year. All other courses are offered sporadically as interest demands and in order to provide a varied curriculum.

General education courses are marked with stars (★).

1100 Introduction to Physics (3) Prereq.: credit or registration in MATH 1550. Measurement, vectors, kinematics, Newton's laws of motion, wave motion, temperature, the electric field, DC circuits, and geometrical optics.

★ 1201, ★ 1202 General Physics for Physics Majors (4,4) F,S Prereq. for 1201: PHYS 1100 or placement by examination; credit or registration in MATH 1550. Prereq. for 1202: PHYS 1201 and credit or registration in MATH 1552. 4 hrs. lecture/demonstration. Primarily for students intending to major in physics. Credit will not be given for these courses and PHYS 2001, 2002 or 2101, 2102. Fundamentals of classical physics and some concepts of modern physics; calculus and vector analysis introduced and used in development of subject matter.

★ 1208, ★ 1209 General Physics Laboratory for Physics Majors (1,1) F,S Prereq. for 1208: credit or registration in PHYS 1201. Prereq. for 1209: credit or registration in PHYS 1202. 3 hrs. lab. Credit will not be given for these courses and PHYS 2108, 2109. Laboratory to accompany PHYS 1201, 1202.

★ 2001, ★ 2002 General Physics (3,3) Prereq. for PHYS 2001: MATH 1022 or 1023; Prereq. for PHYS 2002: PHYS 2001. 3 hrs. lecture/demonstration. Credit will not be given for these courses and PHYS 1201, 1201 or 2101, 2102. Mechanics, heat, sound, light, electricity, and magnetism; topics in modern physics.

★ 2101 General Physics for Technical Students (3) Prereq.: PHYS 1100 or placement by examination; credit or registration in MATH 1552. Credit will not be given for both this course and PHYS 1201, 2001. Mechanics, wave motion, thermodynamics, and kinetic theory.

★ 2102 General Physics for Technical Students (3) Prereq.: PHYS 2101 and MATH 1552. Credit will not be given for both this course and PHYS 1202, 2002. Electricity, magnetism, physical optics, and topics from modern physics.

★ 2108 Introductory Physics Laboratory (1) Prereq.: credit or registration in PHYS 2001 or 2101. 3 hrs. lab. Credit will not be given for both this course and PHYS 1208. Laboratory to accompany PHYS 2001 or 2101.

★ 2109 General Physics Laboratory (1) Prereq.: PHYS 2108 and credit or registration in PHYS 2002 or 2102. 3 hrs. lab. Credit will not be given for both this course and PHYS 1209. Laboratory to accompany PHYS 2002 and 2102; electricity, magnetism, geometrical and physical optics, and other topics in modern physics.

2111 Elementary Mathematical Physics (3) F Prereq.: PHYS 1202 or 2102; and credit in MATH 1552. Mathematical methods of physics: vector calculus, complex variables, Fourier series, matrices and determinants, differential equations with application to selected problems in physics.

2203 Introductory Modern Physics (3) F Prereq.: PHYS 1202 or 2102. Elementary modern physics; special relativity, wave/particle duality, quantum mechanics, hydrogen atom, many-electron atoms, nuclear structure, elementary particles, solid state, astrophysics, and cosmology.

2207 Introductory Modern Physics Laboratory (1) F Corey: PHYS 2203. Required for physics majors. Laboratory to accompany PHYS 2203.

2221 Introduction to Mechanics (3) Prereq.: PHYS 1202 or 2102 and MATH 2057. Basic concepts of mechanics with emphasis on corresponding mathematical techniques.

2231 Electricity and Magnetism (3) S Prereq.: PHYS 2221 or CHEM 4581 and credit or registration in MATH 2065 or 2090. Electricity and magnetism; static and quasistatic electromagnetic fields in vacuo and in dielectric and magnetic media.

★ 2401 Introduction to Concepts in Physics (3) V Prereq.: MATH 1021 or an ACT math score of at least 25. Primarily for students in liberal arts and education. Historical evolution and underlying philosophy of principles of physics; provides appreciation of physics; does not develop technical skill.

2411 Computational Science I (3) Prereq.: PHYS 2221 or PHYS 1202 or 2102 and MATH 2057; or CHEM 4581 and credit or registration in MATH 2065. 2 hrs. lecture, 2 hrs. lab. Introduction to symbolic manipulation and numerical techniques used to analyze or simulate a broad range of physical systems.

2995 Research Internship (1) Prereq.: consent of instructor and department chair. May be repeated for credit. Individual reading and theoretical and/or experimental research on introductory problems in physics.


4098 Instrumentation Electronics for Scientists (3) S Prereq.: credit or registration in PHYS 1202 or 2102; and credit in MATH 1552. Credit will not be given for both this course and PHYS 1202, 2002.

4112 Intermediate Mathematical Physics (3) V Prereq.: PHYS 2221 or CHEM 4581; and credit or registration in MATH 2065 or 2090. Mathematical methods of physics, with application to selected problems.

4123 Intermediate Mechanics (3) Prereq.: PHYS 2221 and MATH 2057. Lagrangian mechanics; central force motion; rigid body dynamics; small oscillations.

4125 Thermodynamics and Statistical Mechanics (3) V Prereq.: PHYS 2221 and credit or registration in MATH 2065 or 2090; or CHEM 4581 and credit or registration in MATH 2052 or 2090. Basic physical concepts and methods appropriate for description of systems involving many particles; unified view point of thermodynamics, statistical mechanics, and kinetic theory.


4135 Modern Optics (3) V Prereq.: PHYS 2221 and MATH 2065 or 2090; or CHEM 4581 and MATH 2065 or 2090. Review of geometrical optics and optical instruments, scalar diffraction theory, spatial filtering and holography, Gaussian beam optics, optical resonators, lasers, and optical properties of materials.

4136 Modern Optics Laboratory (3) V Prereq.: PHYS 4135. 1 hr. lecture; 5 hrs. lab. Techniques in modern optics, including interferometers, electrooptic and magnetooptic devices, fiber optics, spatial filtering, holography, and spectroscopy.

4141, 4142 Introduction to Quantum Mechanics (3,3) F,S Prereq. for PHYS 2221 and credit or registration in MATH 2065 or 2090; or CHEM 4581 and credit or registration in MATH 2065 or 2090. PHYS 4141 is prerequisite for 4142. Elementary principles of quantum mechanics, including Schrodinger equation, one-dimensional problems, harmonic oscillator, angular momentum, perturbation theory, matrix mechanics, and spin.

4198 Advanced Modern Physics Laboratory (3) S Prereq.: PHYS 2209 or 4053 or 4141. 1 hr. lecture; 6 hrs. lab/computations. Electricity and magnetism, optics, and atomic, nuclear, and solid-state physics.

4201, 4202 Survey of Contemporary Physics (3,3) F Prereq.: PHYS 4142 or equivalent. Current research in physics: relativity, atomic physics, solid-state physics, nuclear physics, elementary particles, astrophysics.

4251 Atomic Physics (3) V Prereq.: PHYS 4142 or credit or registration in 4132. Modern theory of atomic structure, radiations, and processes.

4261 Introduction to Solid-State Physics (3) V Prereq.: PHYS 2203 or 4141 or CHEM 4492. Properties of the crystalline state and the free-electron; band theories of metals, insulators, and semiconductors.

4271 Nuclear Physics (3) V Prereq.: PHYS 2203 or 4141. Nuclear properties, abundance and stability of nuclei, nuclear instrumentation, particle accelerators and detectors, and nuclear reactions.

4399 Research in Experimental Physics (3) F Prereq.: PHYS 4198 or consent of instructor and department chair. Individual research project conducted and reported under supervision of individually selected faculty member.

4412 Computational Science II (3) Prereq.: PHYS 2411 or equivalent. Continuation of PHYS 2411. Advanced techniques for numerical computations in the physical
sciences.

4991 Special Problems in Physics (1-3) Prereq.: thorough knowledge of the fundamentals of physics and mathematics, demonstrated ability in science, and consent of instructor and department chair. May be taken for a max. of 6 sem. hrs. credit. Individual reading and theoretical and/or experimental work on advanced problems in physics.

6111 Mathematical Physics for Teachers (3) Su only-V Prereq.: PHYS 2002 or 2102. Not for degree credit for physics majors. Mathematical structure of physics.

6121 Classical Physics for Teachers (3) Su only-V Prereq.: PHYS 2002 or 2102. For high school and junior college teachers; part of the M.N.S. degree program. Application of conservation principles to development of classical physics.

6141 Quantum Physics of Atoms, Molecules, Solids, and Nuclei for Teachers (3) Su only-V Prereq.: PHYS 2002 or 2102. For high school and junior college teachers. Treats a variety of problems of quantum mechanics; application to atoms, molecules, solids, and nuclei.

6191 Research Participation for Teachers (3) Su only-V Prereq.: PHYS 2002 or 2102. May be taken for a max. of 9 hrs. of credit.

6198 Laboratory Methods for Teachers (3) Su only-V Prereq.: PHYS 2002 or 2102. 1 hr. lecture; 6 hrs. lab. For high school and junior college teachers; part of the M.N.S. degree program. May be taken for a max. of 9 hrs. of credit. Analysis of laboratory experiments in current high school physics curriculum; selected experiments in modern physics.

6991 Seminar in Current Developments in Physics Curriculum Materials (1-3) Su only-V Prereq.: PHYS 2002 or 2102. For high school and junior college teachers; part of the M.N.S. degree program. May be taken for a max. of 6 sem. hrs. credit.

7211, 7212 Mathematical Methods of Theoretical Physics (3,3) F,S Prereq.: PHYS 4112 or equivalent. PHYS 7211 is prerequisite for 7212. Advanced topics in mathematical methods of theoretical physics; mathematical foundations of quantum mechanics.

7221 Classical Mechanics (3) Su Study of particle mechanics and rigid body mechanics using the methods of Lagrange’s equations, Hamilton’s equations, canonical transformations, and Hamilton-Jacobi theory.

7222 Mechanics of Deformable Bodies (3) V Mechanics of inviscid and Newtonian viscous fluids; elasticity of solids.

7225 Statistical Mechanics (3) Su Principles of classical and quantum statistics, with application to special problems.

7231, 7232 Classical Electrodynamics (3,3) F,S PHYS 7231 is prerequisite for 7232. Problems in electrostatics and magnetostatics; Maxwell’s equations, electromagnetic waves, wave guides, and antennas; relativistic electrodynamics and radiation from moving charges.

7241, 7242 Quantum Mechanics (3,3) F,S Prereq.: PHYS 4142 or equivalent. PHYS 7241 is prerequisite for 7242. Basic concepts of nonrelativistic quantum mechanics, operators and matrices, intrinsic and orbital angular momenta, perturbation theory, atomic structure, second quantization, and scattering theory.

7336 General Relativity (3) V General tensor analysis; postulates of general relativity, field equations, motions of a particle, interior and exterior Schwarzschild solutions; cosmology.

7343 Advanced Quantum Mechanics (3) V Prereq.: PHYS 7242. The Lorentz group, relativistic wave equations, introduction to quantum field theory.

7353, 7354 Atomic and Optical Physics I, II (3,3) V Prereq.: PHYS 7242; PHYS 7353 is prerequisite for 7354. Applications of quantum mechanics to atomic systems and their interaction with radiation; spectral levels, photoabsorption and collisions with charged particles.

7360 Low-Temperature Physics (3) V Properties of matter at temperatures near absolute zero; methods of producing low temperatures; superfluidity of liquid helium, superconductivity, magnetic effects, and adiabatic demagnetization.

7363, 7364 Condensed Matter Physics (3,3) V Prereq.: PHYS 7225 and 7242. PHYS 7363 is prerequisite for 7364. Application of quantum mechanics and statistical mechanics to condensed matter; lattice vibrations, energy bands in crystals, transport properties, collective excitations, ferromagnetism and superconductivity; theory of Fermi and Bose quantum fluids, phase transitions, and critical phenomena.

7373, 7374 Nuclear Physics (3,3) V Prereq.: PHYS 4271 and 7241. PHYS 7373 is prerequisite for 7374. Applications of quantum mechanics to the two-nucleon system, to a system of many nucleons, and to nuclear reactions, with comparisons between theory and experimental results.

7383, 7384 High Energy Particle Physics (3,3) V Prereq.: PHYS 7231 and 7242. Strong electromagnetic and weak interactions of hadrons and leptons, including symmetries and selection rules; quantum chromodynamics and electroweak theory; accelerator and nonaccelerator experiments including cosmic rays and high energy astrophysics.

7398 Graduate Laboratory (3) S,Su 1 hr. lecture; 6 hrs. lab. Practical experience in modern experimental physics laboratory techniques.

7411, 7412 Computational Physics (3,3) V Prereq.: PHYS 7211. PHYS 7411 is prerequisite for PHYS 7412. Basic numerical techniques for solution of mathematical equations, including coupled linear algebraic and differential equations, and numerical simulation techniques; emphasis on application to physical problems.


7537 Radiation Interactions and Transport (3) F Prereq.: PHYS 2203 or equivalent, CSC 2262, or equivalent. Same as MEDP 7537.

7538 Monte Carlo Simulation of Radiation Transport (3) S Prereq.: MEDP 7537 or consent of instructor, CSC 2262 or equivalent experience in computer programming. Same as MEDP 7538.

7741, 7742 Stellar Astrophysics (3,3) F,S PHYS 7741 is prerequisite for PHYS 7742. See ASTR 7741, 7742.

7745 Advanced Quantum Theory of Particles and Fields (3) V May be taken for a max. of 9 hrs. of credit.

7751, 7752 Galactic Astrophysics (3,3) F,S PHYS 7751 is prerequisite for PHYS 7752. See ASTR 7751, 7752.

7777 Seminar in Astronomy and Astrophysics (1-6) V May be taken for a max. of 6 sem. hrs. of credit. See ASTR 7777.

7783 Topics in Astronomy and Astrophysics (3) V May be taken for a max. of 6 hrs. of credit when topics vary. See ASTR 7783.

7857 Graduate Student Seminar (1) Pass-fail grading. May be repeated for credit. Introduction to research areas in the department; training for presentation of scientific talks; preparation of research proposals.

7893 Many-Body Theory (3) V Prereq.: PHYS 7242. Pass-fail grading. May be taken for a max. of 6 hrs. of credit. Diagrammatic techniques, thermal Green’s functions, transport theory, Fermi liquids, collective excitations, phase transitions.

7895 Selected Topics in Advanced Physics (3) V May be repeated for credit. Pass-fail grading.

7896 Current Developments (3) V May be repeated for credit. Pass-fail grading.

7996 Independent Research in Physics (3) V Prereq. permission of department. An approved independent research project in experimental or theoretical physics; final written report and oral presentation to a faculty committee is required.

8000 Thesis Research (1-12 per sem.) “S”/“U” grading.

9000 Dissertation Research (1-12 per sem.) “S”/“U” grading.