

Department of Physics

Physics majors acquire a firm foundation for careers in physics and related fields and excellent preparation for further study. Through the judicious use of electives, this curriculum provides not only a thorough understanding of physics, but also the ability to solve problems in other fields of interest to the student.

Majors

- Physics (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/physics/physics_major/)
- Physics - Pre-professional concentrations:
 - Physics — Pre-Medicine, Pre-Dental, Pre-Optometry (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/physics/physics_major_pre-med/)
 - Physics — Pre-Physical Therapy, Pre-Physician Assistant (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/physics/physics_major_pre-pphsppat/)

Minors

- Physics (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/physics/physics_minor/)

Courses

PHYS 1000 FOUNDATIONS OF PHYSICS (4) LEC. 3. LAB. 2. Science Core. Newton's Laws, momentum and energy, solids, liquids, gases, plasma, thermodynamics, electricity, magnetism, light, atomic and nuclear physics. Students who have previous credit in any higher-numbered physics course may not receive credit.

PHYS 1001 FOUNDATIONS OF PHYSICS LABORATORY (1) LAB. 2. Coreq. PHYS 1003. Core-curriculum laboratory course in physics focusing on practical applications and hands-on experience. Topics include: Newton's Laws, momentum and energy, solids, liquids, gases, plasma, thermodynamics, electricity, magnetism, light, atomic and nuclear physics.

PHYS 1100 PHYSICS ORIENTATION (1) LEC/SEM. SU. The course will provide incoming Physics majors with an orientation to the Physics program and will develop critical thinking and professional skills that complement academic and research training. Students will be exposed to aspects of physics research through a broad range of topical discussions with the instructor, other faculty and/or outside speakers.

PHYS 1150 ASTRONOMY (4) LEC. 3. LAB. 3. Science Core. Open to non-science majors. Earth, the solar system, stars, neutron stars, black holes, supernova, galaxies, the expanding universe, and modern cosmological theories.

PHYS 1400 PHYSICS FOR AVIATORS (4) LEC. 3. LAB. 3. Pr. (MATH 1130 or MATH 1150 or MATH 1610 or MATH 1617) and SCMH 1010. Departmental approval. The course provides students with an overview of introductory physics topics such as kinematics, laws of motion, conservation laws, thermodynamics, waves, basic electrical circuits, magnetic fields, and optics essential as a foundation of aviation. The course will specifically utilize examples and problems related to aviation.

PHYS 1500 GENERAL PHYSICS I (4) LEC. 3. LAB. 3. Pr. MATH 1130 or MATH 1133 or MATH 1150 or MATH 1153 or P/C MATH 1610 or P/C MATH 1613 or P/C MATH 1617 or P/C MATH 1620 or P/C MATH 1623 or P/C MATH 1627 or P/C MATH 1710 or P/C MATH 1720 or P/C MATH 2630 or P/C MATH 2637. Science Core. Introduction to Newton's Laws, gravitation and cosmology, concept of conservation laws, solids and fluids, thermodynamics. Math at level of MATH 1130 or higher is expected. Credit will not be given for both PHYS 1500 and PHYS 1600 or PHYS 1607.

PHYS 1510 GENERAL PHYSICS II (4) LEC. 3. LAB. 3. Pr. PHYS 1500 or PHYS 1600 or PHYS 1607. Science Core. Electricity and magnetism, AC circuits, waves, nuclear physics, radioactivity and particle physics. Physics at the level of PHYS 1500 or higher is expected. Credit will not be given for both PHYS 1510 and PHYS 1610 or PHYS 1617.

PHYS 1600 ENGINEERING PHYSICS I (4) LEC. 3. LAB. 3. Pr. MATH 1610 or MATH 1613 or MATH 1617 or P/C MATH 1620 or P/C MATH 1623 or P/C MATH 1627 or P/C MATH 2630 or P/C MATH 2637. Science Core. Introduction to Newton's Laws, gravitation, cosmology, conservation of energy, momentum and angular momentum, special relativity, and fluids using introductory calculus. Math at the level of MATH 1610 or higher is required as a prerequisite. Credit will not be given for both PHYS 1500 and PHYS 1600 or PHYS 1607.

PHYS 1607 HONORS PHYSICS I (4) LEC. 3. LAB. 3. Pr. Honors College. Science Core. Honors version of PHYS 1600. Membership in the Honors College or Departmental approval required. Recommended for Physics majors. Math at the level of MATH 1610 or higher is required as a prerequisite. Credit will not be given for both PHYS 1500 and PHYS 1600 or PHYS 1607.

PHYS 1610 ENGINEERING PHYSICS II (4) LEC. 3. LAB. 3. Pr. (PHYS 1600 or PHYS 1607) and (MATH 1620 or MATH 1623 or MATH 1627). Science Core. Thermodynamics, electricity and magnetism, simple AC circuits, waves, and geometric optics. Physics at the level of PHYS 1600 or higher is expected. Math at the level of MATH 1620 or higher is required as a prerequisite. Credit will not be given for both PHYS 1510 and PHYS 1610 or PHYS 1617.

PHYS 1617 HONORS PHYSICS II (4) LEC. 3. LAB. 3. Pr. Honors College. MATH 1620 and PHYS 1600 or PHYS 1607. Science Core. Honors version of PHYS 1610. Membership in the Honors College or Departmental approval required. Recommended for Physics majors. Math at the level of MATH 1620 or higher is required as a prerequisite. Physics at the level of PHYS 1600 or higher is expected. Credit will not be given for both PHYS 1510 and PHYS 1610 or PHYS 1617.

PHYS 2100 INTERMEDIATE MECHANICS (3) LEC. 3. Pr. (PHYS 1610 or PHYS 1617) and (P/C MATH 2630 or P/C MATH 2637 or P/C MATH 2633). Principles and applications of Newtonian mechanics, noninertial reference frames, harmonic motion, central forces, rigid bodies, introduction to Lagrangian and Hamiltonian mechanics.

PHYS 2200 INTRODUCTORY QUANTUM PHYSICS AND RELATIVITY (3) LEC. 3. Pr. PHYS 1617 or PHYS 1610. Observational foundations of quantum physics, relativity and developments of several branches of physics up to their present frontiers.

PHYS 2300 PHYSICS LABORATORY SKILLS (3) LEC. 1. LAB. 5. Pr. PHYS 1617 or PHYS 1610. The measurement process and its unavoidable uncertainties; standard laboratory instruments; data analysis techniques and tools.

PHYS 2400 MATHEMATICAL AND COMPUTATIONAL METHODS OF PHYSICS (3) LEC. 3. Pr. (MATH 2630 or MATH 2637) and (PHYS 1610 or PHYS 1617). This course introduces students of physics and related fields to mathematical tools and techniques that are needed later in the physics curriculum. Topics include complex numbers, linear algebra, linear and partial differential equations, Fourier series and integrals, and vector calculus with physical application. Students will be introduced to the Python-based computational toolkits to aid in their problem solving.

PHYS 3100 INTERMEDIATE ELECTRICITY AND MAGNETISM (3) LEC. 3. Pr. (PHYS 1617 or PHYS 1610) and (MATH 2630 or MATH 2637 or MATH 2730). Electrostatics, Magnetostatics, Laplace's equation, boundary-value problems, multipole expansions, dielectric and magnetic materials. Faraday's law, AC circuits, and Maxwell's equations.

PHYS 3200 STATISTICAL THERMODYNAMICS (3) LEC. 3. Pr. PHYS 2200. The basic laws of thermodynamics, kinetic theory, and statistical mechanics including entropy, the partition function, free energy, and the quantum statistics of Fermions and Bosons.

PHYS 3500 PHYSICS OF THE WORLD AROUND US (3) LEC. 3. Interdisciplinary topic e.g. Biophysics, Astrophysics, Physics of Weather, Physics of Music, or Environmental Physics. Course may be repeated for a maximum of 12 credit hours.

PHYS 3610 APPLICATIONS OF MODERN PHYSICS (3) LEC. 3. Pr. PHYS 2200. Survey of contemporary subdisciplines in physics and technology that are based on the principles of quantum mechanics such as atomic/molecular physics, statistical mechanics, condensed matter/material science, astrophysics, nuclear physics, and elementary particle physics.

PHYS 3620 OBSERVATIONAL ASTRONOMY (3) LEC. 3. Pr. PHYS 1600 and (MATH 1620 or MATH 1627). This course will introduce students to astronomy from an observational perspective. Students will first learn about astronomical images and data analysis and discuss the physics of the solar system, stars, galaxies, and the universe. As part of the course, students will collect and analyze astronomical data using departmental telescopes and access publicly available data from facilities to demonstrate astrophysical principles.

PHYS 4100 FUNDAMENTALS OF QUANTUM MECHANICS (3) LEC. 3. Pr. PHYS 2200 and MATH 2650. Schrodinger equation, stationary and time-dependent solutions, spin and the exclusion principle, perturbation theory, scattering and resonances, the interpretation of quantum mechanics.

PHYS 4200 FUNDAMENTAL EXPERIMENTS IN PHYSICS (3) LEC. 1. LAB. 5. Pr. PHYS 2300. Experiments that demonstrate the fundamental ideas and facts of physics. Data will be collected, analyzed, interpreted and reported in comprehensive lab reports.

PHYS 4930 DIRECTED STUDIES IN PHYSICS (1-5) IND. Departmental approval. Student will study a topic of interest under the direction of a faculty member. Course may be repeated for a maximum of 10 credit hours.

PHYS 4967 HONORS SPECIAL PROBLEMS (1-3) IND. Pr. Honors College. Departmental approval.. Course may be repeated for a maximum of 6 credit hours.

PHYS 4980 UNDERGRADUATE RESEARCH IN PHYSICS (1-5) IND. Departmental approval. Student will work under the direction of a faculty member on a problem of mutual interest. Course may be repeated for a maximum of 10 credit hours.

PHYS 4997 HONORS THESIS (1-6) IND. Pr. Honors College. Departmental approval.. Course may be repeated for a maximum of 6 credit hours.

PHYS 5100 APPLICATIONS OF QUANTUM MECHANICS (3) LEC. 3. Pr. PHYS 4100. Quantum mechanics applied to atomic physics, solid state physics, nuclear physics, particle physics, electrodynamics, and cosmology.

PHYS 5200 TEACHING AND LEARNING OF STEM (3) LEC. 3. This course will provide students with a basic knowledge of the relevant research in cognitive psychology and learning science and the ability to apply that knowledge to enhance their ability to learn and teach science, particularly at the undergraduate level. This course will involve readings, discussion, and application of the ideas through the creation of learning activities. It is suitable for advanced undergraduates and graduate students with some science background.

PHYS 5300 OPTICS (3) LEC. 2. LAB. 2. Pr. PHYS 1617 or PHYS 1610. An overview of optics to include geometrical optics, electromagnetic waves, interference of light, diffraction of light, optical detectors, instrumentation and displays.

PHYS 5500 FUNDAMENTALS OF PHYSICS (3) LEC. 3. A subject such as Wave Mechanics, Mathematical Physics, Nonlinear Dynamics, Optics, Nuclear Physics, Elementary Particles, Relativity, or Electrodynamics. Course may be repeated for a maximum of 9 credit hours.

PHYS 5600 FRONTIERS OF PHYSICS (3) LEC. 3. A subject from the research areas in the Department such as Solid State, Atomic, Plasma, Space, or Computational Physics will be selected by the lecturer. Course may be repeated for a maximum of 9 credit hours.

PHYS 5610 INTRODUCTION TO SOLID STATE PHYSICS (3) LEC. 3. Lattice vibrations, band description of electronic states in metals, semiconductors and insulators, and magnetic, superconducting and defect properties of solids.

PHYS 5620 SURVEY OF PLASMA PHYSICS (3) LEC. 3. Pr. PHYS 3100. Single particle motions: fluid description of a plasma; plasma waves and oscillations; kinetic description, diffusion, and resistivity; non-linear effects.

PHYS 5900 PHYSICS TEACHING SEMINAR (1) LEC. 1. LAB. 0. SU. Introduction to issues, resources and best practices related to the teaching of physics. Physics undergraduate student or instructor approval required.

PHYS 6100 APPLICATIONS OF QUANTUM MECHANICS (3) LEC. 3. Quantum mechanics applied to atomic physics, solid state physics, nuclear physics, particle physics, electrodynamics, and cosmology.

PHYS 6200 TEACHING AND LEARNING OF STEM (3) LEC. 3. This course will provide students with a basic knowledge of the relevant research in cognitive psychology and science education and the ability to apply that knowledge to enhance their ability to learn and teach science, particularly at the undergraduate level. The course will involve readings, discussion, and application of the ideas through the creation of learning activities. It is suitable for advanced undergraduates and graduate students with some science background. Prerequisite: B.S. in a STEM discipline or 20+ credit hours of STEM coursework.

PHYS 6300 OPTICS (3) LEC. 2. LAB. 2. An overview of optics to include geometrical optics, electromagnetic waves, interference of light, diffraction of light, optical detectors, instrumentation and displays.

PHYS 6500 FUNDAMENTALS OF PHYSICS (3) LEC. 3. A subject such as Wave Mechanics, Mathematical Physics, Nonlinear Dynamics, Optics, Nuclear Physics, Elementary Particles, Relativity, or Electrodynamics. Course may be repeated for a maximum of 9 credit hours.

PHYS 6600 FRONTIERS OF PHYSICS (3) LEC. 3. A subject from the research areas in the Department such as Solid State, Atomic, Plasma, Space, or Computational Physics will be selected by the lecturer. Course may be repeated for a maximum of 9 credit hours.

PHYS 6610 INTRODUCTION TO SOLID STATE PHYSICS (3) LEC. 3. Lattice vibrations, band description of electronic states in metals, semiconductors and insulators, and magnetic, superconducting and defect properties of solids.

PHYS 6620 SURVEY OF PLASMA PHYSICS (3) LEC. 3. Single particle motions: fluid description of a plasma; plasma waves and oscillations; kinetic description, diffusion, and resistivity; non-linear effects.

PHYS 6900 PHYSICS TEACHING SEMINAR (1) LEC. 1. LAB. 0. SU. Graduate Students in Physics or Departmental Approval. Introduction to issues, resources and best practices related to the teaching of physics.

PHYS 7100 CLASSICAL MECHANICS (3) LEC. 3. Lagrangian and Hamiltonian formulations of mechanics, canonical transforms. Hamilton-Jacobi theories, action angle variables, rigid rotators, normal modes, and mechanics of continuous media.

PHYS 7200 ELECTRICITY AND MAGNETISM I (3) LEC. 3. Electrostatics, special function expansions, magnetostatics, linear media and Maxwell's equations.

PHYS 7250 ELECTRICITY AND MAGNETISM II (3) LEC. 3. Time dependent Maxwell theory, wave propagation and dispersion, diffraction, scattering, radiation, relativistic covariance and applications.

PHYS 7300 QUANTUM MECHANICS I (3) LEC. 3. Schrodinger wave equation, discrete and continuous spectra, matrix formulation, perturbation theory.

PHYS 7350 QUANTUM MECHANICS II (3) LEC. 3. Time-dependent approximation methods, relativistic wave equations, and second quantization.

PHYS 7400 STATISTICAL PHYSICS (3) LEC. 3. Thermodynamic quantities, equilibrium ensembles for classical and quantum systems, fluctuations, phase transitions and critical phenomena.

PHYS 7850 GRADUATE PHYSICS RESEARCH SEMINAR (1) LEC. 1. LAB. 0. SU. This course is designed to develop and expand incoming graduate student's knowledge and experience with state-of-the-art research as it is done in the Auburn University Department of Physics.

PHYS 7900 DIRECTED STUDIES (1-5) IND. SU. Student will work with a faculty member to study a topic of interest. Course may be repeated for a maximum of 6 credit hours.

PHYS 7930 DIRECTED STUDIES (1-5) IND. Student will work with a faculty member to study a topic of interest. Course may be repeated for a maximum of 6 credit hours.

PHYS 7950 PHYSICS COLLOQUIUM (1) SEM. SU. Offers a series of talks presented by invited speakers on broad fields of physics. Check with graduate advisor for credit allowed. Course may be repeated for a maximum of 6 credit hours.

PHYS 7970 SPECIAL TOPICS IN PHYSICS (1-5) SEM. Seminar or lecture series in a rapidly advancing specialty of physics. Course may be repeated for a maximum of 6 credit hours.

PHYS 7990 RESEARCH AND THESIS (1-10) MST. May be repeated as often as is appropriate. Course may be repeated with change in topics.

PHYS 8100 RELATIVISTIC QUANTUM MECHANICS (3) LEC. 3. Dirac equation, 1D barrier scattering, 3D central potentials, S-matrix theory, Feynman diagrams, quantum electrodynamics, renormalization, tree and loop level problems.

PHYS 8200 INTRODUCTION TO ATOMIC PHYSICS (3) LEC. 3. Hydrogen atom, Hartree-Fock theory, radiative transitions, photoionization, autoionization, electron-atom scattering.

PHYS 8600 PLASMA PHYSICS (3) LEC. 3. A detailed study of plasma physics including particle orbit theory, magnetohydrodynamics, plasma waves and transport phenomena.

PHYS 8700 SOLID STATE PHYSICS (3) LEC. 3. Atomic and electronic structures of solids and the associated electrical, optical and transport properties.

PHYS 8900 DIRECTED STUDIES (1-5) IND. SU. Students will work with a faculty member to study a topic of interest. Course may be repeated for a maximum of 10 credit hours.

PHYS 8930 DIRECTED STUDIES IN ADVANCED PHYSICS (1-5) IND. Student will work with a faculty member to study a topic of interest. Course may be repeated for a maximum of 10 credit hours.

PHYS 8970 SPECIAL TOPICS IN ADVANCED PHYSICS (1-5) LEC. Departmental approval. Topic at the forefront of physics research will be chosen by the lecturer. Course may be repeated for a maximum of 10 credit hours.

PHYS 8990 RESEARCH AND DISSERTATION (1-10) DSR. May be repeated as often as is appropriate. Course may be repeated with change in topics.