PHYSICS (PHY)

PHY 500 Selected Topics (1-6 Credits)
Arts & Sciences
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable 6 times for 6 credits maximum

PHY 514 Advanced Experimental Physics (3 Credits)
Arts & Sciences
The student will undertake an open-ended investigation of one or more physics experiments either in an active research laboratory or using departmental facilities. Ideas and progress will be discussed in regular seminars throughout the semester.
Advisory recommendation PHY 344 or Graduate standing

PHY 517 Fluid Dynamics (3 Credits)
Arts & Sciences
Fluid dynamics including Lagrangian vs. Eulerian fluid descriptions, inviscid and compressible fluids, viscosity and conduction, waves and oscillations, two-dimensional and incompressible flow, fluid instabilities, and boundary layer theory. Applications to astrophysics and/or biophysics.
Prereq: PHY 302 OR MAT 485 OR (MAT 331 AND MAT 414) Coreq: MAT 517 OR PHY 524

PHY 523 Advanced Mechanics (3 Credits)
Arts & Sciences
Moving coordinate systems, systems of particles, mechanics of rigid bodies. Lagrangian mechanics, normal modes of vibrating systems.
Prereq: PHY 360 and MAT 397
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

PHY 524 Electromagnetics I (3 Credits)
Arts & Sciences
Vector analysis, electrostatics, LaPlace's equation, dielectrics, magnetostatics, magnetic materials.
Prereq: (PHY 212 or 216 or AP Physics C (Elec & Mag) exam score min 3) and MAT 397
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

PHY 525 Electromagnetics II (3 Credits)
Arts & Sciences
Faraday's Law, displacement current, Maxwell's equations, plane waves, power flow in waves, reflection and transmission of waves, wave-guides, radiation, and antennas.
Prereq: PHY 524

PHY 531 Thermodynamics and Statistical Mechanics (3 Credits)
Arts & Sciences
Laws of thermodynamics, temperature, work, heat. Thermodynamic potentials and methods. Application to special systems, low-temperature physics. Classical statistical mechanics. Quantum statistics. Connections between thermodynamics and statistical mechanics.
Prereq: PHY 361
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

PHY 534 Electromagnetics (4 Credits)
Arts & Sciences

PHY 545 Electrical Measurements (4 Credits)
Arts & Sciences

PHY 557 Quantum Information Science (3 Credits)
Arts & Sciences
Quantum mechanics from the standpoint of information science. Storage, transmission, and processing of quantum information. Quantum entanglement, quantum cryptography, and quantum computing. Open quantum systems, quantum entropy.
Repeatable 2 times for 6 credits maximum
Advisory recommendation Prereq: PHY 361 and (either MAT 485 or (both MAT 331 and MAT 414))

PHY 567 Introduction to Quantum Mechanics I (3 Credits)
Arts & Sciences
Problems with classical physics; one dimensional Schrodinger equation, concepts and illustrative problems; N particle systems including separation of center of mass, identical particles, and Pauli principle; Schrodinger equation in three dimensions.
Prereq: PHY 361 and ((PHY 302 or MAT 485) or (MAT 331 and MAT 414))
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

PHY 568 Introduction to Quantum Mechanics II (3 Credits)
Arts & Sciences
Angular momentum including raising/ lowering operators and spherical harmonics; hydrogen atom; spin and addition of angular momentum; time independent perturbation theory; structure of and radiation from atoms; scattering; and elementary particles.
Prereq: PHY 567

PHY 576 Introduction to Solid-State Physics (3 Credits)
Arts & Sciences
Cross-listed with ELE 642
Elementary aspects of physics of solids; crystal lattices and diffraction, phonons and thermal properties in crystals, elementary band theory, and semi-conductor physics.
Prereq: PHY 567

PHY 580 International Course (1-12 Credits)
Arts & Sciences
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

PHY 581 Methods of Theoretical Physics I (3 Credits)
Arts & Sciences
Calculus of variations. Fourier series and integrals. Matrices. Linear vector spaces. Orthogonal polynomials. Sturm-Liouville equations. Singular points of differential equations. Special functions. Distributions.
Prereq: MAT 511

PHY 585 Principles of General Relativity (3 Credits)
Arts & Sciences
Mathematical and physical principles of general relativity and its applications, including tensor calculus, gravitational time dilation, black holes, the Schwarzschild metric, gravitational redshift, relativistic advance of periapsis, Shapiro delay, gravitational waves.
Prereq: (PHY 302 OR MAT 485 OR (MAT 331 AND MAT 414)) AND (MAT 517 OR PHY 524) AND PHY 523

PHY 600 Selected Topics: Physics (1-6 Credits)
Arts & Sciences
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

PHY 607 Computational Physics (3 Credits)
Arts & Sciences
Necessary numerical and computations tools for research in physics. The scope and implementation of scientific simulation algorithms for solving specific physics problems.
Advisory recommendation Prereq: PHY 211 or 215 or AP Physics C (Mech) exam score min 3

PHY 608 Computational Physics (4 Credits)
Arts & Sciences
Double-numbered with PHY 308
An introduction to computational physics. Numerical methods, design of simulations, validation and interpretation, algorithm analysis, and computational and visualization tools. Applications to physical systems that are analytically difficult. Strong emphasis on technical writing and scientific presentation. Additional work required of graduate students.

PHY 621 Classical Mechanics (3 Credits)
Arts & Sciences
Aspects of classical mechanics of significance to modern physical theory. Conceptual structure of Newton's mechanics, Lagrange's equations, Hamilton's principle, canonical equations and canonical transformations, Hamilton-Jacobi theory, small oscillations, rigid-body motion.

PHY 635 Physical Cell Biology (3 Credits)
Arts & Sciences
Cross-listed with CHE 635, BIO 635, CEN 635, BEN 635
This interdisciplinary class for science and engineering students provides an introduction to the quantitative description of biological systems and processes. The focus is on the biological and physical aspects of structure and function of cells and their subsystems.

PHY 638 Open Problems in Soft Interfaces (3 Credits)
Arts & Sciences
Cross-listed with BIO 638, CHE 638, CEN 638, BEN 638
In this seminar course on soft and biological materials and interfaces, teams from science and engineering will identify, discuss and assess current articles from the literature. Writing skills related to publishing peer-reviewed research are introduced.

PHY 641 Advanced Electromagnetic Theory I (3 Credits)
Arts & Sciences
Review of Maxwell's equations, Relativity and Covariant electrodynamics, conservation laws, Green function approach. Radiation from point and extended sources. Radiation reaction.
Advisory recommendation Prereq: PHY 425 or ELE 325

PHY 651 Instrumentation in Modern Physics (3 Credits)
Arts & Sciences
Double-numbered with PHY 351
Familiarizing students with instrumentation used in modern laboratories. Topics include detectors used in science and medicine, electronic noise mechanisms, computerized data acquisition systems. Independent research projects are encouraged. Additional work required of graduate students.
Advisory recommendation Prereq: PHY 221 or AP Physics C (Mech) exam score min 3; Coreq: PHY 222 or AP Physics C (Elec & Mag) exam score min 3

PHY 657 Statistics and Data Analysis in Physics (3 Credits)
Arts & Sciences
This course provides the skills needed to analyze experimental and observational data without getting lost in abstract general principles. While these skills are critical to experimental physics and astrophysics, they are also relevant to numerical approaches in theoretical physics.
Advisory recommendation Prereq: PHY 607

PHY 661 Quantum Mechanics I (3 Credits)
Arts & Sciences
Origins of quantum mechanics. Schrödinger and Heisenberg formulation. Problems in one, two, and three dimensions. Abstract formalism. Angular momentum and spin. Scattering theory. Symmetry properties. Perturbation methods. Identical particles. Applications to atomic and nuclear systems.
Advisory recommendation Prereq: PHY 567

PHY 662 Quantum Mechanics II (3 Credits)
Arts & Sciences
Origins of quantum mechanics. Schrödinger and Heisenberg formulation. Problems in one, two, and three dimensions. Abstract formalism. Angular momentum and spin. Scattering theory. Symmetry properties. Perturbation methods. Identical particles. Applications to atomic and nuclear systems.
Advisory recommendation Prereq: PHY 567 and 661

PHY 663 Problem Solving in Graduate Physics (3 Credits)
Arts & Sciences
Problem solving skills and topics not covered in courses the previous year.
Advisory recommendation Prereq: PHY 662

PHY 670 Experience Credit (1-6 Credits)
Arts & Sciences
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

PHY 690 Independent Study (1-6 Credits)
Arts & Sciences
In-depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor or instructors and the department.
Repeatable

PHY 731 Thermodynamics and Statistical Mechanics (3 Credits)
Arts & Sciences
First and second laws of thermodynamics, Boltzman's integrodifferential equation, Gibb's statistical mechanics, petit and grand ensembles, quantum statistics.
Advisory recommendation Prereq: PHY 531

PHY 750 Topics in Advanced Condensed Matter/Physics Theory (3 Credits)
Arts & Sciences
Electron band theory. Electron-phonon interaction. Superconductivity. Impurities in crystals. Many-body Green's function. Disorder and localization. Amorphous materials.
Repeatable
Advisory recommendation Prereq: PHY 731

PHY 763 Quantum Mechanics III (3 Credits)
Arts & Sciences
Relativistic quantum mechanics; second quantization of many-particle systems; quantum theory of the electromagnetic field.
Advisory recommendation Prereq: PHY 662

PHY 771 High Energy Particle Physics (3 Credits)
Arts & Sciences
Classification of subatomic particles. Passage of particles through matter. Production, selection, and detection of high-energy particles. Invariance principles and dynamic laws of strong, electromagnetic, and weak interactions: their experimental discovery and confirmation. Review of outstanding problems.
Advisory recommendation Prereq: PHY 662

PHY 775 Quantum Field Theory (3 Credits)
Arts & Sciences
Physical foundations of field quantization. Free fields. Fock space. Lagrangian and functional formulations. Interacting fields: quantum electrodynamics, weak and strong interactions. Renormalization. Path integrals. Symmetry and invariance. Nonabelian gauges.
Advisory recommendation Prereq: PHY 662

PHY 785 Theory of Relativity (3 Credits)
Arts & Sciences
Special and general theory of relativity. First semester: technical introduction to established theory. Part of second semester: current research topics.
Advisory recommendation Prereq: PHY 621

PHY 795 Modern Cosmology (3 Credits)
Arts & Sciences
Introduction to main ideas of modern cosmology. Expanding universe within general relativity; thermodynamics and cosmology; the cosmic microwave background; dark matter; dark energy and inflation; structure formation in the universe and connections between cosmology and particle physics.
Advisory recommendation Prereq: PHY 621

PHY 800 Selected Topics (1-6 Credits)
Arts & Sciences
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

PHY 831 Statistical Mechanics of Fields and the Renormalization Group (3 Credits)
Arts & Sciences
A continuation of graduate statistical physics. Topics include: collective modes and quasiparticles, Ginzburg-Landau theory, modern theory of phase transitions, and the renormalization group.
Advisory recommendation Prereq: PHY 731

PHY 880 Selected Topics in Advanced Theoretical Physics (3 Credits)
Arts & Sciences
Topics vary over advanced field theory, gravitational physics, condensed matter theory, solitons, supersymmetry, cosmology, string theory, and others. With permission, may be taken more than once for credit.
Repeatable 2 times for 3 credits maximum
Advisory recommendation Prereq: PHY 662

PHY 881 Sel Topics: Classical Physics (3 Credits)
Arts & Sciences

PHY 890 Minor Problems In Physics (1-3 Credits)
Arts & Sciences
Independent study and experimentation in some subject in physics.
Repeatable

PHY 990 Independent Study (1-6 Credits)
Arts & Sciences
In-depth exploration of a problem or problems. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor or instructors and the department.
Repeatable

PHY 997 Masters Thesis (1-6 Credits)
Arts & Sciences
Repeatable

PHY 999 Dissertation (1-15 Credits)
Arts & Sciences
Repeatable