PHYSICS (PHY)

PHY 100 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 101 Major Concepts of Physics I (4 Credits)
Arts & Sciences
Explores the fundamental laws which govern the universe with emphasis on the concept of energy as a unifying principle. No science prerequisites. Knowledge of elementary algebra required. Includes Laboratory.

PHY 102 Major Concepts of Physics II (4 Credits)
Arts & Sciences
Explores the fundamental laws which govern the universe. Presents overview of basic ideas and contemporary research in physics. No science prerequisites. Knowledge of elementary algebra required. Includes Laboratory.
Prereq: PHY 101 or 211 or AP Physics B exam score min 3 or AP Physics C (Mech) exam score min 3

PHY 180 International Course (1-6 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 SU academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable 2 times for 999.99 credits maximum

PHY 200 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 204 Case Std/Physics & Technl (1 Credit)
Arts & Sciences

PHY 211 General Physics I (3 Credits)
Arts & Sciences
First half of a two semester introduction to classical physics including mechanics and thermal physics. Uses calculus. Knowledge of plane trigonometry required.
Coreq: (PHY 221 or AP Physics C (Mech) exam score min 3) and (MAT 285 or 295 or AP MAT Calc AB exam score min 3 or AP MAT Calc BC exam score min 4)

PHY 212 General Physics II (3 Credits)
Arts & Sciences
Second half of a two semester introduction to classical physics including electricity, magnetism and light.
Prereq: ((PHY 211 or 215) and PHY 221) or AP Physics C Mech exam score min 3; Coreq: (PHY 222 or AP Physics C Elec & Mag exam score min 3) and (MAT 286 or 296 or AP MAT Calc BC exam score min 4 or AP MAT AB exam score min 4).

PHY 215 General Physics I for Scientists (3 Credits)
Arts & Sciences
Introductory calculus-based physics emphasizing topics important in modern research and technology. For students in the Honors Program, prospective physics majors, and others with strong science interests. Newtonian mechanics and selected modern topics. Student cannot receive credit for both PHY 215 and PHY 211.
Coreq: PHY 225 and (MAT 295 OR (AP MAT Calc AB exam score min 3 or AP MAT Calc BC min score 4))
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 216 General Physics II for Scientists (3 Credits)
Arts & Sciences
Electricity, magnetism and light. Student cannot receive credit for both PHY 216 and 212.
Prereq: ((PHY 211 or PHY 215) and (PHY 221 or PHY 225)) OR (AP Physics C (Mech) exam score min 4) Coreq: PHY 226 and (MAT 296 or AP MAT Calc BC exam score min 4 or AP MAT AB exam score min 4)
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 221 General Physics Laboratory I (1 Credit)
Arts & Sciences
Techniques of laboratory work: treatment of random errors, graphical representation of data. Experimental demonstration of principles of mechanics, thermodynamics, and waves (of vector forces, conservation of momentum and energy, thermal properties of gases).
Coreq: PHY 211 or 215

PHY 222 General Physics Laboratory II (1 Credit)
Arts & Sciences
Experimental study of principles of electromagnetism and their application in electrical circuits. Use of electronic instruments, such as the oscilloscope.
Coreq: PHY 212 or 216

PHY 225 Experiencing Physics I (2 Credits)
Arts & Sciences
Introduction to modes of inquiry into physical law: Experimental observations, error handling techniques. Hypothesis generation and testing. Visualizing and writing for dissemination of acquired knowledge. Computers as scientific tools.
Coreq: PHY 215

PHY 226 Experiencing Physics II (2 Credits)
Arts & Sciences
Introduction to modes of inquiry into physical law: Experimental observations, error handling techniques. Hypothesis generation and testing. Visualizing and writing for dissemination of acquired knowledge. Computers as scientific tools. Tools for electrical signal analysis.
Coreq: PHY 216

PHY 244 Experimental Physics I (4 Credits)
Arts & Sciences

PHY 250 Physics Journal Workshop (1 Credit)
Arts & Sciences
Introduction to physics research by reading and critical discussion of articles from the current or recent physics literature. For physics majors and minors; others may enroll with permission of instructor.
Repeatable
Prereq: PHY 211 or 215 or AP Physics C (Mech) exam score min 3

PHY 270 Experience Credit (1-6 Credits)
Arts & Sciences
Participation in a discipline- or subject-related experience. Students must be evaluated by written or oral reports or an examination. Limited to those in good academic standing.
Repeatable

PHY 280 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 2 times for 12 credits maximum

PHY 290 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 300 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 302 Mathematical Skills for Physicists (3 Credits)
Arts & Sciences
To acquire a knowledge and an understanding of the mathematics required for the physics degree programs. Topics include series expansions, complex numbers and functions, Fourier series and transforms, techniques for solving differential equations, and linear algebra and eigenvalue equations.
Prereq: MAT 397 AND (PHY 212 OR PHY 216)
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 305 Solar Energy Science and Architectures (3 Credits)
Arts & Sciences
Properties of solar energy. Photons, blackbody radiation, and the planetary greenhouse effect. Solar thermal, solar electric, and biomass applications. Architectural and economic implications.
Coreq: MAT 285 or 295 or AP MAT Calc AB exam score min 3 or AP MAT Calc BC exam score min 4

PHY 306 Nuclear Physics in our Lives (3 Credits)
Arts & Sciences
An introduction to nuclear physics and applications of nuclear physics in our society. Includes fundamentals of nuclear structure, decays, and energy. Applications include industrial uses, medicine, and power generation.
Prereq: PHY 212 or PHY 216 or AP PHYSICS C (ELEC & MAG) EXAM SCORE MIN 3

PHY 307 Science and Computers I (3 Credits)
Arts & Sciences
An introduction to the use of computers to solve problems in science. Development of algorithms, numerical solutions, plotting and manipulating data, statistical analysis and problems involving random numbers.
Coreq: PHY 211 or 215 or AP Physics C (Mech) exam score min 3
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 312 Relativity, Black Holes, and the Big Bang (3 Credits)
Arts & Sciences
Cross-listed with AST 312
Introduction to spacetime and relativity, cosmological redshift, binary systems, black holes, gravitational waves, and the Big Bang. No science prerequisite. For non-majors and majors.
Coreq: MAT 285 or 295 or AP MAT Calc AB exam score min 3;

PHY 314 Quantum Computing Demystified (3 Credits)
Arts & Sciences
Introduction to quantum computers and their applications. Elements of quantum mechanics used in computing. Comparison of conventional digital and quantum computing. Prior enrollment in a physics course is not a requirement.
Prereq: (MAT 285 or MAT 295) or (3 on AP CALC AB or 3 on AP MAT CALC BC-AB)

PHY 315 Biological and Medical Physics (3 Credits)
Arts & Sciences
Signal, energy, and information processing by cells. Evolution; cell structure and function; neurophysiology; biological control, chaos; biological motors, pumps, and receptors; systems analysis, scaling, dimensionality; spectroscopy and biomedical imaging. Additional work required of graduate students.
Prereq: PHY 212 or 216 or AP Physics C (Elec & Mag) exam score min 3

PHY 316 Econophysics (3 Credits)
Arts & Sciences
This course uses statistical physics to understand economic theory. Physics topics include thermodynamics, statistical mechanics, and random walks. Economic topics include macroeconomics, the labor market, and income distribution.
Coreq: MAT 285 OR MAT 295

PHY 317 Modern Astrophysics (3 Credits)
Arts & Sciences
Cross-listed with AST 317
A broad introduction to important and timely topics in astrophysics. Topics will include our local universe (the Sun and Moon), cosmology (the universe as a whole), star formation, stellar evolution, compact objects, black holes, multi-messenger astronomy and gravitational waves.
Prereq: 211 or 215 or AP Physics C (Elec & Mag) min score 3

PHY 319 Introduction to Astrobiology (3 Credits)
Arts & Sciences
Cross-listed with AST 319
The emergence and development of life in the universe. Topics: elements of astrophysics, origin of life on earth, current research in astrobiology.
Prereq: MAT 285 or 295 or AP MAT Calc AB exam score min 3 or AP MAT Calc BC min score 4

PHY 322 Intermediate Mechanics I (3 Credits)
Arts & Sciences
Mechanics of a single particle. Conservation theorems. Central forces and gravitation. Lagrangian mechanics and Hamiltonian methods.
Prereq: MAT 397

PHY 351 Instrumentation in Modern Physics (3 Credits)
Arts & Sciences
Double-numbered with PHY 651
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.
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 360 Vibrations, Waves and Thermal Physics (3 Credits)
Arts & Sciences
Exploration of the rich behavior of vibrating and thermal systems. Simple harmonic motion, driven oscillators and resonance, normal modes, thermodynamics.
Prereq: PHY 212 or 216 or AP Physics C (Elec & Mag) exam score min 3
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 361 Statistical Physics and Quantum Phenomena (3 Credits)
Arts & Sciences
Modern physical theories, including statistical physics of many particles, and quantum mechanics. Applications to molecular, atomic, and nuclear structures. Principles of lasers, nuclear reactors. Particle accelerators.
Prereq: PHY 212 or 216 or AP Physics C (Elec & Mag) exam score min 3
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 365 Experiencing Physics III (2 Credits)
Arts & Sciences
The first in a two-course 300-level sequence covering intermediate modes of inquiry into physical law. An emphasis on growing independence in using tools and techniques for exploring the laws of nature. Scientific programming, advanced laboratory techniques, collaboration, and scientific writing/oral dissemination are all emphasized.
Prereq: PHY 212 OR PHY 216 OR AP PHYSICS C (ELEC & MAG) EXAM SCORE MIN 3

PHY 366 Experiencing Physics IV (2 Credits)
Arts & Sciences
The second in a two-course 300-level sequence covering intermediate modes of inquiry into physical law. An emphasis on growing independence in using tools and techniques for exploring the laws of nature. Scientific programming, advanced laboratory techniques, collaboration, and scientific writing/oral dissemination are all emphasized.
Prereq: PHY 365

PHY 380 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 398 Junior seminar in Energy and its Impacts (1 Credit)
Arts & Sciences
Interdisciplinary examination of energy use and its impact on the natural and social environment. Special focus on issues in the Syracuse area.

PHY 399 Practicum and Seminar in Physics Education (1-3 Credits)
Arts & Sciences
Student peers assist in a physics class and participate in a physics education seminar. Questioning, curriculum, teaching methods, assessment.

PHY 400 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 408 Computational Physics (4 Credits)
Arts & Sciences
Double-numbered with PHY 608
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.
Prereq: MAT 396 and WRT 105 Coreq: PHY 212 or PHY 216

PHY 443 Experimental Physics (4 Credits)
Arts & Sciences
Laboratory projects emphasizing mechanics, electromagnetism, and atomic physics. Projects include chaos in a compass needle, the Franck-Hertz experiment, and the Hall effect.
Prereq: (PHY 211 or 215 or AP Physics C (Mech) exam score min 3) and (PHY 212 or 216 or AP Physics C (Elec & Mag) exam score min 3)
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

PHY 444 Soft Matter (3 Credits)
Arts & Sciences
Introduction to the physics of soft (easily deformable) materials such as polymers, liquid crystals, membranes, and colloids. Learn to appreciate the myriad of phases in the world of squishy physics and their statistical behavior.

PHY 451 Problems of Contemporary Physics (2 Credits)
Arts & Sciences
Integrated approach to solving physics problems that may cross traditional boundaries between courses. Improve the preparation of students for post-graduate education and physics-related careers.
Prereq: PHY 361

PHY 462 Experimental Physics II (4 Credits)
Arts & Sciences
Laboratory projects emphasizing optics and nuclear physics. Projects include diffraction, interferometry, detection of nuclear radiation, interaction of radiation and matter, and nuclear lifetime measurements.
Prereq: PHY 344

PHY 465 Methods in Astronomy and Astrophysics (4 Credits)
Arts & Sciences
Cross-listed with AST 465
Mathematical and observational methods in astronomy, including coordinate systems, parallax and apparent magnitude, command line computing, spectra, focusing power, the diffraction limit, interferometric design, orbital motion and Keplerian dynamics, order-of-magnitude estimates and secular dynamics.
Prereq: (PHY 212 OR PHY 216) AND (PHY 222 OR PHY 226)) OR AP PHYSICS C (ELEC & MAG) EXAM SCORE MIN 3

PHY 467 Optics and Photonics (4 Credits)
Arts & Sciences
Fundamentals of optics, including ray tracing, reflection, refraction, wave-nature of light, light-matter interactions, lasers and interferometers, microscopes and nonlinear optics. Develop foundations to understand optical systems and experimental skills to build optical systems.
Prereq: PHY 212 OR PHY 216 OR AP PHYSICS C (ELEC & MAG) EXAM SCORE MIN 3

PHY 470 Experience Credit (1-6 Credits)
Arts & Sciences
Participation in a discipline- or subject-related experience. Students must be evaluated by written or oral reports or an examination. Limited to those in good academic standing.
Repeatable

PHY 490 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 498 Capstone Seminar in Energy and its Impacts (3 Credits)
Arts & Sciences
Study of a local energy-related issue.. Study will be carried out in an interdisciplinary team. For students in the Integrated Learning Major on Energy and its Impacts.
Prereq: PHY 398

PHY 499 Honors Capstone Project (1-3 Credits)
Arts & Sciences
Completion of an Honors Capstone Project under the supervision of a faculty member.
Repeatable 3 times for 3 credits maximum

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