PHYSICS (PH-UY)

PH-UY 1002 Physics: The Genesis of Technology (2 Credits)
Typically offered Fall
This course introduces contemporary topics in physics, along with readings and discussions of topics with technological implications. | Prerequisite: Only first-year students are permitted to enroll in this introductory level course.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: Only first-year students are permitted to enroll in this introductory level course.

PH-UY 1013 Mechanics (3 Credits)
Typically offered Fall, Spring, and Summer terms
This course is the first of a three-semester lecture sequence in general physics for science and engineering students. Motion of particles and systems of particles. One-dimensional motion. Vectors and two-dimensional motions. Forces and acceleration. Conservation of energy and momentum. Rotations. The free and driven harmonic oscillator. Gravitation. (This class meets four hours per week for lectures and recitation.) | Prerequisites: MA-UY 1024 or an approved equivalent. Co-requisites: MA-UY 1124 or approved equivalent, and EX-UY 1
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: MA-UY 1024 or an approved equivalent.
Corequisites: MA-UY 1124 or approved equivalent, and EX-UY 1.

PH-UY 1213 Motion and Sound (3 Credits)
Typically offered Fall
First of a two courses introductory sequence in general physics for majors other than science or engineering. (Not an acceptable substitute for PH-UY 1013) One-dimensional motions. Vectors and Two-Dimensional Motions. Newton's Laws of motion. Conservation Laws of Energy and Momentum. Collisions. Rotational motions. Gravity. Statics and Elasticity. Fluids. Oscillations. Mechanical Waves. Superposition and Standing Waves. Sound and Acoustics. | Prerequisite: Math placement exam or MA-UY 914, Co-requisite: EX-UY 1, Anti-requisite: PH-UY 1013
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: Math placement exam or MA-UY 914, Co-requisite: EX-UY 1,.
Antirequisites: PH-UY 1013.

PH-UY 1223 Electricity and Light (3 Credits)
Typically offered Spring
Second of two introductory courses in general physics for non science or engineering majors. (Not an acceptable substitute for PH-UY 2023 or PH-UY 2033) Electric forces and fields. Electric potential and capacitance. Electric current. Magnetic forces and fields. Faradays law and inductance. Maxwell's Theory of Electromagnetism. Electromagnetic waves. Light and Color. Geometrical optics. Image Formation. Interference and diffraction. | Prerequisite(s): PH-UY 1213 or PH-UY 1013; Co-requisite: EX-UY 1.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 1213 or PH-UY 1013; Co-requisite: EX-UY 1.
Antirequisites: PH-UY 2023 or PH-UY 2033.

PH-UY 2002 Introduction to Quantum Science (2 Credits)
Typically offered Spring
This course offers an introduction to the essential concepts of quantum mechanics. Topics covered include basic principles like superposition, measurement and entanglement, along with elementary mathematical models such as wave functions and probability amplitudes. While the course does involve mathematical descriptions, the emphasis is on developing an intuitive understanding of quantum principles. | Prerequisites: PH-UY 1013 and MA-UY 1124
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 1013 and MA-UY 1124.

PH-UY 2012 Introduction to Quantum Programming (2 Credits)
Typically offered Fall
This course offers an accessible introduction to quantum programming. Students will explore fundamental quantum algorithms and learn to implement them using popular quantum programming languages and frameworks, with a particular focus on Python-based tools. Topics will include qubits, quantum gates, quantum circuits, and essential quantum algorithms like Deutsch-Josza and Grover's algorithm. | Prerequisites: PH-UY 2002 and (CS-UY 1113 or CS-UY 1114)
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2002 and (CS-UY 1113 or CS-UY 1114).

PH-UY 2023 Electricity, Magnetism, & Fluids (3 Credits)
Typically offered Fall, Spring, and Summer terms
This is the second course of a three-semester lecture sequence in general physics for science and engineering students. Fluids at rest and in motion. An introduction to electric and magnetic forces and fields. Electric charge density. Electric fields from simple charge distributions. Electric potential. Capacitance. Magnetic forces. Magnetic field from a current loop. Inductance. Magnetism in matter. Current and resistance. (This class meets four hours per week for lectures and recitation.) | Prerequisites: PH-UY 1013 and MA-UY 1124 or an approved equivalent. Co-requisite: EX-UY 1
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 1013 and MA-UY 1124 or an approved equivalent.
Corequisites: EX-UY 1.

PH-UY 2023G Electricity, Magnetism, & Fluids (3 Credits)
Typically offered Fall
This is the second course of a three-semester lecture sequence in general physics for science and engineering students. Fluids at rest and in motion. An introduction to electric and magnetic forces and fields. Electric charge density. Electric fields from simple charge distributions. Electric potential. Capacitance. Magnetic forces. Magnetic field from a current loop. Inductance. Magnetism in matter. Current and resistance. (This class meets four hours per week for lectures and recitation.) | Prerequisites: PH-UY 1013 and MA-UY 1124 or an approved equivalent. Co-requisite: EX-UY 1
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 1013 and MA-UY 1124 or an approved equivalent.
Corequisites: EX-UY 1.

PH-UY 2033 Waves, Optics, & Thermodynamics (3 Credits)
Typically offered Fall, Spring, and Summer terms
This is the third course of a three-semester lecture sequence in general physics for science and engineering students. Water, sound and electromagnetic waves. Reflection, scattering and absorption. Standing waves and spectra. Superposition, diffraction and beats. Geometrical optics. Introduction to thermodynamics; temperature, heat, and entropy. (This class meets four hours per week for lectures and recitation.) | Prerequisites: PH-UY 2121 and PH-UY 2023. Co-requisites: EX-UY 1.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2121 and PH-UY 2023.
Corequisites: EX-UY 1.

PH-UY 2033G Waves, Optics, & Thermodynamics (3 Credits)
Typically offered Spring
This is the third course of a three-semester lecture sequence in general physics for science and engineering students. Water, sound and electromagnetic waves. Reflection, scattering and absorption. Standing waves and spectra. Superposition, diffraction and beats. Geometrical optics. Introduction to thermodynamics; temperature, heat, and entropy. (This class meets four hours per week for lectures and recitation.) | Prerequisites: PH-UY 2121 and PH-UY 2023. Co-requisites: EX-UY 1.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2121 and PH-UY 2023.

PH-UY 2104 Analytical Mechanics (4 Credits)
Typically offered Fall
The course covers statics by virtual work and potential energy methods. Stability of equilibrium. Particle dynamics, harmonic oscillator and planetary motion. Rigid body dynamics in two and three dimensions. Lagrangian mechanics. Dynamics of oscillating systems. | Prerequisite: PH-UY 2023; Co-requisite: MA-UY 2034
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2023; Co-requisite: MA-UY 2034.

PH-UY 2121 General Physics Laboratory I (1 Credit)
Typically offered Fall, Spring, and Summer terms
An introductory level experimental course. Fundamental laboratory experiments in classical mechanics and electrostatics. Stresses basic experimental techniques, error analysis, and written presentation of experiment results. Experiments require progressively more detailed and sophisticated analysis. This laboratory class meets for three hours on alternate weeks. | Prerequisites: PH-UY 1013 and MA-UY 1124 or equivalent. Co-requisite: PH-UY 2023.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 1013 and MA-UY 1124 or equivalent.
Corequisites: PH-UY 2023.

PH-UY 2121G General Physics Laboratory I (1 Credit)
Typically offered Fall
An introductory level experimental course. Fundamental laboratory experiments in classical mechanics and electrostatics. Stresses basic experimental techniques, error analysis, and written presentation of experiment results. Experiments require progressively more detailed and sophisticated analysis. This laboratory class meets for three hours on alternate weeks. | Prerequisites: PH-UY 1013 and MA-UY 1124 or equivalent. Co-requisite: PH-UY 2023.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 1013 and MA-UY 1124 or equivalent.
Corequisites: PH-UY 2023.

PH-UY 2131 General Physics Laboratory II (1 Credit)
Typically offered Fall, Spring, and Summer terms
The second part of the introductory physics laboratory program. Fundamental laboratory experiments in E&M, waves, optics, and thermodynamics. Stresses experimental models and design, error and data analysis. This laboratory class meets for three hours on alternate weeks. | Prerequisites: PH-UY 2121 and PH-UY 2023. Co-requisite: PH-UY 2033
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2121 and PH-UY 2023.
Corequisites: PH-UY 2033.

PH-UY 2131G General Physics Laboratory II (1 Credit)
The second part of the introductory physics laboratory program. Fundamental laboratory experiments in E&M, waves, optics, and thermodynamics. Stresses experimental models and design, error and data analysis. This laboratory class meets for three hours on alternate weeks. | Prerequisites: PH-UY 2121 and PH-UY 2023. Co-requisite: PH-UY 2033
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2121 and PH-UY 2023 AND Corequisite: PH-UY 2033G.

PH-UY 2344 Introduction to Modern and Solid State Physics (4 Credits)
Typically offered Spring
Special theory of relativity, Michelson-Morley experiment. Planck's quantum hypothesis, photoelectric effect, Compton effect, Rutherford scattering, Bohr's atom, DeBroglie wavelength, electron diffraction, wave function, uncertainty principle, Schrodinger equation. Application to: square well potential, one electron atom. Atomic nucleus, fission and fusion. Energy bands in a periodic lattice, Kronig Penney model, valence, conduction bands, impurity states, electron mobility. Semiconductor properties. Introduction to superconductivity; electron pairs, energy gap, Josephson effect. | Prerequisites: PH-UY 2023; Co-requisite: PH-UY 2033 and MA-UY 2034.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2023; Co-requisite: PH-UY 2033 and MA-UY 2034.

PH-UY 2813 Astronomy and Astrophysics (3 Credits)
Typically offered occasionally
This course covers historical development of observational astronomy. Traditional and modern observational techniques. Theories of formation and evolution of stars, planets and galaxies. Current developments in astronomy, cosmology and astrophysics. | Prerequisites: PH-UY 2131 and PH-UY 2033.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2131 and PH-UY 2033.

PH-UY 2823 Geology and Geophysics (3 Credits)
Typically offered Fall
An introduction to physical geology, familiarizing students with basic geological processes, and emphasizing the interdisciplinary interactions involved. | Prerequisites: PH-UY 1013
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 1013.

PH-UY 3002 Junior Physics Laboratory (2 Credits)
Typically offered Spring
An intermediate level laboratory course providing in depth exposure to a selection of classic physics experiments. Students' experimental skill set is expanded and data analysis and communication skills developed. | Prerequisites: PH-UY 2131 and PH-UY 2033; Co-requisites: PH-UY 2344 and MA-UY 2224.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2131 and PH-UY 2033; Co-requisites: PH-UY 2344 and MA-UY 2224.

PH-UY 3103 Fundamentals of Applied Nuclear Physics (3 Credits)
Typically offered Spring
This course surveys the fundamentals of nuclear physics with application to nuclear engineering. Topics include an introduction to quantum mechanics, nuclear forces and nuclear structure, nuclear stability and reactions, natural and induced radioactivity. | Prerequisites: PH-UY 2023
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2023.

PH-UY 3234 Electricity and Magnetism (4 Credits)
Typically offered Spring
The course covers properties of the electrostatic, magnetostatic and electromagnetic field in vacuum and in material media. Maxwell's equations with applications to elementary problems. | Prerequisites: PH-UY 2033 and MA-UY 2114.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2033 and MA-UY 2114.

PH-UY 3424 Light and Lighting (4 Credits)
Typically offered occasionally
The course explores physical concepts in conversion of electric energy into visible light. Nature of light. Visualization of light. Principles of operation and characteristics of modern light sources. Incandescent and tungsten halogen lamps. Fluorescent mercury lamps. Low-pressure sodium lamps. High intensity discharge (HID) lamps. Solid-state light sources. Latest trends in lighting technology. (Crosslisted as EE-UY 3424.) | Prerequisites: CM-UY 1004, and PH-UY 2033 or PH-UY 2004.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: (PH-UY 2004 with a Minimum Grade of D OR PH-UY 2033 with a Minimum Grade of D OR PH-UY 2033H with a Minimum Grade of D) AND CM-UY 1003 with a Minimum Grade of D.

PH-UY 3474 Introduction to Modern Optics and Photonics (4 Credits)
Typically offered Spring
This course covers the physics of optics using both classical and semi-classical descriptions. The classical and quantum interactions of light with matter. Diffraction of waves and wave packets by obstacles. Fourier transform optics, holography, Fourier transform spectroscopy. Coherence and quantum aspects of light. Geometrical optics. Matrix optics. Crystal optics. Introduction to electro-optics and nonlinear optics. | Prerequisites: PH-UY 2033.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2033.

PH-UY 3503 Introduction to Radiation Physics and Dosimetry (3 Credits)
Typically offered occasionally
The course examines the basic theory and practice of Radiation and Health Physics. Atomic and nuclear radiation. X-ray and gamma radiation. Interaction of radiation with matter, and the effects on living tissue. Principles of radiation detection, radiation measurement, external and internal dosimetry. Radiation Protection. | Prerequisite: PH-UY 2023.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2023.

PH-UY 3513 Nuclear and Radiation Instrumentation and Methods (3 Credits)
Typically offered Fall
An intermediate level undergraduate course focusing on the theory and practice of nuclear and radiation measurements and instrumentation. Detector properties and principles, pulse electronics and counting statistics will be discussed in detail in the lecture classes. The experiments will illustrate the lecture topics and compliment the companion theory courses. This course meets five hours per week. | Prerequisite: PH-UY 3103; Co-requisite: PH-UY 3503.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 3103; Co-requisite: PH-UY 3503.

PH-UY 3604 Mathematical Methods for Physics and Engineering (4 Credits)
Typically offered Fall
First course of two-semester lecture sequence in mathematical physics for undergraduate students in physics and engineering. Line, surface and volume integrals, gradient, divergence, and curl. Cylindrical and spherical coordinate systems. Tensors and tensor transformations. The Dirac delta function, and integrals and derivatives of the delta function. Functions of complex variables, analytic functions, and the residue theorem. Fourier series, integrals, and transforms. | Prerequisites: PH-UY 2023 and MA-UY 2114; Co-requisites: PH-UY 2033 and (MA-UY 1044 or MA-UY 2034 or MA-UY 3054).
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2023 and MA-UY 2114; Co-requisites: PH-UY 2033 and (MA-UY 1044 or MA-UY 2034 or MA-UY 3054).

PH-UY 3613 Mathematical Foundations for Quantum Computing (3 Credits)
Typically offered Fall
This course provides a rigorous mathematical foundation tailored to support advanced studies in quantum computing. It is designed to bridge the gap between general mathematics education and the specialized mathematical understanding required for in-depth quantum computing work. Topics covered are linear algebra, probability and statistics, differential equations, Fourier transforms, complex analysis, and discrete mathematics. | Prerequisites: MA-UY 1124 and PH-UY 2002
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: MA-UY 1124 and PH-UY 2002.

PH-UY 3614 Computational Physics (4 Credits)
Typically offered Spring
An introduction to numerical methods. Solving ordinary differential equations, root finding, fourier transforms, numerical integration, linear systems. Techniques are applied to projectile motion, oscillatory motion, planetary motion, potentials and fields, waves and quantum mechanics. This class meets four hours per week for lectures | Prerequisites: PH-UY 2033, CS-UY 1133 (or CS-UY 1114), and MA-UY 1124.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2033, CS-UY 1133 (or CS-UY 1114), and MA-UY 1124.

PH-UY 3801 Guided Studies in Physics (1 Credit)
Typically offered Fall, Spring, and Summer terms
These guided studies courses in physics are supervised by staff member. | Prerequisites: Physics adviser approval. (Course may be repeated for additional credit.)
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

PH-UY 3802 Guided Studies in Physics (2 Credits)
Typically offered Fall, Spring, and Summer terms
These guided studies courses in physics are supervised by staff member. | Prerequisites: Physics adviser approval. (Course may be repeated for additional credit.)
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

PH-UY 3803 Guided Studies in Physics (3 Credits)
Typically offered Fall, Spring, and Summer terms
These guided studies courses in physics are supervised by staff member. | Prerequisites: Physics adviser approval. (Course may be repeated for additional credit.)
Grading: Ugrd Tandon Graded
Repeatable for additional credit: Yes

PH-UY 3804 Guided Studies in Physics (4 Credits)
Typically offered Fall, Spring, and Summer terms
These guided studies courses in physics are supervised by staff member. | Prerequisites: Physics adviser approval. (Course may be repeated for additional credit.)
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

PH-UY 4124 Thermodynamics and Statistical Physics (4 Credits)
Typically offered Spring
The course covers fundamental laws of macroscopic thermodynamics, heat, internal energy and entropy. Topics include an introduction to statistical physics, and applications of Maxwell, Fermi-Dirac and Bose-Einstein distributions. | Prerequisites: PH-UY 2344, MA-UY 2114, and MA-UY 2224.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 2344, MA-UY 2114, and MA-UY 2224.

PH-UY 4553 Introduction to the Physics of Quantum Computing (3 Credits)
Typically offered Fall
This course aims to introduce undergraduate students to the foundational principles of quantum computation and quantum information processing. Topics covered are Hilbert space, Bloch vector, unitary and Hermitian operators, quantum measurement, electron spin, multi-qubit systems, quantum algorithms, and quantum error correction. | Prerequisites: PH-UY 3613
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 3613.

PH-UY 4603 Special Topics in Physics (3 Credits)
Typically offered occasionally
Variable credit special topics courses in physics. | Prerequisites: CS-UY 1133 and Physics adviser approval. (Course may be repeated for additional credit.)
Grading: Ugrd Tandon Graded
Repeatable for additional credit: Yes

PH-UY 4902 Introduction to Senior Project in Physics (2 Credits)
Typically offered Fall and Spring
A qualified senior physics student or group of students work with a faculty member (and possibly graduate students) on an advanced problem in physics. In this introductory phase the student(s) and adviser select a suitable theoretical or experimental problem in the subject area and use various resources to solve it.
Grading: Satisfactory/Unsatisfactory
Repeatable for additional credit: No

PH-UY 4904 Senior Project in Physics (4 Credits)
Typically offered Fall and Spring
In the project's concluding phase, senior physics students or group of students work with a faculty member (and possibly graduate students) to solve an advanced problem in interdisciplinary physics. The conclusion of the project is a written report and an oral presentation made to the supervising faculty. | Prerequisite: PH-UY 4902
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: PH-UY 4902.

PH-UY 4912 Senior Seminar in Physics (2 Credits)
Typically offered Fall
Senior physics students, in consultation with the instructor, study and prepare presentations on several current research topics in the general area of interdisciplinary physics. Students' performance is based on the mastery of the material chosen and also on the quality of the presentation made to the instructor and the seminar members.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

PH-UY 4994 Bachelor's Thesis in Physics (4 Credits)
Typically offered Fall and Spring
Cannot receive credits for both PH-UY 4904 and PH-UY 4994.
Grading: Satisfactory/Unsatisfactory
Repeatable for additional credit: Yes