PHYSICS (PH-UY)

PH-UY 1  Pre-college Physics (0 Credits)
Typically offered Summer term
This course introduces the foundational concepts and laws of physics and their connection to the engineering disciplines. The subject matter helps students apply scientific methods to physical problems and prepares them for physics at the university level. Topics include vectors, kinematics, Newton’s Laws, work and energy, momentum and collision theory, rotational motion, and angular momentum.
Grading: Ugrd Tandon Pass/Fail
Repeatable for additional credit: No

PH-UY 323  Electricity and Magnetism (4 Credits)
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

PH-UY 381  READING COURSE IN INTERDISCIPLINARY PHYSICS (1 Credit)
Special topics in interdisciplinary physics supervised by staff member.
Prerequisites: PH-UY 2344, must be an interdisciplinary physics major.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

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

PH-UY 1004  Introductory Physics I (4 Credits)
Typically offered occasionally
Prerequisite: MA-UY 1024 or an approved equivalent.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Prerequisites: MA-UY 1024 or an approved equivalent.

PH-UY 1004H  HONORS PHYSICS I: PHYSICS TAUGHT SOCRATICALLY (4 Credits)
Typically offered not typically offered
The course involves students in debate while covering fundamental principles of natural law and their applications to contemporary areas of technology. Effectively, this course can be considered an Oxford model. Examples will not be limited to material in traditional textbooks. Rather, areas from conventional physics to biomedical physics will be discussed with both analytical and quantitative problems. The emphasis is on individual growth toward independent thinking.
Prerequisites: MA-UY 1024 or approved equivalent. Co-Requisites: MA-UY 1124 or a approved equivalent, and EX-UY 1
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

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.
Corequisites: MA-UY 1124 or approved equivalent, and EX-UY 1
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

PH-UY 1013H  HONORS MECHANICS (3 Credits)
Typically offered not typically offered
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 1024/1054/1324 and Enrolled in Honors Program; Corequisites: MA-UY 1124/1154/1424, and EX-UY 1
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

PH-UY 1213  MOTION AND SOUND (3 Credits)
Typically offered Spring
Co-requisite: EX-UY 1.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
### PH-UY 1214 PHYSICS OF MOTION AND SOUND (4 Credits)
*Typically offered not typically offered*
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

### PH-UY 1223 ELECTRICITY AND LIGHT (3 Credits)
*Typically offered Fall*
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

### PH-UY 1224 Physics of Electricity and Light (4 Credits)
*Typically offered not typically offered*
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

### PH-UY 2004 INTRODUCTORY PHYSICS II (4 Credits)
*Typically offered occasionally*
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Corequisites: EX-UY 1.

### PH-UY 2004H ELECTRICITY AND MAGNETISM: FUNDAMENTALS AND TECHNOLOGICAL IMPLICATIONS (4 Credits)
*Typically offered not typically offered*
This is the second of two introductory courses in general physics. Electric forces and fields. Electric potential and capacitance. Electric current. Magnetic forces and fields. Faraday's law and inductance. Maxwell's equations. Mechanical and electromagnetic waves. Geometrical optics. Interference and diffraction. | Prerequisites: PH-UY 1004, MA-UY 1122. The theory class meets five hours per week for lectures and recitation. The laboratory class meets for three hours on alternate weeks. Corequisite: EX-UY 1
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

### PH-UY 2021H HONORS INTRODUCTORY PHYSICS LAB I (0.5 Credits)
*Typically offered not typically offered*
First part of introduction to the science of measurement. Students perform experiments chosen to illustrate basic physical principles and requiring a variety of measurement techniques and equipment. Results require progressively more detailed and sophisticated analysis. This course treats the same topics as PH-UY 2021 but because of the intended audience, in greater depth. | Prerequisites: Enrollment in Honors Program, PH-UY 1013 and MA-UY 1124 or an approved equivalent. Corequisites: PH-UY 2023.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

### 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. Corequisite: EX-UY 1
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

### PH-UY 2023H HONORS ELECTRICITY, MAGNETISM, & FLUIDS (3 Credits)
*Typically offered not typically offered*
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
PH-UY 2031H  HONORS INTRODUCTORY PHYSICS LAB II (0.5 Credits)
Typically offered not typically offered
Continuation of introduction to the science of measurement. Students perform experiments chosen to illustrate basic physical principles and requiring a variety of measurement techniques and equipment. Results require progressively more detailed and sophisticated analysis. This course treats the same topics as PH-UY 2031 but because of the intended audience, in greater depth. | Prerequisites: Enrolled in Honors Program, PH-UY 2021 and PH-UY 2023. Co-requisites: PH-UY 2033 and EX-UY 1.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

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

PH-UY 2033G WAVES, OPTICS, & THERMODYNAMICS (3 Credits)
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

PH-UY 2033H HONORS WAVES, OPTICS, & THERMODYNAMICS (3 Credits)
Typically offered not typically offered
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 course treats the same topics as PH-UY 2033 but because of the intended audience, in greater depth. | Corequisite: EX-UY 1
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

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
PH-UY 2121 General Physics Laboratory I (0.5:1:0:1). 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

PH-UY 2131 General Physics Laboratory II (1 Credit)
Typically offered Fall, Spring, and Summer terms
PH 2131 General Physics Laboratory II (0.5:1:0:1). 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. Corequisite: PH-UY 2033
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No
Corequisites: PH-UY 2033.

PH-UY 2131G General Physics Laboratory II (1 Credit)
PH 2131 General Physics Laboratory II (0.5:1:0:1). 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. Corequisite: PH-UY 2033
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

PH-UY 2344 INTRODUCTION TO MODERN AND SOLID STATE PHYSICS (4 Credits)
Typically offered Spring
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

PH-UY 2813 Astronomy and Astrophysics (3 Credits)
Typically offered Spring
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
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<tr>
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<th>Credits</th>
<th>Typically Offered</th>
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<td>PH-UY 2823</td>
<td>GEOLOGY AND GEOPHYSICS</td>
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<td>Ugrd Tandon Graded</td>
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<td>PH-UY 3002</td>
<td>JUNIOR PHYSICS LABORATORY</td>
<td>2</td>
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<td>PH-UY 2131 and PH-UY 2033; Co-requisite: PH-UY 2344 and MA-UY 2224</td>
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<td>PH-UY 3054</td>
<td>Introduction to Polymer Physics</td>
<td>4</td>
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<td>PH-UY 3103</td>
<td>Fundamentals of Applied Nuclear Physics</td>
<td>3</td>
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<td>PH-UY 3234</td>
<td>Electricity and Magnetism</td>
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<td>PH-UY 3244</td>
<td>Concepts of Nanotechnology</td>
<td>4</td>
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<td>No</td>
<td>Ugrd Tandon Graded</td>
<td>PH-UY 2004 or PH-UY 2033</td>
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<td>PH-UY 3424</td>
<td>Light and Lighting</td>
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<td>No</td>
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<td>PH-UY 3503</td>
<td>Introduction to Radiation Physics and Dosimetry</td>
<td>3</td>
<td>Fall</td>
<td>No</td>
<td>Ugrd Tandon Graded</td>
<td>PH-UY 2023</td>
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<tr>
<td>PH-UY 3513</td>
<td>NUCLEAR AND RADIATION INSTRUMENTATION AND METHODS</td>
<td>3</td>
<td>Fall</td>
<td>No</td>
<td>Ugrd Tandon Graded</td>
<td>PH-UY 3103; Co-requisite: PH-UY 3503</td>
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<td>PH-UY 3503</td>
<td>MATH PHYSICAL METHODS</td>
<td>3</td>
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*Prerequisites: PH-UY 1013 and PH-UY 2033.*

*Graduation requirements: 124 credits.*
PH-UY 3614 COMPUTATIONAL PHYSICS (4 Credits)
Typically offered Spring term of odd numbered years
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: Ugrad Tandon Graded
Repeatable for additional credit: No

PH-UY 3703 MATHEMATICAL PHYSICS II (3 Credits)
Typically offered Spring term of even numbered years
Second course of two-semester lecture sequence in mathematical physics for undergraduate students in physics and engineering. Review of ordinary differential equations, including first and second order linear equations. Series solutions of differential equations, involving Legendre polynomials, Bessel functions, Hermite functions, and Laguerre functions. Partial differential equations, including Laplace’s equation, the diffusion equation, the wave equation, and Poisson’s equation. Integral transforms, including Laplace and Fourier Transforms, convolution, and Green functions. Prerequisites: PH-UY 2033 and PH-UY 3603.
Grading: Ugrad Tandon Graded
Repeatable for additional credit: No

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

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

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

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

PH-UY 3811 READING COURSE IN INTERDISCIPLINARY PHYSICS (1 Credit)
Typically offered Fall
Special topics in interdisciplinary physics supervised by staff member. Prerequisites: PH-UY 2344, must be an interdisciplinary physics major.
Grading: Ugrad Tandon Graded
Repeatable for additional credit: No

PH-UY 3812 READING COURSE IN INTERDISCIPLINARY PHYSICS (2 Credits)
Typically offered Fall
Special topics in interdisciplinary physics supervised by staff member. Prerequisites: PH-UY 2344, must be an interdisciplinary physics major.
Grading: Ugrad Tandon Graded
Repeatable for additional credit: No

PH-UY 3813 READING COURSE IN INTERDISCIPLINARY PHYSICS (3 Credits)
Typically offered occasionally
Special topics in interdisciplinary physics supervised by staff member. Prerequisites: PH-UY 2344, must be an interdisciplinary physics major.
Grading: Ugrad Tandon Graded
Repeatable for additional credit: No

PH-UY 3814 READING COURSE IN INTERDISCIPLINARY PHYSICS (4 Credits)
Typically offered Fall
Special topics in interdisciplinary physics supervised by staff member. Prerequisites: PH-UY 2344, must be an interdisciplinary physics major.
Grading: Ugrad 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: Ugrad Tandon Graded
Repeatable for additional credit: No

PH-UY 4244 Techniques and Applications of Nanotechnology (4 Credits)
Typically offered not typically offered
This is the second of a two-course sequence on concepts and techniques of nanotechnology. Novel function and performance can occur with materials or devices of size scales of one to 100 nanometers, a range extending from molecular scale to that of typical linewidths in contemporary microelectronics. Nanosystems may provide entirely new functions, by virtue of access enabled by the small size. Photo and x-ray lithographic patterning, Scanning probe microscopes for observation and for fabrication. Molecular machines as envisioned by Drexler. The role of Van der Waals force. Questions of machine manufacturability on the nm scale. The IBM GMR hard-drive read head. Micro- and nanoelectromechanical devices and systems. Single-electron electronics. Prerequisite: PH-UY 3244.
Grading: Ugrad Tandon Graded
Repeatable for additional credit: No

PH-UY 4364 Introduction to the Quantum Theory (4 Credits)
Typically offered occasionally
The course introduces qualitative introduction to the quantum theory, which describes understanding light, electrons, atoms, nuclei and solid matter. Superposition principle, expectation values, momentum operator and wave function, duality, current vector, Hermitian operators, angular momentum, solution of the radial equation, electron in a magnetic field, perturbation theory, WKB approximation, identical particles. Applications include alpha decay, electrons in a periodic lattice, hydrogen spectrum, helium atom, neutron-proton scattering, and quark model of baryons. Prerequisites: PH-UY 2344, MA-UY 2114, and MA-UY 2224.
Grading: Ugrad Tandon Graded
Repeatable for additional credit: No
PH-UY 4444 QUANTUM OPTICS (4 Credits)
Beginning with a review of classical optics and quantum mechanics, this course covers foundations of spectroscopy, including atomic transition rates, selection rules and spectral line shapes. The course explores the quantum nature of light. Topics include photon statistics, coherent states, squeezed light, resonant light-atom interactions, atoms in cavities and laser cooling. | Prerequisite: PH-UY 3474.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

PH-UY 4554 SOLID STATE PHYSICS (4 Credits)
Typically offered not typically offered
The course covers basic concepts in condensed matter physics and preparation for the advanced quantum theory of solid state. | Prerequisites: PH-UY 2344, MA-UY 2114, and MA-UY 2224.
Grading: Ugrd Tandon Graded
Repeatable for additional credit: No

PH-UY 4601 SPECIAL TOPICS IN PHYSICS (1 Credit)
Variable credit special topics courses in physics. | Prerequisites: PH 2344 and Physics adviser approval. (Course may be repeated for additional credit.)
Grading: Ugrd Tandon Graded
Repeatable for additional credit: Yes

PH-UY 4602 SPECIAL TOPICS IN PHYSICS (2 Credits)
Typically offered not typically offered
Variable credit special topics courses in physics. | Prerequisites: PH 2344 and Physics adviser approval. (Course may be repeated for additional credit.)
Grading: Ugrd Tandon Graded
Repeatable for additional credit: Yes

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
Prerequisites: CS-UY 1133.

PH-UY 4604 SPECIAL TOPICS IN PHYSICS (4 Credits)
Variable credit special topics courses in physics. | Prerequisites: PH-UY 2344 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, Spring, and Summer terms
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