Physics-PH (PH)

Courses

PH 110 Descriptive Physics (GT-SC2) Credits: 3 (3-0-0)
Course Description: Conceptual aspects of physics applied to phenomena in everyday life and to problems in other fields of science.
Prerequisite: None.
Registration Information: Credit not allowed for both PH 110 and PH 121.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Traditional.
Special Course Fee: No.
Additional Information: Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

PH 111 Descriptive Physics Laboratory (GT-SC1) Credit: 1 (0-2-0)
Course Description: Experiments dealing with basic physics concepts including explorations of everyday phenomena.
Prerequisite: PH 110, may be taken concurrently.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Traditional.
Special Course Fee: No.
Additional Information: Biological & Physical Sciences 3A, Natural & Physical Sciences w/ lab (GT-SC1).

PH 121 General Physics I (GT-SC1) Credits: 5 (3-2-1)
Course Description: Concepts of force, torque, energy, momentum, work used to cover fluids, waves, sound, temperature, heat; biological, physical examples (noncalculus).
Prerequisite: MATH 125, may be taken concurrently.
Registration Information: Must register for lecture, laboratory and recitation. Credit not allowed for both PH 121 and PH 110; or for both PH 121 and PH 141.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Traditional.
Special Course Fee: No.
Additional Information: Biological & Physical Sciences 3A, Natural & Physical Sciences w/ lab (GT-SC1).

PH 122 General Physics II Credits: 5 (3-2-1)
Course Description: Electricity including electrostatics and simple circuits; magnetism; optics; nuclear physics, radiation; biological, physical examples (noncalculus).
Prerequisite: PH 121 or PH 141.
Registration Information: Must register for lecture, laboratory, and recitation. Credit not allowed for both PH 122 and PH 142.
Terms Offered: Fall, Spring.
Grade Mode: Traditional.
Special Course Fee: No.
Additional Information: Biological & Physical Sciences 3A.

PH 121 and PH 141.
Course Description: Electricity and magnetism, circuits, light, optics (calculus based).
Prerequisites: (PH 141) and (MATH 161, may be taken concurrently or MATH 255, may be taken concurrently).
Registration Information: Must register for lecture, laboratory and recitation. Credit not allowed for both PH 142 and PH 122.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Traditional.
Special Course Fee: No.
Additional Information: Biological & Physical Sciences 3A, Natural & Physical Sciences w/ lab (GT-SC1).

PH 140 Basic Physics and Physical Worldview Credits: 3 (0-0-3)
Course Description: Physics, cultural and historical background of physical thought, humans' relationship to physical world.
Prerequisites: (MATH 118) and (MATH 126).
Registration Information: High school algebra can be substituted for MATH 118; MATH 126. Offered as a telecourse only.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Traditional.
Special Course Fee: No.

PH 192 The Flying Circus of Physics Credits: 2 (0-0-2)
Course Description: Richness and variety of physical phenomena; physical world view including appreciation for the academic community.
Prerequisite: None.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

PH 245 Introduction to Electronics Credits: 3 (2-3-0)
Course Description: AC circuits, physical bases and applications of electronic devices.
Prerequisites: MATH 161 and PH 142.
Registration Information: Must register for lecture and laboratory.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 293 Selected Topics in Physics Credit: 1 (1-0-0)
Course Description: Selected topics in physics with emphasis on depth of understanding.
Prerequisite: PH 142.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Traditional.
Special Course Fee: No.
PH 298  Introduction Research  Credits: Var[1-6]
Course Description: Preparation and presentation of seminars on selected modern topics.
Prerequisite: None.
Registration Information: Written consent of instructor required.
Term Offered: Spring. 
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 314  Introduction to Modern Physics  Credits: 4 (4-0-0)
Course Description: Experiments in modern physics.
Prerequisite: PH 314, may be taken concurrently.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 315  Modern Physics Laboratory  Credits: 2 (0-4-0)
Course Description: Experiments in modern physics.
Prerequisite: None.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 341  Mechanics  Credits: 4 (4-0-0)
Course Description: Particle dynamics, translation and rotation of rigid bodies, moving coordinate systems, Lagrangian mechanics, matrix and tensor methods.
Prerequisites: (MATH 340 or MATH 345) and (PH 141).
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 351  Electricity and Magnetism  Credits: 4 (4-0-0)
Course Description: Electrostatics, magnetostatics, currents, time-dependent electric and magnetic fields, radiation.
Prerequisites: (MATH 340 or MATH 345) and (PH 142).
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 353  Optics and Waves  Credits: 4 (3-3-0)
Course Description: Geometrical optics; wave optics; interference, diffraction, and polarization; quantum optics.
Prerequisites: MATH 261 and PH 142.
Registration Information: Must register for lecture and laboratory. 
Term Offered: Fall. 
Grade Modes: S/U within Student Option, Trad within Student Option. 
Special Course Fee: No.

PH 361  Physical Thermodynamics  Credits: 3 (3-0-0)
Course Description: Laws of thermodynamics; thermodynamic potentials; applications such as fluids, phase transitions, electrical and magnetic systems, binary mixtures.
Prerequisites: MATH 261 and PH 142.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 384  Supervised College Teaching  Credits: Var[1-5]
Course Description: Participation as a physics tutor.
Prerequisite: PH 121 or PH 141.
Registration Information: Written consent of department chair required. A maximum of 10 combined credits for all 384 and 484 courses are counted towards graduation requirements.
Term Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 425  Advanced Physics Laboratory  Credits: 2 (0-4-0)
Course Description: Advanced experiments in electricity and magnetism, statistical physics and quantum mechanics.
Prerequisites: PH 315 and PH 451.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 451  Introductory Quantum Mechanics I  Credits: 3 (3-0-0)
Course Description: Schrodinger's theory of wave mechanics, potential wells, harmonic oscillators, wave packets, operators, angular momentum.
Prerequisites: (MATH 340 or MATH 345) and (PH 314).
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 452  Introductory Quantum Mechanics II  Credits: 3 (3-0-0)
Course Description: Approximation techniques, perturbation theory, identical particles and spin, structure and spectra of atoms and molecules, hydrogen atom.
Prerequisite: PH 451.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 462  Statistical Physics  Credits: 3 (3-0-0)
Course Description: Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein distribution functions; kinetic theory; applications to solids, metals, semiconductors, and gases.
Prerequisites: MATH 340 and PH 314 and PH 361.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 492  Seminar  Credit: 1 (0-0-1)
Course Description: Preparation and presentation of seminars on selected modern topics.
Prerequisite: None.
Registration Information: Written consent of instructor required.
Term Offered: Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 495  Independent Study  Credits: Var[1-6]
Course Description: Preparation and presentation of seminars on selected modern topics.
Prerequisite: None.
Registration Information: Written consent of instructor required.
Term Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.
PH 498 Research Credits: Var[1-6]
Course Description:
Prerequisite: None.
Registration Information: Written consent of instructor.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 517 Chaos, Fractals, and Nonlinear Dynamics Credits: 3 (3-0-0)
Course Description: Strange attractors, fractal dimensions, Lyapunov exponents, multifractal spectrum, period doubling, universality, intermittency, time-delay embedding.
Prerequisites: (MATH 261 and PH 341) and (MATH 340 or MATH 345).
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

PH 521 Introduction to Lasers Credits: 3 (3-0-0)
Course Description: Stimulated emission; laser resonators; theory of laser oscillation; specific laser systems; applications.
Prerequisites: (MATH 340 and PH 353) and (CHEM 476 or PH 451).
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 522 Introductory Laser Laboratory Credit: 1 (0-2-0)
Course Description: Experiments providing hands-on experiences with lasers.
Prerequisite: PH 521, may be taken concurrently.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

PH 531 Introductory Solid State Physics Credits: 3 (3-0-0)
Course Description: Crystal structures and bonding, electronic levels and vibrations, dielectric, optical and magnetic properties, quasiparticles, superconductivity.
Prerequisites: PH 451 and PH 361.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

PH 541 Classical Physics Credits: 3 (3-0-0)
Course Description: Linear and orbital motions, rotation, moment-of-inertia matrix; electrostatics, images, magnetostatics, induction, Maxwell's equations.
Prerequisites: PH 314 and PH 351.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 551 Modern Physics Credits: 3 (3-0-0)
Course Description: Wave functions, energy levels, harmonic oscillator, transmission and reflection, perturbation theory, thermodynamic potentials, partition function.
Prerequisites: PH 452 and PH 462, may be taken concurrently.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 561 Elementary Particle Physics Credits: 3 (3-0-0)
Course Description: Particle interactions and detection techniques. Quark model, scattering models and standard model of electroweak interactions, physics of colliders.
Prerequisite: PH 451.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

PH 571 Mathematical Methods for Physics I Credits: 3 (3-0-0)
Course Description: Vector analysis, eigenvalues and eigenvectors, infinite series, method of Frobenius, complex variables, contour integration.
Prerequisite: MATH 340.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 572 Mathematical Methods for Physics II Credits: 3 (3-0-0)
Course Description: Partial differential equations, Sturm-Liouville theory, special functions, Green's functions, Fourier series, Fourier and Laplace transforms.
Prerequisite: PH 571.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 621 Classical Mechanics Credits: 3 (3-0-0)
Course Description: Central forces, scattering, noninertial reference frames, Coriolis force, Lagrange's and Hamilton's equations, small oscillations, continuum mechanics.
Prerequisites: (PH 341) and (PH 571, may be taken concurrently).
Restriction: Must be a: Graduate, Professional.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 631 Solid State Physics Credits: 3 (3-0-0)
Course Description: Electronic band structure and conduction phenomena; cohesive energy; lattice dynamics and thermal properties; metals; insulators; semiconductors.
Prerequisite: PH 531.
Restriction: Must be a: Graduate, Professional.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 641 Electromagnetism I Credits: 3 (3-0-0)
Course Description: Electrostatics in a vacuum and a medium, general solution of Laplace's equation, Green's functions, magnetostatics in a vacuum and a medium.
Prerequisites: (PH 351) and (PH 572).
Restriction: Must be a: Graduate, Professional.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.
PH 642 Electromagnetism II Credits: 3 (3-0-0)
Course Description: Maxwell's equations, electromagnetic waves, radiation by accelerated charges, special relativity, Lagrangian formulation of electromagnetism.
Prerequisite: PH 641.
Restriction: Must be a: Graduate, Professional.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 651 Quantum Mechanics I Credits: 3 (3-0-0)
Course Description: WKB theory, Heisenberg picture, 3D wells, hydrogen atom, time-independent perturbation theory, angular momentum and spin, Clebsch-Gordan coefficients.
Prerequisites: (PH 452) and (PH 571, may be taken concurrently).
Restriction: Must be a: Graduate, Professional.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 652 Quantum Mechanics II Credits: 3 (3-0-0)
Course Description: Wigner-Eckhart theorem, symmetries, density matrix, identical particles, interaction picture, time-dependent perturbation theory, scattering.
Prerequisite: PH 651.
Restriction: Must be a: Graduate, Professional.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 671 Statistical Mechanics Credits: 3 (3-0-0)
Course Description: Canonical and grand-canonical ensembles; Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics; density operator; Bose-Einstein condensation.
Prerequisites: (PH 452 and PH 462) and (PH 571, may be taken concurrently).
Restriction: Must be a: Graduate, Professional.
Term Offered: Fall.
Grade Modes: Traditional.
Special Course Fee: No.

PH 672 Principles of Semiconductors Credits: 3 (3-0-0)
Also Offered As: ECE 471B.
Course Description: Electronic properties of semiconductors; band structure, statistics, transport properties, photoelectronic properties, potential barriers, interfaces.
Prerequisite: PH 531 or ECE 471B.
Restriction: Must be a: Graduate, Professional.
Registration Information: Credit not allowed for both PH 672 and ECE 672.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

PH 692 Seminar Credit: 1 (0-0-1)
Course Description: 
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Terms Offered: Fall, Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 693 Current Topics in Physics Research Credits: 3 (0-0-3)
Course Description: 
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Registration Information: Written consent of instructor.
Term Offered: Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 698 Research Credits: Var[1-18]
Course Description: 
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Registration Information: Written consent of instructor.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 699 Thesis Credits: Var[1-18]
Course Description: 
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Registration Information: Written consent of instructor.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 722 Quantum Electronics Credits: 3 (3-0-0)
Course Description: One- and two-photon spectroscopy; broadening mechanisms; nonlinear optics; coherent phenomena; experimental methods.
Prerequisite: PH 521.
Restriction: Must be a: Graduate, Professional.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

PH 731 Condensed Matter Theory Credits: 3 (3-0-0)
Course Description: Second quantization; electrons; phonons; electron-phonon interaction; superconductivity; magnetism; spin waves; density-functional methods; symmetry.
Prerequisites: (PH 462) and (PH 531) and (PH 652).
Restriction: Must be a: Graduate, Professional.
Term Offered: Fall (odd years).
Grade Mode: Traditional.
Special Course Fee: No.

PH 762 Elementary Particle Theory Credits: 3 (3-0-0)
Course Description: Symmetries, electrodynamics, renormalization, and the running coupling constant. Hadron structure, QCD, gauge symmetry and electroweak interaction.
Prerequisites: PH 561 and PH 652.
Restriction: Must be a: Graduate, Professional.
Term Offered: Fall (even years).
Grade Mode: Traditional.
Special Course Fee: No.
PH 770 Quantum Theory Credits: 3 (3-0-0)
Course Description: Formal scattering theory; relativistic quantum mechanics, quantum theory of radiation, symmetries and statistics, many-body theory.
Prerequisite: PH 652.
Restriction: Must be a: Graduate, Professional.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

PH 784 Supervised College Teaching Credits: Var[1-5]
Course Description: Supervised teaching of general physics laboratory and recitation sections.
Prerequisite: None.
Registration Information: Written consent of instructor.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 793A Seminar: Condensed Matter Physics Credits: Var[1-5]
Course Description:
Prerequisite: None.
Registration Information: Written consent of instructor.
Terms Offered: Fall, Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 793B Seminar: Laser Spectroscopy/Quantum Electronics Credits: Var[1-5]
Course Description:
Prerequisite: None.
Registration Information: Written consent of instructor.
Terms Offered: Fall, Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 793C Seminar: Statistical Mechanics Credits: Var[1-5]
Course Description:
Prerequisite: None.
Registration Information: Written consent of instructor.
Terms Offered: Fall, Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 793D Seminar: Mathematical Physics Credits: Var[1-5]
Course Description:
Prerequisite: None.
Registration Information: Written consent of instructor.
Terms Offered: Fall, Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 793E Seminar: High Energy Physics Credits: Var[1-5]
Course Description:
Prerequisite: None.
Registration Information: Written consent of instructor.
Terms Offered: Fall, Spring.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 795 Independent Study Credits: Var[1-6]
Course Description:
Prerequisite: None.
Registration Information: Written consent of instructor.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.

PH 799 Dissertation Credits: Var[1-18]
Course Description:
Prerequisite: None.
Registration Information: Written consent of instructor.
Terms Offered: Fall, Spring, Summer.
Grade Mode: Instructor Option.
Special Course Fee: No.