

# PHYSICS (PHYSICS)

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## Courses

PHYSICS 5500 Methods Of Mathematical Physics I Credits: 3

Intended to provide the student with the advanced mathematical techniques needed for beginning graduate studies in the physical sciences. Content includes real variables, infinite series, complex analysis, linear algebra and partial differential equations.

PHYSICS 5501 Methods Of Mathematical Physics II Credits: 3

A continuation of Physics 500 which includes Sturm-Liouville operators, special functions, Fourier transforms, distributions and Green functions, Laplace transforms, linear groups and tensor analysis.

PHYSICS 5505 Survey Of Recent Development In Physics Credits: 3

Specifically designed to help high school and junior college science teachers keep pace with current developments in various subdivisions of physics and their impact on society and technology. (Not applicable for graduate degree in Physics).

**Prerequisite:** Baccalaureate degree and one year science teaching experience.

PHYSICS 5510 Theoretical Mechanics I Credits: 3

A review of undergraduate mechanics precedes the study of generalized classical mechanics in this course. Topics include variational principles, Lagrangian and Hamilton methods, conservation laws and Hamilton-Jacobi theory.

PHYSICS 5511 Theoretical Mechanics II Credits: 3

A continuation of PHYSICS 5510, this course covers topics such as normal coordinates, small oscillations, continuum mechanics and special/general relativity.

PHYSICS 5520 Electromagnetic Theory And Applications I Credits: 3

Electrostatics, magnetostatics and various approaches in solving boundary value problems of electromagnetism, Green's functions, conformal transformations and polynomial expansions, Maxwell's equations and waves.

PHYSICS 5521 Electromagnetic Theory And Applications II Credits: 3

Waveguides, fiberoptics, radiation systems and antenna for wireless communications, scattering and diffraction of electromagnetic waves, multipole fields, special relativity and relativistic particle dynamics and radiation.

PHYSICS 5530 Quantum Mechanics I Credits: 3

Review of elementary methods, formal preliminaries, axioms, commuting operators, angular momentum, static perturbation theory, Wigner-Eckart theorem.

PHYSICS 5531 Quantum Mechanics II Credits: 3

Time dependent perturbation theory, scattering, applications to atoms, molecules and nuclei, reactions, relativistic methods.

PHYSICS 5535 Optical Properties Of Matter Credits: 3

Maxwell's equations and the dielectric function, absorption and dispersion, free-electron metals, interband transitions, dispersion relations and sum rules, self-consistent field approximation, current-current correlations and the fluctuation-dissipation theorem, plasmons and characteristic energy loss.

**Prerequisites:** PHYSICS 450, PHYSICS 460, PHYSICS 461, PHYSICS 472, PHYSICS 5500.

PHYSICS 5537 Particle Physics Credits: 3

Essential aspects of modern particle physics are examined in a historical context, and also in terms of the standard model describing concisely the fundamental interactions among particles. Conservation laws are discussed, and recent developments such as String Theory are considered.

**Prerequisites:** (for undergraduates) PHYSICS 240, PHYSICS 250, and PHYSICS 350 or PHYSICS 472.

PHYSICS 5540 Statistical Physics I Credits: 3

Statistical mechanics as a basis for thermodynamics; classical distribution functions; quantum statistical mechanics, kinetic theory, transport phenomena; application to systems of interacting particles.

**Prerequisites:** PHYSICS 410, PHYSICS 472.

PHYSICS 5541 Statistical Physics II Credits: 3

Special topics in advanced statistical physics including: second quantization, modern many body theory, interacting Fermi and Bose systems, superfluidity and superconductivity, renormalization group and computer simulation techniques.

**Prerequisites:** PHYSICS 5540.

PHYSICS 5550 Atomic And Molecular Structure Credits: 3

Experimental results and theoretical models by quantum mechanics. Special emphasis on the interaction between radiation and matter.

PHYSICS 5553 Practical Astronomy Credits: 3

A practical overview of the basic methods of observational astronomy research, including the principles of telescopes, detectors and measurement theory, as well as hands-on experience with data reduction and analysis. This course is open to graduate students from all majors.

## 2 Physics (PHYSICS)

### PHYSICS 5555 Stellar Astrophysics Credits: 3

A mathematical and conceptual overview of the observed properties of stars and the fundamental astrophysics of radiative transfer, hydrostatic equilibrium, atomic processes and thermonuclear energy production that govern their structure, atmospheres and remnants.

### PHYSICS 5556 Galaxies Credits: 3

A mathematical and conceptual overview of the observed properties and astrophysics of galaxies highlighting star formation and evolution, the interstellar medium, the Milky Way, galaxy populations and demographics, active galactic nuclei, and galaxy formation and evolution.

### PHYSICS 5560 Nuclear Physics Credits: 3

Fundamental properties of the atomic nucleus discussed in terms of experimental results and theoretical models. Quantum and statistical mechanics are used where appropriate.

### PHYSICS 5565 Cosmology Credits: 3

This course provides a foundation in both physical and observational cosmology. Students will acquire both a mathematical and conceptual understanding of the formation and dynamics of the Universe.

### PHYSICS 5570 Quantum Theory Of Solids I Credits: 3

Lattice dynamics and thermal conductivity. Neutron scattering. Symmetry principles in crystals and consequences. Point group, space group and irreducible representations. Energy band theory and methods of band calculation. Elementary Theory of Magnetism. Spin wave theory.

### PHYSICS 5571 Quantum Theory Of Solids II Credits: 3

Topics will include crystal imperfections, impurities and defects, optical properties of metals and semiconductors, electron-lattice interaction and transport theory, superconductivity and theory of disordered systems.

### PHYSICS 5580 Physics Seminar Credit: 1

Contemporary publications and research.

### PHYSICS 5585 Physics of Electronics Credits: 3

An introduction to the solid state physics of basic electronic components and their operation through both theory and practical lab work.

### PHYSICS 5590 Topics In Physics Credits: 1-3

Contemporary publications and research.

### PHYSICS 5590A Topics In Physics Credits: 1-3

Contemporary publications and research.

### PHYSICS 5590B Special Topics Credits: 1-3

### PHYSICS 5590R Topics in Physics Credits: 1-3

Contemporary publications and research.

### PHYSICS 5595L Computer Interfacing Laboratory Credits: 3

An introduction to computer interfacing through the use of serial and parallel ports and digital-to-analog and analog-to-digital converters. The course also introduces digital filtering techniques, data analysis techniques, and graphical presentation of data. The programming techniques are taught using high level programming languages currently used in research and development labs.

### PHYSICS 5599 Research And Thesis Credits: 1-9

Research for thesis in partial fulfillment of the master's degree in physics.

### PHYSICS 5680 Research Seminar Credits: 1-2

Seminars on current research topics of research programs in the department and those of external distinguished scientists. (Must be taken by Physics Ph.D. students).

### PHYSICS 5690 Special Research Topics Credits: 1-3

A lecture course presenting advanced research-level topics.

**Prerequisites:** Ph.D. candidacy. This course is intended to allow faculty and visiting scholars to offer special courses in selected research areas.

### PHYSICS 5696 Dissertation Research Credits: 1-3

This course is individually directed research leading to the fulfillment of the Comprehensive Exam requirements of the Department of Physics and Astronomy. These include (i) completion of an NSF-style research proposal and (ii) successful oral defense of it before the student's research advisory committee.

**Prerequisites:** Completion of at least 80% of coursework hours, as per the student's Plan of Study and Permission of the instructor.

### PHYSICS 5699 Research And Dissertation Credits: 1-9

Research for dissertation in partial fulfillment of the Ph.D. degree requirements in physics.

### PHYSICS 5899 Required Graduate Enrollment Credit: 1