Physics (PHYS)

Course information contained within the Bulletin is accurate at the time of publication in June 2025 but is subject to change. For the most up-to-date course information, please refer to the Course Catalog.

PHYS 5000. Topical Seminar. 3 Credit Hours.
This course considers special topics in Physics, not considered in our other courses. The level of this course is graduate, but the content could be accessible to upper-level undergraduate Physics majors.

Repeatability: This course may be repeated for additional credit.

PHYS 5001. Introduction to Quantum Computing. 3 Credit Hours.
This course will give an elementary introduction to some basics of quantum information and quantum computing that are accessible to not only physicists but also people with a variety of backgrounds. It will introduce the students to the latest scientific and technological advancement, and prepare for further study and/or initiating research if one wishes to pursue in this field.

Repeatability: This course may not be repeated for additional credits.

PHYS 5002. Physics Research and Ethics. 1 Credit Hour.
This course will introduce new graduate students to the diverse faculty research programs in physics at Temple, and help them to make an informed choice of research advisor and topic. It will also make sure that all students are aware of the ethical code for physicists. The course will meet for one hour per week. In the first 3 to 5 weeks, the instructor will lecture on the ethical and etiquette responsibilities of students, teachers, and researchers in physics. In each of the next 10 to 12 weeks, a faculty volunteer will explain his or her research program and opportunities for student participation in it. A faculty member may also nominate a graduate student to speak to the class. Former graduate students who hold physics research positions could also be invited to speak. Students will have ample opportunity to ask questions. They will be required to turn in one-page summaries of the lectures for grading by the lecturers; this should measure the students' understanding and improve their writing skills. A possible text for the ethics lectures would be the National Academy of Sciences booklet "On Being a Scientist".

Repeatability: This course may not be repeated for additional credits.

PHYS 5101. Analytical Mechanics. 3 Credit Hours.
Variational principles, Lagrange's and Hamilton's equations; canonical transformations; small oscillations; dynamics of particles, rigid bodies, strings and membranes; hydrodynamics; chaos in deterministic systems.

Repeatability: This course may not be repeated for additional credits.

PHYS 5103. Ionizing Radiation on Living Systems. 3 Credit Hours.
This course will include topics related to the study of the action of ionizing radiation on living things and more specifically the human body. Some of the topics covered are: cellular response to radiation, radiation carcinogenesis, radiation effects on the developing embryo and fetus, and whole-body radiation effects. Additional emphasis is given on the effect of ionizing radiation in the context of radiation treatments and in particular on factors affecting the therapeutic ratio.

Repeatability: This course may not be repeated for additional credits.

PHYS 5201. Physics of Medical Imaging I. 3 Credit Hours.
This is an introductory course in the physics of Medical Imaging. The goal of the course is to allow the students to gain insight of how modern imaging systems work and what they can tell us about the function and health of our body. The course will discuss how various physics concepts are applied to medicine and state of the art diagnostic radiology and radiotherapy techniques. It is the first of a series of two courses and will be primarily focused on the interaction of radiation with matter and all the physics principles that are involved with applications in medicine. Examples include x-rays, tomography, radiation detection and radioactivity. Topics covered are: 1) Interaction of radiation with matter; 2) X-rays and X-ray CT; 3) Mammography; 4) Fluoroscopy; 5) Radioisotopes and Radiopharmaceuticals; 6) Radiation detectors; 7) SPECT, PET; and 8) Introduction to Radiation Therapy.

Repeatability: This course may not be repeated for additional credits.

PHYS 5202. Physics of Medical Imaging II. 3 Credit Hours.
This will be the second of a series of two courses that will be focused on physics principles and their use in medical imaging. This second course reviews the production of medical images with ultrasound, MRI and other state of the art imaging techniques. Additional fundamental principles of physics important to the production and use of radiation for treatment and diagnostic purposes are reviewed. More detailed radiation detection methods, focused on dose measurement, utilizing a variety of methods, are discussed along with the appropriate instrumentation. More specialized topics of Radiation Safety and Radiation Protection in Diagnostic Radiology will be covered in association with The Environmental Health and Radiation Safety Department of Temple University. Topics covered are: 1) MRI; 2) Ultrasounds; 3) Infrared Imaging; 4) Imaging of Tissue Electrical Impedance; 5) Optical Imaging; 6) Multimodality Imaging; 7) Medical Image Processing; 8) Radiation safety.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C in PHYS 5201.

PHYS 5301. Electromagnetic Theory. 3 Credit Hours.
Boundary value problems of the electrostatic and magnetostatic fields; Maxwell's equations; plane waves at boundaries in dielectric and conducting media; potentials in the Lorentz gauge; Green's functions for wave and Helmholtz equations; multipole radiation; material dispersion; diffraction.

Repeatability: This course may not be repeated for additional credits.

PHYS 5302. Advanced Electromagnetic Theory. 3 Credit Hours.
Maxwell stress tensor; relativistic dynamics; Lagrangian formulation of electrodynamics; Noether's theorem; laser resonant cavities and optics of Gaussian beams; Eikonal and geometrical optics limit; synchrotron radiation.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in PHYS 5301.

PHYS 5401. Medical Dosimetry I. 3 Credit Hours.
In this course the students should become familiar with treatment planning principles for the most common cases of cancer patients. Techniques of simulation of treatment set-ups are reviewed and advanced methods of virtual simulation are explored. The course is accompanied by a laboratory giving students the opportunity to practice the material. The laboratory sections will be designed to accompany the corresponding lectures and will allow the students to gain hands-on experience on treatment planning and simulation problems, while using the state of the art software currently used in clinical facilities. Topics covered are: 1) Statistical terminology; 2) Treatment simulation; 3) Dose calculation methods; 4) External Beam Radiation Therapy; 5) Dose calculation for external beams; 6)Treatment Planning: External Beam; 7) Localization.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B in BIOL 5333.

PHYS 5402. Medical Dosimetry II. 3 Credit Hours.
This course will continue building upon the material introduced during Medical Dosimetry I. More details are discussed about the factors that affect dose delivered in radiation treatments and how these factors are accounted for in dose calculations. Methods of treatment planning techniques for various diseases using single and multiple field arrangements using photons and electrons are discussed. Advanced treatment planning techniques of conformal radiation therapy including 3D treatment planning, IMRT, IGRT, Gating, Protons, and Stereotactic are also discussed. The use of Brachytherapy in radiation therapy is addressed. Characteristics of sources utilized for treatment as well as determination of source activity and dose delivered are included. Methods and instruments utilized to apply Brachytherapy treatment planning techniques to clinical treatment situations are discussed. Finally, the Ethical Standards and procedures that have been set by the Medical Dosimetrist Certification Board ("the MDCB") must also be discussed. The course is accompanied by a laboratory giving students the opportunity to practice the material. The laboratory sections will be designed to accompany the corresponding lectures and will allow the students to gain hands-on experience on advanced treatment planning problems, while using the state of the art software currently used in clinical facilities. Topics covered are: 1) Advanced Dose Calculation techniques; 2) Advanced Treatment Planning; 3) Brachytherapy; 4) Quality Assurance; 5) Ethical Standards.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B in PHYS 5401.

PHYS 5501. Mathematical Physics. 3 Credit Hours.
Tensor analysis; group theory; complex variable theory; partial differential equations; Sturm-Liouville systems; integral transforms; integral equations and Green's function methods.

Repeatability: This course may not be repeated for additional credits.

PHYS 5502. Computational and Mathematical Physics. 3 Credit Hours.
Preliminaries; numerical applicability, survey of algorithms, computer modeling, programming considerations; basic numerical methods; numerical linear algebra; numerical solution to ordinary and partial differential equations; molecular dynamics; Monte Carlo simulations; nonlinear methods.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in PHYS 5501.

PHYS 5701. Quantum Mechanics I. 3 Credit Hours.
Fundamental principles of quantum mechanics; relation to classical mechanics; Schroedinger and operator formulations; path integrals; Aharonov-Bohm effect; examples of exact solutions; central forces and angular momentum; scattering theory; Bell's theorem.

Repeatability: This course may not be repeated for additional credits.

PHYS 5702. Quantum Mechanics II. 3 Credit Hours.
Matrix mechanics; theory of electron spin; Hilbert space formulation of quantum mechanics; transformation theory; theory of rotations; spin and statistics; stationary approximation methods with application to atomic systems; time-dependent perturbation theory; exponential decay.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in PHYS 5701.

PHYS 8001. Practicum Teaching of Physics. 1 Credit Hour.
Required of all graduate teaching assistants in their first semester. Consists of supervised instruction in undergraduate laboratories and a weekly two-hour class.

Repeatability: This course may not be repeated for additional credits.

PHYS 8004. Problems in Experimental Physics. 1 to 6 Credit Hour.
Special problems in the field of experimental physics. The course is designed to acquaint the student with the research techniques employed in experimental physics.

Repeatability: This course may be repeated for additional credit.

PHYS 8005. Problems in Theoretical Physics. 1 to 6 Credit Hour.
Special problems in the field of theoretical physics. The course is designed to acquaint the student with the research techniques employed in theoretical physics.

Repeatability: This course may be repeated for additional credit.

PHYS 8020. Topical Seminar I. 3 Credit Hours.
This course considers special topics in Physics, not considered in depth in our other courses.

Repeatability: This course may be repeated for additional credit.

PHYS 8030. Topical Seminar II. 3 Credit Hours.
This course considers special topics in Physics, not considered in depth in our other courses.

Repeatability: This course may be repeated for additional credit.

PHYS 8050. Physics Seminar. 0 Credit Hours.
This course provides the graduate students with the state of the field knowledge about Physics. Students attend 10 to 12 Colloquium/Seminars per semester given by the experts, mostly drawn from national and international authorities in the field. The students are graded on the basis of their attendance in these seminars, and are encouraged to discuss their research with these visiting experts. Last year's colloquium included among other experts, a Nobel Laureate, Sir Anthony Leggett, 2003.

Repeatability: This course may be repeated for additional credit.

PHYS 8102. Statistical Mechanics. 3 Credit Hours.
Review of thermodynamics; kinetic theory; statistical definition of entropy; microcanonical, canonical, and grand canonical ensembles; applications to gases, diatomic molecules, magnetic systems, phase transitions; quantum statistics; ideal boson and fermion systems; Bose-Einstein condensation; black body radiation; models of solids; properties of liquid helium.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in (PHYS 5501 and PHYS 5701)

PHYS 8701. Quantum Field Theory. 3 Credit Hours.
Properties of quantized radiation field; emission, absorption and scattering of photons by atoms; nonrelativistic Lamb shift; Dirac equation: nonrelativistic limit, Lorentz covariance, exact solutions; hole theory; Lagrangian field theory; field quantization; S-matrix; covariant perturbation theory; Feynman rules for QED with application to various processes.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in PHYS 5702.

PHYS 8702. Solid State Physics. 3 Credit Hours.
Crystal and x-ray diffraction; lattice vibrations and thermal properties; energy bands and electronic properties; semiconductors; optical and dielectric properties; para-, ferro-, and antiferromagnetism; introduction to superconductivity and superfluidity.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in PHYS 5701 and PHYS 5702.

PHYS 8703. Nuclear and Elementary Particle Physics. 3 Credit Hours.
The Standard Model (SM); gauge invariance, non-Abelian gauge theories, SM Lagrangian, electroweak theory and QCD, Higgs mechanism, confinement; experimental considerations: accelerators and detectors, elastic scattering and form factors, deep inelastic scattering and structure functions; advanced topics in the SM: grand unification, neutrino mass, big bang cosmology, dark matter.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in PHYS 5701 and PHYS 5702.

PHYS 8704. Many Electron Theory. 3 Credit Hours.
The course is at an intermediate level and is appropriate for students of experimental and theoretical condensed matter and AMO physics. The course familiarizes students with the theory of correlated electrons and states with broken electron symmetry, it also provides a framework for the description of experimental properties in materials with electron correlations. Topics include: Phenomenology of cohesion in molecules and solids, Many-electron wavefunctions, Functionals and their extrema, Wavefunction variational principles, Hellmann-Feynman theorem, One- and two-particle density matrices, and the electron density Wavefunction vs. density functional methods, Hohenberg-Kohn theorem, Functional derivatives, Uniform electron gas Kohn-Sham spin-density functional theory, Approximate functionals, Linear Response Theory and Stability, Collective Excitations, Superconducting Instability, Magnetic Instabilities, Charge Density Wave Instabilities in low-dimensional systems, Ferromagnetic, Spin and Orbital density wave phases, Instabilities of the Half-Filled Band, BCS Theory of Superconductivity, s, p and d wave pairing, the Integer and Fractional Quantum Hall States, Collective Excitations and Goldstone Modes.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in PHYS 8702.

PHYS 8705. Advanced Topics in Nuclear and Particle Physics. 3 Credit Hours.
The course is at an intermediate level and is appropriate for students of experimental and theoretical nuclear and particle physics. Topics include: Accelerators, Detectors, Essential elements of data analysis and statistics, Selected advanced topics in QFT, Hard scattering processes and the parton structure of hadrons, Breaking of global and local symmetries (Higgs mechanism), Effective field theory, Neutrino physics, Physics beyond the SM, Nuclear matter under extreme conditions, Overview of nuclear structure and reactions.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in PHYS 8703.

PHYS 8985. Teach in Higher Ed: Phys. 2 Credit Hours.
Teaching in Higher Ed: Physics. This course focuses on learning theory and the best teaching practices, with the aim of preparing students for effective higher education teaching.

Repeatability: This course may not be repeated for additional credits.

PHYS 9991. Master's Research Projects. 1 to 6 Credit Hour.
Short-term, limited research project or laboratory project in the field. This course is not the capstone project course, nor can it be used for thesis based research. The course is for master's students only, including PSM, MA or MS. This class will not confer full-time program status unless nine credits are taken.

Repeatability: This course may be repeated for additional credit.

PHYS 9994. Preliminary Examination Preparation. 1 to 6 Credit Hour.
This course is required for students who are preparing for the preliminary or candidacy examination. Students should enroll after coursework is completed or when preparing for the candidacy exam until the time that the preliminary or candidacy examination is completed. This course will confer full-time status at the minimum credit hour registration limit of one credit. All students must complete a minimum of one credit of this course. Students must complete a total of 6 credit hours of 9994, 9998 and 9999.

Repeatability: This course may be repeated for additional credit.

PHYS 9995. Capstone Project. 1 to 6 Credit Hour.
Capstone project for master's students including students in PSM, MA or MS. This class will provide full-time status. Students in PSM programs need to register for at least one credit of this course to fulfill program requirements. Additional credits may be required for specific programs. This course will confer full-time status at the minimum credit hour registration limit of one credit.

Repeatability: This course may be repeated for additional credit.

PHYS 9996. Master's Thesis Research. 1 to 6 Credit Hour.
Course for master's thesis research. Only intended for students in thesis bearing master's programs. A minimum of one credit is required. This course will confer full-time status at the minimum credit hour registration limit of one credit.

Repeatability: This course may be repeated for additional credit.

PHYS 9998. Pre-Dissertation Research / Elevation to Candidacy. 1 to 6 Credit Hour.
This course is intended for students who are performing research prior to candidacy. Students can register for this course after required courses are completed. This course will confer full-time status at the minimum credit hour registration limit of one credit. Students must be registered for this course during the semester that they are to be elevated to candidacy examination. Students must complete a total of 6 credit hours of 9994, 9998 and 9999.

Repeatability: This course may be repeated for additional credit.

PHYS 9999. Dissertation Research. 1 to 6 Credit Hour.
The course is for Ph.D. students who have been elevated to candidacy. During the course of their candidacy students must complete a minimum of two credits of dissertation research. This course will confer full-time status at the minimum credit hour registration limit of one credit. Students must complete a total of 6 credit hours of 9994, 9998 and 9999.

Repeatability: This course may be repeated for additional credit.