PHYSICS (PHYS)

PHYS 1000. Physics Orientation. 1 Credit Hour.
Guest lectures will describe career opportunities in physics; the role physicists play in education, government, and industrial laboratories; and programs available to physics majors.

PHYS 11X1. Transfer Non-Calc Phys I. 1-21 Credit Hours.

PHYS 11X2. Transfer Non-Calc Phys II. 1-21 Credit Hours.

PHYS 1XXX. Physics Elective. 1-21 Credit Hours.

PHYS 2001. Physics of Space and Time. 2 Credit Hours.
The development of physics concepts and doctrines from early times to the near future, with social and philosophical correlates.

PHYS 2021. The Solar System. 3 Credit Hours.
This course covers Ancient and Renaissance astronomy, gravity, sky phenomena, telescopes, and the solar system.

PHYS 2022. Stars, Galaxies, and the Universe. 3 Credit Hours.
This course covers optics, telescopes, stellar characteristics and evolution, galaxies, the universe, and the big bang. Physics topics include mechanics, optics, atomic physics, nuclear physics, and relativity.

PHYS 2030. Physics Of Music. 2 Credit Hours.
An introduction to the physical principles underlying the production, transmission, and detection of musical sounds.

PHYS 2210. Introduction to Astrophysics. 3 Credit Hours.
This course provides an overview of modern astrophysics including stars, galaxies, black holes and other dense stellar remnants, and the physics of the expanding Universe.

PHYS 2211. Introductory Physics I. 4 Credit Hours.
An introductory course which will include mechanics (kinematics, dynamics, work and energy, momentum and collisions, and rotational motion and statics), and may also include oscillations and computational methods. This is a calculus-based course.

PHYS 2212. Introductory Physics II. 4 Credit Hours.
An introductory course which will include electrostatics, electric current and circuits, electromagnetism, and may also include light and computational methods. This is a calculus-based course.

PHYS 2213. Introduction to Modern Physics. 3 Credit Hours.
A survey of twentieth century physics. Developments of several branches of physics up to their present frontiers, including historical and philosophical perspectives.

PHYS 2231. Honors Physics I. 5 Credit Hours.
Parallels introductory Physics I (PHYS 2211). Some topics treated in more depth or more extensively. A rigorous physics foundation requiring demonstrated competence in mathematics.

PHYS 2232. Honors Physics II. 5 Credit Hours.
Parallels introductory Physics II (PHYS 2212). Some topics treated in more depth or more extensively. No modern physics content. A rigorous physics foundation requiring demonstrated competence in mathematics.

PHYS 25X1. Transfer Physics I. 4 Credit Hours.

PHYS 2698. Undergraduate Research Assistantship. 1-12 Credit Hours.
Independent research conducted under the guidance of a faculty member.

PHYS 2699. Undergraduate Research. 1-12 Credit Hours.
Independent research conducted under the guidance of a faculty member.

PHYS 2750. Physics of the Weather. 3 Credit Hours.
An introductory treatment applying basic physical laws to understanding weather phenomena. Crosslisted with EAS 2750.

PHYS 2801. Special Topics. 1 Credit Hour.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 2802. Special Topics. 2 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 2803. Special Topics. 3 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 2804. Special Topics. 4 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 2900. Special Problems. 1-21 Credit Hours.
Course involving special problems in physics are offered from time to time.

PHYS 2901. Special Problems. 1-21 Credit Hours.
Courses involving special problems in physics are offered from time to time.

PHYS 2902. Special Problems. 1-21 Credit Hours.
Courses involving special problems in physics are offered from time to time.

PHYS 2XXX. Physics Elective. 1-21 Credit Hours.

PHYS 3021. Nuclear Astrophysics and Stellar Evolution. 3 Credit Hours.
This course covers stellar atmospheres, interiors and evolution, as well as the formation and physical properties of planetary systems.

PHYS 3022. Stars and Planets. 3 Credit Hours.
This course covers stellar atmospheres, interiors and evolution, as well as the formation and physical properties of planetary systems.

PHYS 3034. Principles of Quantum Mechanics. 3 Credit Hours.
A first introduction to wave mechanics, with emphasis on practical calculations. The rules of quantum mechanics will be illustrated by many working examples.

PHYS 3120. Computational Physics. 3 Credit Hours.
Introduction to computational methods in physics, including numerical integration and solving ordinary and partial differential equations. Applications to a range of physics problems are presented.

PHYS 3122. Electrostatics and Magnetostatics. 3 Credit Hours.
First of two courses on the physics of electromagnetism. Topics include Coulomb's Law, Ampere's Law, scalar and vector potentials, Laplace's equation and electric and magnetic fields in matter.

PHYS 3123. Electrodynamics. 3 Credit Hours.
Second of two courses on the physics of electromagnetism. Topics include time-dependent phenomena including Faraday's Law, the Maxwell equations, electromagnetic radiation, and electromagnetic waves.

PHYS 3141. Thermodynamics. 3 Credit Hours.
Introduction to the basic concepts of thermodynamics. Thermodynamic laws will be developed with an emphasis on the macroscopic point of view. Applications of the basic principles will be considered briefly.
PHYS 3143. Quantum Mechanics I. 3 Credit Hours.
First of two courses that develop the principles of quantum mechanics. Topics include the state vector concept. Heisenberg and Schrödinger pictures, uncertainty relations, and exact solvable models in one dimension.

PHYS 3151. Mathematical Physics. 3 Credit Hours.
A review of the mathematical techniques required for the description of physical systems encountered in mechanics, electromagnetism, thermal physics, and quantum mechanics.

PHYS 3201. Classical Mechanics I. 3 Credit Hours.
Dynamics of particles including oscillations and planetary motion, rotation of rigid bodies, and collisions.

PHYS 3202. Classical Mechanics II. 3 Credit Hours.
A continuation of PHYS 3201. Topics include Lagrangians and Hamiltonian techniques, and many body mechanics.

PHYS 3208. Modern Optics Laboratory. 3 Credit Hours.
Measurement of parameters of optical surfaces, lenses, and systems using a variety of modern optics techniques.

PHYS 3209. Electronics I. 3 Credit Hours.
A first course in both theoretical and applied electronics that is based on a thorough grounding in circuit as well as device physics.

PHYS 3210. Astronomy & Astrophysics Lab. 2 Credit Hours.
An introduction to astronomical and astrophysical data reduction and analysis, drawing on instrumentation and telescopes from across modern astrophysics.

PHYS 3211. Electronics I. 5 Credit Hours.
A first course in both theoretical and applied electronics that is based on a thorough grounding in circuit as well as device physics.

PHYS 3222. Geometrical Optics and Lens Design. 3 Credit Hours.
Principles of geometrical optics using ray tracing techniques. Stops, pupils, aberrations, and photometry. Design and analysis of lenses using current lens design software.

PHYS 3223. Modern Optics Laboratory. 2 Credit Hours.
Measurement of parameters of optical surfaces, lenses, and systems using a variety of techniques.

PHYS 3226. Modern Optics Laboratory. 2 Credit Hours.
Measurement of parameters of optical surfaces, lenses, and systems using a variety of modern optics techniques.

PHYS 3227. Optics I. 3 Credit Hours.
Optics principles, including waves, reflection, refraction, absorption, scattering, group velocity, lasers, polarization geometrical optics, the Fourier transform, coherence, interference, and diffraction.

PHYS 3250. Principles of the Physics of Living Systems. 4 Credit Hours.
Hands-on lecture/lab undergraduate survey course enabling discovery of principles of Physics of Living Systems across scales.

PHYS 3265. Introduction to Acoustics. 3 Credit Hours.
A course in classical acoustics and applied electroacoustics taught through the palliative of a study of sound reinforcement and reproduction systems.

PHYS 3266. Computational Physics. 4 Credit Hours.
Computer solutions of realistic physics problems such as projectiles in resistive media, electromagnetic sources and fields, atomic scattering, and band pass filters.

PHYS 3801. Special Topics. 1 Credit Hour.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 3802. Special Topics. 2 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 3803. Special Topics. 3 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 3804. Special Topics. 4 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 3806. Special Topics. 2 Credit Hours.

PHYS 3807. Special Topics. 3 Credit Hours.

PHYS 3814. Special Topics. 4 Credit Hours.

PHYS 3900. Special Problems. 1-21 Credit Hours.
Courses involving special problems in physics are offered from time to time.

PHYS 3901. Special Problems. 1-21 Credit Hours.
Courses involving special problems in physics are offered from time to time.

PHYS 3902. Special Problems. 1-21 Credit Hours.
Courses involving special problems in physics are offered from time to time.

PHYS 3XXX. Physics ELective. 1-21 Credit Hours.

PHYS 4142. Statistical Mechanics. 3 Credit Hours.
The statistical basis of thermodynamics is developed. Topics include entropy and the second law, partition functions and free energy, systems of variable particle number, and quantum statistics.

PHYS 4143. Quantum Mechanics II. 3 Credit Hours.
Second of two courses that develop the principles of quantum mechanics. Topics include angular momentum, hydrogen atom, variation methods, perturbation theory, matter-radiation interactions, identical particles.

PHYS 4147. Relativity. 3 Credit Hours.
The course provides an introduction to the special and general theories of relativity that govern gravitational physics including experimental tests, astrophysical applications, black holes and gravitational waves.

PHYS 4206. Electronics II. 5 Credit Hours.
A course in electronic instrumentation with an emphasis on signal processing, both analog and digital, and computer interfacing.

PHYS 4222. Solid-state Devices. 3 Credit Hours.
Course provides an understanding of contemporary research on solid state devices. Topics include band structure, p-n junctions, transistors, superlattices, lasers and detectors, charge coupled devices, and others.

PHYS 4247. Cosmology. 3 Credit Hours.
Modern cosmology of the universe, with the emphasis on the origin and evolution of galaxies and clusters of galaxies, inflation, the cosmic microwave background, dark matter and dark energy.
PHYS 4260. Quantum Technologies. 3 Credit Hours.
Introduction to quantum information systems, with an emphasis on the physics (superconductivity, ion and atom trapping, quantum dots) behind the leading candidate platforms.

PHYS 4261. Atomic Physics. 3 Credit Hours.
Course provides an introduction to the fundamentals of atomic physics, the structure of atoms, and their interaction with static and radiation fields.

PHYS 4262. Solid-state Physics. 3 Credit Hours.
A first course in the physics of crystalline solids. Core topics include crystal lattices, diffraction, bonding, elastic properties, band theory, as well as others.

PHYS 4263. Nuclei, Particles, and Fields. 3 Credit Hours.
An introduction to nuclear and subnuclear systems. Topics include nuclear models, radioactive decay, nuclear reactions, quarks, accelerators, reactors, and stellar nucleosynthesis.

PHYS 4264. Nuclear Power. 3 Credit Hours.
Historical aspects of the development of nuclear power. Emphasis on the structure of the atom and properties of the nucleus. Examples drawn from physical systems.

PHYS 4265. Introduction to Nuclear Physics. 3 Credit Hours.
Course provides an introduction to the fundamentals of atomic physics, the structure of atoms, and their interaction with static and radiation fields.

PHYS 4266. Biophysics. 3 Credit Hours.
Physical principles applied to molecular and cellular biology. Topics include chemiosmosis, self-assembly, protein biosynthesis, and the mechanisms of muscle and nerve function.

PHYS 4267. Nonlinear Dynamics and Chaos. 3 Credit Hours.
A modern introduction to nonlinear phenomena. Topics include driven oscillators, entrainment, bifurcation, fractals, and control of chaos. Examples are drawn from physical systems.

PHYS 4268. Advanced Laboratory I. 3 Credit Hours.
Experiments are conducted that demonstrate basic principles from various fields of physics. An emphasis is placed on contemporary concepts in modern physics.

PHYS 4269. Advanced Laboratory II. 3 Credit Hours.
A continuation of PHYS 4268. Experiments are conducted that demonstrate basic principles from various fields of physics. An emphasis is placed on contemporary concepts in modern physics.

PHYS 4270. Fundamentals of Astrophysics. 3 Credit Hours.
Theoretical investigation of astrophysical objects and processes, with an emphasis on the interstellar medium, extragalactic astrophysics, gas dynamics, and radiative transfer, and radiation processes.

PHYS 4271. Introduction to Continuum Physics. 3 Credit Hours.
A modern introduction to continuum physics. Topics include elastic theory, dislocations and waves, fluid mechanics and dynamics, and instabilities in fluids.

PHYS 4272. Senior Seminar I. 1 Credit Hour.
Representative research programs in the School are described by advanced graduate students, post-doctoral fellows and faculty members.

PHYS 4273. Senior Seminar II. 1 Credit Hour.
Representative research programs in the School are described by advanced graduate students, post-doctoral fellows, and faculty members.

PHYS 4274. Introductory Diffraction Studies. 4 Credit Hours.
Introductory theory and practice of x-ray and neutron diffraction techniques, including single crystals and powders. Laboratory work is strongly correlated with principles developed in the lectures.
Physics (PHYS)

PHYS 4XXX. Physics Elective. 1-21 Credit Hours.

PHYS 6101. Classical Mechanics I. 3 Credit Hours.
Newtonian mechanics, Hamilton's variational principle, Lagrangian and Hamiltonian mechanics, central forces, rigid body motion, and small oscillations.

PHYS 6103. Electromagnetism I. 3 Credit Hours.

PHYS 6104. Electromagnetism II. 3 Credit Hours.
Theory of generation of electromagnetic waves, their propagation, scattering, and diffraction. Covariant formulation of electrodynamics and application to radiation from charged particles.

PHYS 6105. Quantum Mechanics I. 3 Credit Hours.
An axiomatic development of quantum mechanics. Topics include linear vector spaces, linear operators, infinitesimal transformations, function space, representation and transformation groups.

PHYS 6106. Quantum Mechanics II. 3 Credit Hours.
Applications of quantum mechanics. Topics include systems with spin and angular momentum, atomic structure, time-dependent phenomena, scattering, and various methods of modeling and approximations.

PHYS 6107. Statistical Mechanics I. 3 Credit Hours.
Equilibrium statistical mechanics for closed and open systems. Probability distribution for classical and quantum systems. Partition functions and associated thermodynamical potentials.

PHYS 6108. Statistical Mechanics II. 3 Credit Hours.
Non-equilibrium statistical mechanics. Topics include the Boltzmann equation, hydrodynamics, and scaling arguments, and perturbation theory in different areas of physics.

PHYS 6109. Thermodynamics. 3 Credit Hours.
Introduction to thermodynamics. Topics include the laws of thermodynamics, entropy, and applications.

PHYS 6110. Quantum Information Theory. 3 Credit Hours.
Theoretical foundations of quantum mechanics and its applications in information theory.

PHYS 6111. Condensed Matter Physics I. 3 Credit Hours.
Introduction to condensed matter physics. Crystal structure, electronic and thermal properties, response to external electric and magnetic fields.

PHYS 6112. Condensed Matter Physics II. 3 Credit Hours.
Collective and many-electron properties in condensed matter systems. Topics include second quantization, magnetism, phase transitions, and superconductivity.

PHYS 6120. Biophysics. 3 Credit Hours.
Introduction to physical concepts connect to the workings of biological systems at a molecular level. Topics include polymer theory of proteins, diffusion, and bioelectricity.

PHYS 6121. Computational Physics. 3 Credit Hours.
Applications of numerical methods and computer programming to condensed matter, astrophysical hydrodynamics, gravitational physics, black holes and cosmology.

PHYS 6262. Data Science for Physicists. 3 Credit Hours.
Introduction to probability theory, classical statistics and machine learning, and their application to physics.

PHYS 6265. Atomic Physics I. 3 Credit Hours.
This course provides a detailed description of atomic structures and interactions. It contains applications of advanced quantum mechanics to problems in modern atomic physics.

PHYS 6267. Atomic Physics II. 3 Credit Hours.
A modern introduction to nonlinear phenomena. Topics include driven oscillators, entrainment, bifurcation, fractals, and control of chaos. Examples are drawn from physical systems.

PHYS 6268. Nonlinear Dynamics and Chaos. 3 Credit Hours.
Introduction to nonlinear dynamics and chaos. Applications of order-of-magnitude estimates, dimensional analysis, scaling arguments, and perturbation theory in different areas of physics.

PHYS 6269. Statistical Mechanics I. 3 Credit Hours.

PHYS 6270. Statistical Mechanics II. 3 Credit Hours.
Non-equilibrium statistical mechanics. Topics include the Boltzmann equation, hydrodynamics, and scaling arguments, and perturbation theory in different areas of physics.

PHYS 6271. Optoelectronics: Materials, Processes, Devices. 3 Credit Hours.
Optoelectronic materials, physical processes, and devices. Includes compound semiconductor materials, excitation, recombination, gain, and modulation processes, and devices such as emitters, detectors, and modulators. Crosslisted with ECE 6771.

PHYS 6272. Optical and Quantum Electronics. 3 Credit Hours.
Optoelectronic materials, physical processes, and devices. Includes compound semiconductor materials, excitation, recombination, gain, and modulation processes, and devices such as emitters, detectors, and modulators. Crosslisted with ECE 6771.

PHYS 6273. Quantum Optics. 3 Credit Hours.
Theoretical foundations of quantum mechanics and its applications in information theory.

PHYS 6274. Quantum Information Theory. 3 Credit Hours.
Theoretical foundations of quantum mechanics and its applications in information theory.

PHYS 6275. Quantum Computation. 3 Credit Hours.
Theoretical foundations of quantum mechanics and its applications in information theory.

PHYS 6276. Quantum Information Theory. 3 Credit Hours.
Theoretical foundations of quantum mechanics and its applications in information theory.

PHYS 6277. Quantum Computation. 3 Credit Hours.
Theoretical foundations of quantum mechanics and its applications in information theory.

PHYS 6278. Quantum Computation. 3 Credit Hours.
Theoretical foundations of quantum mechanics and its applications in information theory.

PHYS 6279. Quantum Computation. 3 Credit Hours.
Theoretical foundations of quantum mechanics and its applications in information theory.

PHYS 6280. Quantum Computation. 3 Credit Hours.
Theoretical foundations of quantum mechanics and its applications in information theory.

PHYS 6281. Quantum Computation. 3 Credit Hours.
Theoretical foundations of quantum mechanics and its applications in information theory.

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PHYS 6297. Quantum Computation. 3 Credit Hours.
Theoretical foundations of quantum mechanics and its applications in information theory.

PHYS 6298. Quantum Computation. 3 Credit Hours.
Theoretical foundations of quantum mechanics and its applications in information theory.

PHYS 6299. Quantum Computation. 3 Credit Hours.
Theoretical foundations of quantum mechanics and its applications in information theory.

PHYS 6300. Master's Thesis. 1-21 Credit Hours.
An introduction to the skills of a professional scientist both within academia and beyond, focusing on preparing grants and proposals, scientific communication and career preparation.

PHYS 6XXX. Physics Elective. 1-21 Credit Hours.
PHYS 7141. Many-Particle Quantum Mechanics. 3 Credit Hours.
Quantum mechanics of interacting Fermi and Bose particles. Topics
include second quantization, diagrammatic perturbation theory,
variational methods, and path integrals.

PHYS 7143. Group Theory and Quantum Mechanics. 3 Credit Hours.
Foundations of group representation theory with applications in atomic,
molecular, nuclear, and solid state physics.

PHYS 7147. Quantum Field Theory. 3 Credit Hours.
Introduction to quantum field theory, with an emphasis in quantum
electrodynamics. Second quantization, Dirac equation, Feynman
diagrams, quantum electrodynamics, electro-weak interactions.

PHYS 7222. Quantum Optics I. 3 Credit Hours.
Basic course on the interaction of light with matter, based on quantum
theory. Applications to the laser and to the study of coherence properties
of light.

PHYS 7223. Quantum Optics II. 3 Credit Hours.
Advanced treatment of the interaction of light with matter using modern
methods of open quantum systems. Applications to current research.

PHYS 7224. Nonlinear Hamiltonian Dynamics and Chaos. 3 Credit Hours.
A course on nonlinear dissipative dynamical systems, with an emphasis
in aspects relevant to physicists. Topics include bifurcation theory,
attractors, renormalization group techniques, and pattern formation.

PHYS 7268. Spatio-Temporal Dynamics and Pattern Formation. 3 Credit
Hours.
A theoretical description of dynamics and pattern formation in physical,
chemical and biological systems driven out of equilibrium. Topics include
linear and weakly nonlinear analysis of patterns, bifurcation theory and
amplitude equations.

PHYS 7741. Robotics Professional Preparation. 1 Credit Hour.
Preparation for a professional career in Robotics. Local & visiting
speakers. Program introduction. Technical resume preparation. GT
Robotics labs & resources.

PHYS 7742. Robotics Professional Preparation 2. 1 Credit Hour.
Preparation for a professional career in Robotics. Local & visiting
speakers. Selecting and applying for Internship. Developing capstone
project proposal. Public speaking practice and preparation.

PHYS 7743. Robotics Professional Preparation 3. 1 Credit Hour.
Preparation for a professional career in Robotics. Local & visiting
speakers. Interview preparation & career search. Technical report writing
and presentation.

PHYS 8001. Seminar. 1 Credit Hour.
Representative research programs in the School are described by
advanced graduate students, post-doctoral fellows, and faculty members.
The experimental basis of physics is illustrated through accounts of great
experiments of importance to contemporary research.

PHYS 8002. Graduate Student Seminar. 2 Credit Hours.
Representative research programs in the School are described by
advanced graduate students, post-doctoral fellows, and faculty members.
The experimental basis of physics is illustrated through accounts of great
experiments of importance to contemporary research.

PHYS 8740. Robotics Internship. 1-21 Credit Hours.
Graduate internship at a partner company, GTRI or a GT Robotics lab.

PHYS 8741. Robotics Capstone Project. 3 Credit Hours.
Teams or individuals apply the knowledge and skills acquired throughout
the MS program to a faculty supervised robotics project.