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 PhysII. 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 2211. Introductory Physics I. 4 Credit Hours.
A calculus-based course with a laboratory covering classical mechanics, applications of classical mechanics, oscillations, and waves.

PHYS 2212. Introductory Physics II. 4 Credit Hours.
A calculus-based course with laboratory covering electromagnetism, applications of electromagnetism, light, and modern physics.

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 2814. Special Topics. 4 Credit Hours.
Courses in special topics of current interest in physics.

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.
Develops a working knowledge of stellar and extra-stellar galactic astronomy. Includes stellar structure, nucleosynthesis, stellar evolution, and degenerate objects.

PHYS 3043. 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 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 Schrodinger 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 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 3223. 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 3224. Geometrical Optics Laboratory. 2 Credit Hours.
Measurement of parameters of optical surfaces, lenses, and systems using a variety of techniques.

PHYS 3225. Modern Optics. 3 Credit Hours.
Principles of wave propagation, coherence, polarization, diffraction, and Fourier Optics; laser theory including the interaction of light with matter.

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 3232. 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.
Special Topics.

PHYS 3807. Special Topics. 3 Credit Hours.
Special Topics.

PHYS 3814. Special Topics. 4 Credit Hours.
Special Topics.

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 4220. Optical Design. 3 Credit Hours.
Principles of optical and optomechanical design including tolerancing, specification, and thermal compensation of systems.

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 4250. Neurophysics. 4 Credit Hours.
Hands-on lecture/lab undergraduate course connecting theory and experiment to understand principles of neuron, brain, and heart function. Draws upon nonlinear dynamics, basic electrostatics, and electrophysiology.

PHYS 4251. 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 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 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 4321. 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 4322. Advanced Laboratory II. 3 Credit Hours.
A continuation of PHYS 4321. Experiments are conducted that demonstrate basic principles from various fields of physics. An emphasis is placed on contemporary concepts in modern physics.

PHYS 4347. 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 4421. 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 4601. 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 4602. 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 4655. 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.

PHYS 4698. Undergraduate Research Assistantship. 1-12 Credit Hours.
Independent research conducted under the guidance of a faculty member.

PHYS 4699. Undergraduate Research. 1-12 Credit Hours.
Independent research conducted under the guidance of a faculty member.

PHYS 4740. Estimation and Approximation in Physics. 3 Credit Hours.
Applications of order-of-magnitude estimates, dimensional analysis, scaling arguments, and perturbation theory in different areas of physics.

PHYS 4751. Laser Theory and Applications. 3 Credit Hours.
Provides an introduction to the theory and applications of laser principles and related instrumentation. Emphasis is on the fundamental principles underlying laser action. Crosslisted with ECE 4751.

PHYS 4782. Quantum Information and Quantum Computing. 3 Credit Hours.
Introduction to quantum computing and quantum information theory, formalism of quantum mechanics, quantum gates, algorithms, measurements, coding, and information. Physical realizations and experiments. Crosslisted with MATH 4782.

PHYS 4801. Special Topics. 1 Credit Hour.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 4802. Special Topics. 2 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 4803. Special Topics. 3 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 4804. Special Topics. 4 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 4813. Special Topics. 3 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 4823. Special Topics. 3 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 4833. Special Topics. 3 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 4854. Special Topics. 4 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 4900. Special Problems. 1-21 Credit Hours.
Courses involving special problems in physics are offered from time to time.

PHYS 4901. Special Problems. 1-21 Credit Hours.
Courses involving special problems in physics are offered from time to time.

PHYS 4902. Special Problems. 1-21 Credit Hours.
Courses involving special problems in physics are offered from time to time.

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.
Static and quasistatic phenomena in electromagnetism. Boundary value problems in electrostatics and magnetostatics. Maxwell's equations.

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 6124. Mathematical Methods of Physics I. 3 Credit Hours.
First of two courses on mathematical methods used in classical mechanics, electromagnetism, quantum mechanics, and statistical physics. Topics include complex analysis, vectors and matrices, and Sturm-Liouville theory.

PHYS 6203. 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 6204. Electronics I. 4 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 6206. Electronics II. 4 Credit Hours.
A course in electronic instrumentation with an emphasis on signal processing, both analog and digital, and computer interfacing.

PHYS 6210. 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 6211. 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 6250. 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 6260. 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.
This course will provide detailed descriptions of non-relativistic atomic/molecular scattering/reaction processes.

PHYS 6268. 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 6567. Ultrafast Optics. 3 Credit Hours.
A modern introduction to ultrafast optical phenomena. Topics include the generation, amplification, measurement, nonlinear optics, propagation, focusing, shaping and applications of ultrashort laser pulses.

PHYS 6740. Estimation and Approximation in Physics. 3 Credit Hours.
Applications of order-of-magnitude estimates, dimensional analysis, scaling arguments, and perturbation theory in different areas of physics.

PHYS 6750. Foundations of Quantitative Biosciences. 4 Credit Hours.
Introduction to quantitative methods and logic that enable key advances in understanding living systems, spanning molecules, cells, organisms, and biomes.

PHYS 6771. 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 6801. Grant Writing and Navigating the Scientific Landscape. 3 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 7000. Master's Thesis. 1-21 Credit Hours.

PHYS 7123. Statistical Mechanics II. 3 Credit Hours.
Principles of nonequilibrium statistical mechanics, both classical and quantal. Emphasis is on the dynamics of fluctuations, their measurement, and their relationship to transport properties.

PHYS 7125. Introduction to Relativity. 3 Credit Hours.
The theory of gravity, describing how matter curves spacetime and spacetime guides matter, with its experimental and theoretical applications.

PHYS 7127. Cosmology & Galaxies. 3 Credit Hours.
Overview of the relevant physics that govern cosmological processes, and galaxy formation and evolution. Topics include inflation, gravitational collapse, large-scale clustering, and galaxy mergers.

PHYS 7129. High-Energy Astrophysics. 3 Credit Hours.
Introduction to high-energy astrophysical processes and environments, including astrophysical fluid dynamics (e.g., shocks and blast waves), accretion onto compact objects, and clusters of galaxies.

PHYS 7141. Many-Particle Quantum Mechanics. 3 Credit Hours.
Quantum mechanics of interacting Fermi and Bose particles. Topics include second quantization, diagrammatic purturbation 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.

PHYS 8801. Special Topics. 1 Credit Hour.

PHYS 8802. Special Topics. 2 Credit Hours.

PHYS 8803. Special Topics. 3 Credit Hours.

PHYS 8804. Special Topics. 4 Credit Hours.

PHYS 8805. Special Topics. 5 Credit Hours.

PHYS 8813. Special Topics. 3 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 8814. Special Topics. 4 Credit Hours.
Special Topics for Physics (lecture + supervised lab).

PHYS 8823. Special Topics. 3 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 8833. Special Topics. 3 Credit Hours.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 8901. Special Problems. 1-21 Credit Hours.

PHYS 8991. Master's Practicum. 1-21 Credit Hours.

PHYS 8992. Master's Practicum. 1-21 Credit Hours.

PHYS 8993. Master's Practicum. 1-21 Credit Hours.

PHYS 8997. Teaching Assistantship. 1-9 Credit Hours.
For graduate students holding a graduate teaching assistantship.

PHYS 8998. Research Assistantship. 1-9 Credit Hours.
For graduate students holding a graduate research assistantship.

PHYS 9000. Doctoral Thesis. 1-21 Credit Hours.