Physics

Courses

PHYSICS 1011 Basic Physics I (MOTR PHYS 150L): 3 semester hours
Prerequisites: MATH 1030 and MATH 1035 required, MATH 1100 or MATH 1800 strongly recommended, concurrent enrollment in PHYSICS 1011L recommended. This course is specifically designed for students in health and life sciences covering the topics in classical mechanics such as kinematics, Newton's laws, energy, momentum and oscillations. This course will not fulfill the PHYSICS 2111 requirement for physics, chemistry, and engineering majors.

PHYSICS 1011L Basic Physics I Laboratory: 1 semester hour
Prerequisite: PHYSICS 1011 (may be taken concurrently). This laboratory course accompanies PHYSICS 1011, which is specifically designed for students in health and life sciences covering topics in classical mechanics such as kinematics, Newton's laws, energy, momentum and oscillations.

PHYSICS 1012 Basic Physics II: 3 semester hours
Prerequisites: PHYSICS 1011, concurrent enrollment in PHYSICS 1012L recommended. This continuation of PHYSICS 1011 is specifically designed for students in health and life sciences covering electricity, magnetism, light, optics and waves. This course will not fulfill the PHYSICS 2112 requirement for physics, chemistry, and engineering majors.

PHYSICS 1012L Basic Physics II Laboratory: 1 semester hour
Prerequisites: PHYSICS 1012 (may be taken concurrently). This laboratory course accompanies PHYSICS 1012, which is specifically designed for students in health and life sciences, covering electricity, magnetism, light, optics and waves.

PHYSICS 1099 Windows on Physics: 1 semester hour
A seminar designed to introduce physics majors to research areas in physics and physics-related fields in the Department of Mathematics, Physics, Astronomy and Statistics. In addition to fundamental areas of physics, the areas of astrophysics, biophysics, materials science, and nanotechnology will be included. Career opportunities for students with physics degrees will be discussed and the physics curriculum will be reviewed. The course meets weekly and is required of all physics majors and minors who are transfer students.

PHYSICS 2010 Introduction to Inquiry Approaches to STEM Education (STEP I): 1 semester hour
Same as CHEM 2010, BIOL 2010, MATH 2010, and SEC ED 2010. Prerequisites: Concurrent enrollment BIOL 1821, BIOL 1831, CHEM 1111, CHEM 1121, PHYSICS 2111, PHYSICS 2112, MATH 1800, or MATH 1900 or have a declared STEM major. Students who want to explore teaching careers become familiar with lesson plan development by writing, teaching and observing lessons in a local school class. Students build and practice inquiry-based lesson design skills and become familiar with and practice classroom management in the school setting. As a result of the STEP I experiences students should be able to decide whether to continue to explore teaching as a career and ultimately finishing the remainder of the WE TEACH MO curriculum leading to teacher certification. The classroom observations and teaching represent a major field component and requires at least one two hour block of free time during the school day once a week.

PHYSICS 2011 Designing Inquiry-Based STEM Experiences (STEP II): 1 semester hour
Same as CHEM 2011, BIOL 2011, MATH 2011, and SEC ED 2011. Prerequisites: BIOL 2010, CHEM 2010, PHYSICS 2010, MATH 2010, or SEC ED 2010. Students explore teaching careers, become familiar with STEM school setting through observing and discussing the school environment and by developing and teaching inquiry-based lessons.

PHYSICS 2111 Physics: Mechanics and Heat (MOTR PHYS 200L): 4 semester hours
Prerequisites: MATH 1900 (may be taken concurrently). This course introduces students to the phenomena, concepts, and laws of mechanics and heat for physics majors and students in other departments. Three classroom hours and one hour discussion per week.

PHYSICS 2111L Mechanics and Heat Laboratory: 1 semester hour
Prerequisites: PHYSICS 2111 (may be taken concurrently). This laboratory course accompanies PHYSICS 2111, which covers the phenomena, concepts, and laws of mechanics and heat.

PHYSICS 2112 Physics: Electricity, Magnetism, and Optics: 4 semester hours
Prerequisites: PHYSICS 2111 and MATH 2000 (MATH 2000 may be taken concurrently). This course provides a phenomenological introduction to the concepts and laws of electricity and magnetism, electromagnetic waves, optics and electrical circuits for physics majors and students in other departments. Three hours of lecture and one hour of discussion per week.

PHYSICS 2112L Electricity, Magnetism, and Optics Laboratory: 1 semester hour
Prerequisites: PHYSICS 2112 (may be taken concurrently). This laboratory course accompanies PHYSICS 2112, which covers the phenomena, concepts and laws of electricity and magnetism, electromagnetic waves, optics and electrical circuits.

PHYSICS 3200 Mathematical Methods of Theoretical Physics: 3 semester hours
Prerequisites: PHYSICS 2112, MATH 2000, and MATH 2020 (may be taken concurrently). Mathematical techniques specifically used in the study of mechanics, electricity, magnetism, and quantum physics are developed in the context of various physical problems. Course includes the topics of vector calculus, coordinate systems, the Laplace equation and its solutions, elementary Fourier analysis, & complex variables. Applications to electrostatics, mechanics, and fluid dynamics are emphasized. Three hours of lecture per week.

PHYSICS 3221 Mechanics: 3 semester hours
Prerequisites: PHYSICS 3200 and MATH 2020. Advanced course covering single and many particle dynamics, rigid-body dynamics, and oscillations. Variational principles and Hamiltonian formulations of mechanics are covered. Three hours of lecture per week.

PHYSICS 3223 Electricity and Magnetism: 3 semester hours
Prerequisites: PHYSICS 3200 and MATH 2020. Advanced course covering the rigorous development, from basic laws, of Maxwell's equations for electromagnetic fields along with applications of these equations. Topics covered are electrostatics and electrodynamics including currents, magnetic fields, motion of charged particles in fields and an introduction to electromagnetic waves. Three hours of lecture per week.

PHYSICS 3231 Introduction to Modern Physics I: 3 semester hours
Prerequisites: PHYSICS 2111, PHYSICS 2112, and MATH 2020 (MATH 2020 may be taken concurrently) and PHYSICS 3200 strongly recommended. Photons and the wave nature of particles, wave mechanics, Schroedinger equation, with applications to atomic physics; and radiation; the physics of solids; elementary particles; special relativity; health physics. Three hours of lecture per week.

PHYSICS 3281 Directed Readings in Physics: 1-5 semester hours
Prerequisite: Consent of instructor. An independent study of special topics in physics. A paper may be required on an approved topic. Topics must be substantially different. Hours arranged.

PHYSICS 3390 Research: 1-10 semester hours
Prerequisite: Consent of department. Independent physics research projects arranged between student and instructor. Hours arranged.

PHYSICS 4305 Bayesian Data Analysis for the Sciences: 3 semester hours
Prerequisites: Consent of instructor. This is a cross-disciplinary course in two parts. Part one covers Bayesian inference as applied to data analysis in general, with a special focus on the mathematics of model-selection in the physical and life sciences. Part two concentrates specifically on the Bayesian use of log-probability (i.e. information) measures to track order-disorder transitions in thermodynamics, and to track the evolution of sub-system correlations (via both digital and analog means) in a wide variety of complex systems. Expect weekly empirical observation exercises, and opportunities for asynchronous as well as synchronous collaboration.

PHYSICS 4306 Nanoscience Practicals: 1-3 semester hours
Studies of Nanoscience characterization, synthesis, modeling techniques designed for clients of these tools, as well as for technical users interested in a current overview. Course consists of a set of 1/3 semester modules. Check with the instructor on more specialized modules, (e.g, on materials microscopy), if interested. Each module will cover instrumentation, current applications, weaknesses, and will involve lab visits for hands-on experience, weekly web interaction and classroom hours.

PHYSICS 4310 Modern Electronics: 3 semester hours
Prerequisite: PHYSICS 2112. This course is an integrated recitation/laboratory study of modern analog and digital electronics with emphasis on integrated circuits, which consist of active and passive electrical circuit elements integrated on a single semiconductor substrate. This course includes the study of the properties of the various specialized electronic devices that are constructed with integrated circuits along with a study of the various circuit elements. This course has four contact hours of lecture/laboratory per week.

PHYSICS 4311 Advanced Physics Laboratory I: 3 semester hours
Prerequisites: PHYSICS 3200 and PHYSICS 3231 or consent of instructor. This course introduces students to the experimental techniques used in research. A student will choose and do several special problems during the semester. Six hours of laboratory per week.

PHYSICS 4323 Modern Optics: 3 semester hours
Prerequisite: PHYSICS 3223. A study of modern optics including diffraction theory, polarization, light propagation in solids, quantum optics, and coherence.

PHYSICS 4331 Intro to Quantum Mechanics: 3 semester hours
Prerequisites: PHYSICS 3200 and PHYSICS 3231. Photons and the wave nature of particles; wave mechanics, Schroedinger equation, operator and matrix formulations, and Dirac notation; applications to single particle systems, atomic physics, and spectroscopy.

PHYSICS 4341 Thermal and Statistical Physics: 3 semester hours
Prerequisites: MATH 2000 and PHYSICS 3231. Introduction to statistical mechanics, classical thermodynamics, and kinetic theory.

PHYSICS 4343 Selected Topics in Physics I: 3 semester hours
Prerequisites: PHYSICS 3221, PHYSICS 3223, PHYSICS 3231, PHYSICS 4341. Topics include special phenomena for research areas such as physics of waves, biophysics, nonlinear physics, geophysical fluid dynamics and the atmospheric sciences treated by methods of advanced mechanics, electromagnetism, statistical mechanics, thermodynamics and quantum mechanics. Three hours of lecture per week.

PHYSICS 4345 Introduction to Nonlinear Dynamics and Stochastic Processes: 3 semester hours
Prerequisites: PHYSICS 3221 and PHYSICS 4341 and consent of instructor. This course is an introduction to dynamical systems and stochastic processes and their applications within various fields. Topics may include: theory of oscillations; bifurcation theory and chaos in dissipative systems, dynamics of nonlinear systems perturbed by noise; noise-induced phase transitions; and linear and nonlinear time series analysis. Students may not receive credit for both PHYSICS 4345 and PHYSICS 5345.

PHYSICS 4347 Introduction to Biophysics: 3 semester hours
Prerequisites: PHYSICS 3231, BIOL 1821, and BIOL 1831; or permission of instructor. This course is an introduction to the application of physical principles to problems in biology. The course may cover topics such as molecular biophysics (e.g., ion transport, protein folding, molecular motors), collective dynamics and self-assembly of biological systems, nonlinear dynamics and electrophysiology in the heart and brain, and physics-based approaches to modeling gene networks and evolutionary dynamics. Students will complete a final project investigating a particular area of biophysics. Students may not receive credit for both PHYSICS 4347 and PHYSICS 5347.

PHYSICS 4350 Computational Physics: 3 semester hours
Prerequisites: PHYSICS 3221, PHYSICS 3223, PHYSICS 4331 and MATH 2450. This course explains how to solve physics-based problems using computational techniques. Mechanics, electrodynamics, and quantum physics problems are solved by (1) numerically solving ordinary and partial differential equations, (2) using Fourier analysis, and (3) solving eigenvalue problems.

PHYSICS 4353 Physics of Fluids: 3 semester hours
Prerequisites: PHYSICS 3221, PHYSICS 3223, and PHYSICS 4341, or consent of instructor. Dynamical theory of gases and liquids. Course covers the mathematical development of physical fluid dynamics with contemporary applications.

PHYSICS 4354 Atmospheric Physics: 3 semester hours
Prerequisites: PHYSICS 4341 and PHYSICS 3221. The mathematical application of physical laws to atmospheric dynamics and physical meteorology. Application of mechanics, thermodynamics, optics, and radiation to atmospheric phenomena including the ionosphere.

PHYSICS 4357 Fundamental Particles and Forces: 3 semester hours
Prerequisites: PHYSICS 3223, PHYSICS 3231 and PHYSICS 4331. This course is an introduction to the fundamental theory of matter and energy. Topics may include, high energy particle accelerators and detectors; phenomenology of strong, electromagnetic and weak interactions; symmetry principles; baryon and meson quark compositions; gauge theories, and the standard model of particle interactions; and grand unification.

PHYSICS 4358 Introduction to Global Geodynamics: 3 semester hours
Prerequisites: PHYSICS 3221 and PHYSICS 3223. This advanced course covers the development, from basic laws, of equations describing the many geodynamic processes underpinning geological modeling and geological data. Topics covered are paleomagnetism, plate tectonics, viscoelastic media, heat transfer, gravity, fluid mechanics, rheology, faulting, and geochronology.

PHYSICS 4370 Relativity and Cosmology: 3 semester hours
Prerequisites: PHYSICS 3221, PHYSICS 3223 and PHYSICS 3231. An introduction to Einstein's general theory of relativity. Topics will include special relativity in the formalism of Minkowski's four dimensional space-time, Principle of Equivalence, metric description of curved space, geodesic equation, Einstein Field Equation, black holes, and cosmology.

PHYSICS 4381 Directed Readings in Physics: 1-10 semester hours
Prerequisite: Consent of instructor. An independent study of special topics in physics for senior undergraduates or graduate students.

PHYSICS 5306 Advanced Nanoscience Practicals: 1-3 semester hours
Prerequisites: Graduate standing in physics or consent of instructor. Advanced studies of Nanoscience characterization, synthesis, and modeling techniques designed for clients of these tools, as well as for technical users interested in a current overview. The course consists of a set of 1/3 semester modules. Check with the instructor on more specialized modules, (e.g, on materials microscopy), if interested. Each module will cover instrumentation, current applications, and weaknesses and will involve lab visits for hands-on experience, weekly web interaction and classroom hours.

PHYSICS 5345 Nonlinear Dynamics and Stochastic Processes: 3 semester hours
Prerequisites: PHYSICS 3221 and PHYSICS 4341 and consent of instructor. Dynamical systems; theory of oscillations; introduction to bifurcation theory and chaos in dissipative systems with applications in physics and biology; introduction to stochastic processes with applications in physics, chemistry and biology; dynamics of nonlinear systems perturbed by noise; noise-induced phase transitions; linear and nonlinear time series analysis. Three classroom hours per week.

PHYSICS 5347 Intermediate Biophysics: 3 semester hours
Prerequisites: Graduate standing, PHYSICS 3231, BIOL 1821 and BIOL 1831 or permission of instructor. This course is applies physical principles to problems in biology. Topics may include molecular biophysics (e.g., ion transport, protein folding, molecular motors), collective dynamics and self-assembly of biological systems, nonlinear dynamics and electrophysiology in the heart and brain, and physics-based approaches to modeling gene networks and evolutionary dynamics. Students will complete a final project investigating a particular area of biophysics. Students will be expected to design projects containing a significant component of original research. Students may not receive credit for both PHYSICS 4347 and PHYSICS 5347.

PHYSICS 5350 Intermediate Computational Physics: 3 semester hours
Prerequisites: PHYSICS 3221, PHYSICS 3223, PHYSICS 4331 and MATH 2450; or graduate standing. This course explains how to solve physics-based, intermediate-level problems using computational techniques. Mechanics, electrodynamics, and quantum physics problems are solved by (1) numerically solving ordinary and partial differential equations, (2) using Fourier analysis, and (3) solving eigenvalue problems. Students may not receive credit for both PHYSICS 4350 and PHYSICS 5350.

PHYSICS 5353 Intermediate Physics of Fluids: 3 semester hours
Prerequisites: PHYSICS 3221, PHYSICS 3223, and PHYSICS 4341; or graduate standing. This course covers intermediate level dynamical theory of gases and liquids. This course examines mathematical fluid dynamics along with some contemporary applications. Students may not receive credit for both PHYSICS 4353 and PHYSICS 5353.

PHYSICS 5358 Intermediate Global Geodynamics: 3 semester hours
Prerequisites: Graduate standing, PHYSICS 3221 and PHYSICS 3223 or permission of the Instructor. This course intermediate course covers the development of equations describing the many geodynamic processes underpinning geological modeling and geological data. Topics covered may include paleomagnetism, plate tectonics, viscoelastic media, heat transfer, gravity, fluid mechanics, rheology, faulting, and geochronology. Students will complete a final project investigating a particular area of geodynamics. Students will be expected to develop a more advanced project. Students may not receive credit for both PHYSICS 4358 and PHYSICS 5358.

PHYSICS 5370 Intermediate Relativity and Cosmology: 3 semester hours
Prerequisites: PHYSICS 3221, PHYSICS 3223, and PHYSICS 3231; or graduate standing. Topics will include special relativity in the formalism of Minkowski's four dimensional space-time, Principle of Equivalence, geodesic equation, Einstein Field Equation, black holes, and cosmology. Differential geometry from metric description to Riemann curvature tensor will be studied.

PHYSICS 5402 Introduction to Mathematical Physics: 3 semester hours
Prerequisites: Graduate standing in physics or consent of instructor. A course covering mathematical techniques as applied in advanced theoretical physics including generalized vector spaces and their dual spaces, linear operators and functionals, generalized functions, spectral decomposition of operators, tensor analysis, and complex variables. Three hours of lecture per week.

PHYSICS 6300 Master's Thesis: 3 semester hours
Prerequisite: Consent of instructor. Thesis work under the supervision of a faculty member. The course is designed for those students intending to present a thesis as part of their M.S. program. Students who do not write a thesis cannot apply PHYSICS 6300 to a degree. This course transfers to the Cooperative Ph.D. program as three research credits.

PHYSICS 6400 Special Problems: 1-5 semester hours
Must have faculty mentor and approval of Department Chairperson. A study of special topics in physics for graduate students.

PHYSICS 6401 Special Topics: 1-4 semester hours
Prerequisite: Consent of instructor. This course is designed to give the department an opportunity to test a new course.

PHYSICS 6409 Theoretical Mechanics I: 3 semester hours
Prerequisite: PHYSICS 3221. Classical mechanics, methods of Newton, Lagrange, and Hamilton applied to motion of particles and rigid bodies, elasticity, hydrodynamics.

PHYSICS 6410 Seminar: 1-3 semester hours
Prerequisite: Approval of Department Chair. Discussion of current topics.

PHYSICS 6411 Electrodynamics I: 3 semester hours
Prerequisite: PHYSICS 3223. A rigorous development of the fundamentals of electromagnetic fields and waves. Electrostatics, magnetostatics, Maxwell's equations, Green's functions, boundary value problems, multipoles, conservation laws.

PHYSICS 6413 Statistical Mechanics: 3 semester hours
Prerequisite: PHYSICS 4331, PHYSICS 4341. A study of statistical
ensembles; Maxwell-Boltzmann, Fermi-Dirac and Einstein-Bose
distribution laws, application to some physical systems.

PHYSICS 6423 Electrodynamics II: 3 semester hours
Prerequisite: PHYSICS 6411. A continuation of PHYSICS 6411.
Applications of time-dependent Maxwell's equations to such topics as
plasmas, wave guides, cavities, radiation: fields of simple systems and
multiples. Relativity: covariant formulation of Maxwell's equations and
conservation laws, fields of uniformly moving and accelerated charges.

PHYSICS 6461 Quantum Mechanics I: 3 semester hours
Prerequisite: PHYSICS 4331. A study of the Schroedinger wave equation,
operators and matrices, perturbation theory, collision and scattering
problems.

PHYSICS 6463 Quantum Mechanics II: 3 semester hours
Prerequisite: PHYSICS 6461. Continuation of PHYSICS 6461. To include
such topics as Pauli Spin-Operator Theory, classification of atomic states,
introduction to field quantization, and Dirac Electron Theory.

PHYSICS 6490 Research: 1-10 semester hours
Prerequisite: Must have a faculty mentor and approval of the department
chair. Investigations of an advanced nature leading to the preparation of a
thesis or dissertation.

PHYSICS 6495 Continuous Registration: 1-6 semester hours
Doctoral candidates who have completed all requirements for the degree
except the dissertation, and are away from the campus must continue
to enroll for at least one hour of credit each registration period until the
degree is completed. Failure to do so may invalidate the candidacy.