PHYSICS (PHYS)

PHYS-114 Newtonian Mechanics 3 Credits
Corequisites: MATH-102, PHYS-115
Prerequisites: MATH-101 or MATH-101X
A calculus-based introduction to classical Newtonian mechanics including; vectors, translational and rotational kinematics and dynamics, work, energy, impulse, and linear and angular momentum.
Lecture: 3, Lab 0, Other 1

PHYS-115 Newtonian Mechanics Laboratory 1 Credits
Corequisites: COMM-101, MATH-102, PHYS-114
Prerequisites: MATH-101 or MATH-101X
Laboratory activities will explore position, velocity, and acceleration, force, momentum and energy, all as function of time. Applications to vehicle crash safety are incorporated. Laboratory skills, including: uncertainty, simple data acquisition and sensor instrumentation, and analysis techniques are essential.
Lecture: 0, Lab 2, Other 0

PHYS-224 Electricity and Magnetism 3 Credits
Corequisites: MATH-203, PHYS-225
Prerequisites: PHYS-114 and PHYS-115 and (MATH-102 or MATH-102X or MATH-102H)
An investigation of the physics of electricity and magnetism with a focus on the physics of electric and magnetic fields and their effects on electric charges. Topics will include the relationships between charges, forces, fields, potentials, and currents, as well as the physics of capacitors, resistors, and inductors.
Lecture: 3, Lab 0, Other 1

PHYS-225 Electricity and Magnetism Laboratory 1 Credits
Corequisites: MATH-203, PHYS-224
Prerequisites: PHYS-114 and PHYS-115 and (MATH-102 or MATH-102X or MATH-102H)
This laboratory investigates the physics of electricity and magnetism. It includes a practical study of electric potential and electric current, as well as the fundamental circuit elements: capacitors, resistors, and inductors.
Lecture: 0, Lab 2, Other 0

PHYS-302 Vibration, Sound and Light 4 Credits
Corequisites: MATH-204
Prerequisites: PHYS-224 and PHYS-225 and (MATH-203 or MATH-203H or MATH-203X)
Minimum Class Standing: Sophomore 2
The phenomena of vibration and waves provide a fundamental background necessary to approach a wide variety of applications in physics and engineering. The first part of this course will introduce students to the basics of vibration, including the effects of real damping, response to driving forces, nonlinear oscillation and application to several acoustical, optical, electrical, and mechanical systems. After this introduction to vibration, the course will focus on wave motion. The behavior of non-dispersive waves in solids, acoustic sound waves, electromagnetic waves, and transverse waves on a string will be discussed along with an introduction to Fourier analysis as a means of analyzing wave signals. Non-dispersive waves in non-uniform media will also be explored with applications to several different types of waves occurring in nature. Basic wave phenomena including reflection, refraction, diffraction and interference will be discussed with respect to a variety of wave types. Students successfully completing this course will be well prepared for further study in optics, acoustics, vibration, and electromagnetic wave propagation.
Lecture: 4, Lab 0, Other 0

PHYS-304 The Science of Sensors 4 Credits
Prerequisites: PHYS-224 and PHYS-225
Sensors are a driving technology in nearly every industry. In this course, we will explore the “why’s” and “how’s” behind the operation of sensors in general, and then delve into the science behind your specific types of sensors work. The course will wrap up with a project in which students create their own sensing system using an Arduino microcontroller and multiple sensors to perform a task.
Lecture: 4, Lab 0, Other 0

PHYS-354 Medical Physics Principles 4 Credits
Prerequisites: PHYS-224 and PHYS-225
Minimum Class Standing: Sophomore
This course is designed to give physicists, engineers, chemists, pre-med students, and other technical majors an introduction to the application of physics in the field of medicine. Students will be introduced to the fundamental science and real-world application of diagnostic imaging, nuclear medicine, radiation therapy, and health physics. This course will cover topics such as radiation interactions with matter, the concept of radiation dose, the effect of radiation on biology, 2D x-ray imaging, computed tomography (CT) imaging, magnetic resonance imaging (MRI), ultrasound, biomedical optics, single photon emission computed tomography (SPECT), positron emission tomography (PET), and the treatment of cancer utilizing radiation therapy.
Lecture: 4, Lab 0, Other 0

PHYS-362 Modern Physics and Lab 4 Credits
Corequisites: MATH-204
Prerequisites: PHYS-224 and PHYS-225
Minimum Class Standing: Sophomore
Overview of the discoveries and applications of physics from the early 20th century on. Topics include relativity, quantum phenomena, wave-particle duality, quantum physics, solid state physics, semiconductors and superconductors, and nuclear and particle physics. Laboratory experiments will accompany topics introduced in lecture.
Lecture: 3, Lab 2, Other 0

PHYS-376 Photonics and Optoelectronics 4 Credits
Prerequisites: (MATH-203 or MATH-203H or MATH-203X) and PHYS-224 and PHYS-225
Minimum Class Standing: Sophomore
The course is intended for all those who want to find out and understand what lasers, fiber optics, and photonic devices are all about without a reliance on rigorous mathematical treatment. This course covers the fundamental aspects of optical fibers. It also provides an introduction to integrated optic devices. Various techniques for the manipulation of laser light based on electro-optic, magneto-optic and acousto-optic effects are described. The course ends with a discussion of optical detection principles and the working of a solar cell. While the level of prerequisites and mathematical sophistication is intermediate, intense independent learning and academic maturity is expected.
Lecture: 4, Lab 0, Other 0

PHYS-378 Spectroscopy and Microscopy 4 Credits
Prerequisites: PHYS-362
Minimum Class Standing: Junior
Introduction to the spectroscopy and microscopy techniques and instrumentation most widely used in the characterization and imaging of materials, with applications to materials science, chemistry and life-sciences. The topics include optical spectroscopy instrumentation (light sources, detectors, dispersive elements and instruments) and techniques (UV-VIS, Luminescence, Atomic Emission and Absorption, FTIR and Raman), electronic spectroscopy (XPS-ESCA and Auger), mass spectroscopy (SIMS), optical microscopy, scanning and transmission electron microscopy (SEM, TEM), scanning probe microscopy (AFM, STM, MFM) and combined techniques such as fluorescence microscopy.
Lecture: 4, Lab 0, Other 0

PHYS-388 Acoustics in the Human Environment 4 Credits
Prerequisites: PHYS-224 and PHYS-225
Minimum Class Standing: Junior
This course surveys elements in acoustics that involve human factors, including the physiology of hearing, psychoacoustics and sound quality metrics, and the basic signal processing needed for these metrics. Topics in architectural and room acoustics will also explore how we experience and control our acoustic environment. While the level of prerequisites and mathematical sophistication is intermediate, intense independent learning and academic maturity is expected. Computer software will be used to manipulate audio signals and understand processing that is often automated (and used carelessly). In this course, less emphasis will be placed on technical practice that may change. Instead, students will be challenged to understand why standards are written as they are, how metrics are designed, and how “rules of thumb” originated.
Lecture: 4, Lab 0, Other 0

PHYS-412 Theoretical Mechanics 4 Credits
Prerequisites: PHYS-114 and (MATH-204 or MATH-204H) and (EP-235 or MATH-305)
A look at classical physics. Topics include the projectile motion with air resistance, simple harmonic and nonlinear oscillation, central force motion, Kepler's laws and planetary motion, motion in noninertial reference frames, motion of systems of particles, rigid body motion, Lagrangian mechanics, and Hamiltonian theory. Computational methods for solving advanced physics problems will also be introduced.
Lecture: 4, Lab 0, Other 0

PHYS-452 Thermodynamics and Statistical Physics 4 Credits
Corequisites: MATH-204
Prerequisites: (MATH-203 or MATH-203H or MATH-203X) and PHYS-224 and PHYS-225 and PHYS-362
Minimum Class Standing: Sophomore 2
Introduction to statistical approaches for the analysis of systems containing a large number of particles. Specific topics include the fundamentals of thermodynamics, conditions for equilibrium and stability, ensemble theory, non-interacting systems, and phase transitions.
Lecture: 4, Lab 0, Other 0

PHYS-462 Quantum Mechanics 4 Credits
Prerequisites: (MATH-204 or MATH-204H) and (MATH-305 or MATH-307) and PHYS-362
Minimum Class Standing: Junior
Intoduction to the fundamentals of non-relativistic quantum mechanics. Topics include: photons, matter waves, the Bohr model, the time-independent Schrodinger equation (and its application to one dimensional potentials), quantization of angular momentum, spin, the hydrogen atom, multi-electron atoms, and perturbation theory.
Lecture: 4, Lab 0, Other 0

PHYS-477 Optics and Lab 4 Credits
Prerequisites: (MATH-204 or MATH-204H) and PHYS-302
Minimum Class Standing: Junior
A study of geometrical and physical optics. Topics in geometrical optics include phenomena of reflection, refraction, total internal reflection and their application to imaging systems consisting of lenses and mirrors. Physical optics will start from the electromagnetic wave nature of light and will focus on such wave-like phenomena as optical interference, diffraction, polarization, and dispersion of light. Limited topics in interaction of light with matter, crystal optics, optical properties of materials and their applications in such areas as optoelectronics, photonics and fiber optics will also be addressed. The lab investigates optical component analysis, ray tracing, interferometry, diffraction, polarization, interference, optical fibers and other special topics.
Lecture: 3, Lab 2, Other 0