PHYSICS

(Department of Physics and Engineering)

McCormick Foundation

PROFESSORS REESE, AKINS, DONAGHY, VAN NESS, WILLIAMS
ASSISTANT PROFESSOR SUKOW

MAJOR

A major in **physics** leading to a Bachelor of Science degree requires completion of 50 credits including the following:

1. Physics 111, 112, 113, 114, 210, 215, 220, 225 (Engineering 225), 230, 240 (Engineering 240), 340; and Mathematics 332, 333
2. One of the following laboratory courses: Computer Science 251; Engineering 207, 208, 251; Physics 207, 208
3. Ten additional credits chosen from among the following:
   Chemistry 110 or 111 (not both)
   Chemistry 112 or those numbered 200 or above
   Computer Science 111, 112, 120 or those numbered 200 or above
   Engineering numbered 200 or above
   Mathematics numbered 300 or above
   Physics numbered 200 or above

Additional courses required as prerequisites for completion of the above include Mathematics 101, 102, and 221.

Physics-Engineering major leading to a Bachelor of Science degree. The requirements for this program, which is designed for students interested in the field of physics-engineering, are described under Engineering.

HONORS: An Honors Program in physics is offered for qualified students; see the department head for details.

PHYSICS 100 (Engineering 100) (1)—Computing in Physics and Engineering

Pass/Fail only. Prerequisite: Permission of the instructor. An introduction to the use of computing tools essential to degree work in physics and engineering. Students are instructed in the use of microcomputers, the university network, word processing, spreadsheets, computer algebra packages, and advanced symbolic mathematics tools. *Akins and Williams.*

Fall

★PHYSICS 101 (3)—Natural Philosophy

The study of motion from Copernicus to Einstein. A brief look at the Copernican Revolution is followed by more detailed studies of Newtonian mechanics and Einstein's special theory of relativity. Some of the basic ideas of general relativity and the theory of elementary particles are discussed. Designed for non-science majors wishing to satisfy general education requirements. Elementary algebra and geometry are used. Not open to students who have received credit for Physics 111. Physics 103 is a corequisite for students seeking laboratory science credit in general education (area 5a.) *Donaghy.*

Winter

★PHYSICS 103 (1)—Natural Philosophy Laboratory
Prerequisite or corequisite: Physics 101. A laboratory course to accompany Physics 101. Laboratory exercises in classical and modern physics. *Donaghy.*
Winter

★PHYSICS 104 (Chemistry 104) (3)—The Conceptual Foundations of Quantum Theory
An introduction to what is currently the fundamental theory of nature. Quantum behavior is considered in the context of classical (Newtonian) notions of waves and particles and is applied to atomic, molecular, and nuclear systems. The practical and philosophical implications of quantum theory are examined in detail. No mathematics beyond high school algebra is assumed. *Desjardins and Williams.*
Offered when interest is expressed and departmental resources permit.

★PHYSICS 110 (3)—Energy and the Environment
Not open to students who have received credit for Physics 111. A study of the basic principles underlying the conversion and use of energy. Topics include conservation of energy, the second law of thermodynamics, nuclear energy, solar energy, and the production and transmission of electrical energy. The effects on the environment of the various forms of energy are explored. *Donaghy.*
Spring

★PHYSICS 111 (3)—General Physics I
Prerequisite or corequisite: Mathematics 101. An introduction to classical mechanics and thermodynamics. Topics include Newton's laws, wave motion and the laws of thermodynamics. Under most circumstances, this course should be taken simultaneously with Physics 113. Physics 113 is a corequisite for students seeking laboratory science credit for general education (area 5a.) *Staff.*
Fall

★PHYSICS 112 (3)—General Physics II
Prerequisite: Physics 111. A continuation of Physics 111. Topics include electricity and magnetism, optics, relativity, and quantum theory. Under most circumstances, this course should be taken simultaneously with Physics 114. Physics 114 is a corequisite for students seeking laboratory science credit for general education (area 5a.) *Staff.*
Winter

★PHYSICS 113 (1)—General Physics Laboratory I
Corequisite: Physics 111. A laboratory course to accompany Physics 111. Laboratory exercises in classical mechanics and thermodynamics. *Staff.*
Fall

★PHYSICS 114 (1)—General Physics Laboratory II
Corequisite: Physics 112. A laboratory course to accompany Physics 112. Laboratory exercises in electricity and magnetism, optics and modern physics. *Staff.*
Winter

★PHYSICS 150 (4)—The Immense Journey: Harmonices Mundi
Prerequisite: Permission of the instructor. The classical astronomy of the solar system is traced by a study of Greek astronomy and the revolutionary ideas of Kepler and Newton. The apparent and real motions of the earth, moon, and planets are studied in detail as well as special phenomena such as eclipses, tides and objects such as comets and asteroids. Emphasis is on comprehension and application of principles rather than memorization of facts. The laboratory stresses the observational aspects of astronomy. Elementary geometry, algebra, and trigonometry are used in the course. Laboratory course. *Reese.*
Fall

★PHYSICS 151 (4)—Stellar Evolution and Cosmology
Prerequisite: Permission of the instructor. An introduction to the physics and astronomy of stellar systems and the universe. Stellar evolution, the special and general theories of relativity and cosmology are studied. An assessment is made of the probabilities for life elsewhere in the universe. The feasibility of communication over interstellar distances also is investigated. Emphasis is on comprehension and application of principles rather than memorization of facts. The laboratory stresses the observational aspects of astronomy. Elementary geometry, algebra, and trigonometry are used in the course. Laboratory course. *Sukow*
Spring

PHYSICS 202 (3)—Relativity
Prerequisites: Physics 111 and 113. An examination of the special theory of relativity. Emphasis is placed on simple kinematic effects of the theory, the twin paradox, conservation of momentum, and conservation of energy. A brief introduction to four-vectors is presented and applied to simple electromagnetic problems. *Reese*
Spring

PHYSICS 207 (Engineering 207) (4)—Electrical Circuits
Prerequisites: Physics/Engineering 225. A detailed study of electrical circuits and the methods used in their analysis. Basic circuit components as well as devices such as operational amplifiers are investigated. The laboratory acquaints the student both with fundamental electronic diagnostic equipment and with the design and behavior of useful circuits. Laboratory course. *Sukow.*
Fall

PHYSICS 208 (Engineering 208) (3)—Electronics
Prerequisites: Physics/Engineering 207. An introduction to basic analog and digital electronics. Topics may include diodes, transistors, logic gates, flip-flops, counters and timers, and phase-locked loops. The integrated laboratory component of this course acquaints the student with the design of basic analog and digital circuits, and with the diagnostic techniques used to study these circuits. Laboratory course. *Sukow.*
Offered when interest is expressed and departmental resources permit.

PHYSICS 210 (3)—Modern Physics
Prerequisites: Physics 112. Introductions to the special theory of relativity and quantum mechanics. A selection of topics from atomic, molecular, nuclear, statistical, and solid state physics are discussed. The choice of topics may vary from year to year. *Donaghy.*
Fall

PHYSICS 211 (1)—Experiments in Modern Physics
Corequisite: Physics 210. Some classic experiments of the 20th century are performed, including measurements of the charge-to-mass ratio of the electron, Planck's constant, and atomic spectra, as well as recent experiments in other areas of modern physics. *Donaghy*
Fall

PHYSICS 215 (4)—Optics
Prerequisites: Physics 112 and 114. A study of the properties of electromagnetic waves with special emphasis on visible light. Wave descriptions are developed for scattering, reflection, refraction, interference, diffraction, and polarization. Topics in geometrical optics are also studied, including lenses and aberration theory. Laboratory course. *Sukow.*
Winter

PHYSICS 220 (3)—Electricity and Magnetism
Prerequisites: Physics 112 and 114; Corequisite: Mathematics 242. An introduction to the classical theory of electric and magnetic fields. The basic equations of electromagnetism (Maxwell's equations) are developed through a study of electrostatics, steady-state magnetism, and electromagnetic induction. *Donaghy.*
Winter

PHYSICS 225 (Engineering 225) (3)—Mathematical Methods for Physics and Engineering
Prerequisites: Physics 112, Mathematics 221. Study of a collection of mathematical techniques particularly useful in upper level courses in physics and engineering: vector differential operators – gradient, divergence, and curl; functions of complex variables; Fourier analysis; orthogonal functions; matrix algebra, and the matrix eigenvalue problem. *Williams.*
Winter

PHYSICS 230 (3)—Newtonian Mechanics
Prerequisites: Physics 111 and 113. A thorough study of Newton's laws of motion, rigid body motion, and accelerated reference frames. A student may not receive degree credit for both Engineering 204 and Physics 230. *Reese.*
Winter

PHYSICS 240 (Engineering 240) (3)—Thermodynamics
Prerequisites: Physics 112 and Mathematics 221. A study of the fundamental concepts of thermodynamics; thermodynamic properties of matter; and applications to engineering processes. *Van Ness.*
Winter

PHYSICS 245 (3)—Statistical Physics
Prerequisite: Physics 210 or Physics/Engineering 240. A study of the statistical methods used in various branches of physics. The Fermi-Dirac and Bose-Einstein distribution functions will be derived and applied to problems in thermodynamics and the physics of solids. *Donaghy.*
Offered when interest is expressed and departmental resources permit.

PHYSICS 255 (Engineering 255) (3)—C++ for Engineering and Physics
Prerequisite: Physics 112. An introduction to the C++ computing language, with applications characteristic of computation-intensive work in engineering and physics. Difference approximations to differential equations, stochastic methods, graphical presentation, and nonlinear dynamics are among the topics covered. Students need not have previous experience with C++. *Williams.*
Spring

PHYSICS 260 (Engineering 260) (3)—Materials Science
Prerequisite: Physics 112. An introduction to solid state materials. Study of the relation between microstructure and corresponding physical properties for metals, ceramics, polymers, and composites. *Van Ness*
Winter

PHYSICS 315 (3)—Nuclear Physics
Prerequisites: Physics 210 and Mathematics 221. Topics include radioactivity, nuclear reactions, high-energy physics, and elementary particles. *Donaghy.*
Offered when interest is expressed and departmental resources permit.

PHYSICS 340 (3)—Quantum Mechanics
Prerequisite: Physics 210; Corequisite: Mathematics 332. The Schrödinger wave formalism is established and applied to the harmonic oscillator, a particle in a square well, and the hydrogen atom. *Williams.*
Fall

PHYSICS 361 (Engineering 361) (3)—Polymer Science and Engineering
Prerequisite: Physics/Engineering 240 or Chemistry 261 or permission of the instructor. Science and engineering of large molecules. Physical and chemical structure of polymers correlated with mechanical properties. Crystal morphology. Theory of rubber elasticity. Time and temperature dependent properties of polymers. Relevance to polymer physics and chemical and mechanical engineering. *Van Ness.*
Spring

PHYSICS 401 (1), 402 (2), 403 (3)—Directed Individual Study
Prerequisite: Permission of the instructor. Advanced work and reading in topics selected by the instructor to fit special needs of advanced students. This course may be repeated with permission for a total of six credits. *Staff.*

PHYSICS 421 (1), 422 (2), 423 (3)—Directed Individual Research
Prerequisite: Permission of the instructor. Directed research in physics. May be repeated for degree credit with permission of the instructor. *Staff.*

PHYSICS 493 (3-3)—Honors Thesis
Fall-Winter