

PHYSICS (PHYS)

PHYS 101. Physics for Nonscientists (variable title). 4.

Introductory course, intended for students with limited mathematical background and centered on one of several topics such as an in-depth look at the physics of energy or a survey of modern physical thought. The relevance of physical laws to both society and the environment is discussed. Fulfills natural science/mathematics requirement (1998 & 2019).

PHYS 104. Elementary Electronics (CTIS 104). 4.

Introduces students to the behavior of the fundamental building blocks of modern electronic devices and the underlying scientific principles that make these devices work. Topics will be derived from analog and digital electronics and include resistance, capacitance, diodes, signal filtering, positive and negative feedback, operational amplifiers, Boolean logic, logic gates, and digital to analog conversion. This course is designed for the general student population (but not physics majors and physics minors) who are interested in exploring the fundamentals of electronics.

Prerequisite: Successful completion of the quantitative literacy requirement. Spring. Fulfills natural science/mathematics requirement (1998 2019). Offered in alternate years.

PHYS 107. The Solar System. 4.

This course covers the physical description of the planets, their satellites, the sun, asteroids and comets, with a strong emphasis on recent information from landers and fly-by probes. This course includes discussions of how science is known, learned and taught, which will be of interest to future teachers and others who may wish to combine work with students and science. Fulfills natural science/mathematics requirement (1998 & 2019).

PHYS 108. Realm of the Stars. 4.

Concentrates on the study of stars. Topics include stellar observation and the life, evolution and death of stars. Fulfills natural science/mathematics requirement (1998 & 2019).

PHYS 109. Beyond the Stars. 4.

Concentrates on the study of extra-galactic astronomy. Topics include nebulae, galaxies and cosmology. Fulfills natural science/mathematics requirement (1998 & 2019). Numeric/symbolic engagement requirement (2019).

PHYS 111. Introduction to Physics for the Life Sciences I. 4.

The laws of physics describe the constraints and possibilities within which living organisms must thrive. Organisms must support themselves against gravity, must move through fluids, and must manage the thermodynamics of energy production and consumption. A thorough understanding of the tools and concepts of physics can undergird a richer understanding of the properties and processes of life and the technologies we use for research and medicine. This course will embed the ideas and modeling skills of physics in a rich biological and medical context, emphasizing analytic skills, modeling and problem-solving.

PHYS 112. Introduction to Physics for the Life Sciences II. 4.

The laws of physics describe the constraints and possibilities within which living organisms must thrive. Organisms must support themselves against gravity, must move through fluids, and must manage the thermodynamics of energy production and consumption. A thorough understanding of the tools and concepts of physics can undergird a richer understanding of the properties and processes of life and the technologies we use for research and medicine. This course will embed

the ideas and modeling skills of physics in a rich biological and medical context, emphasizing analytic skills, modeling and problem-solving.

Prerequisite: **PHYS 111**.

PHYS 114. Introduction to Electronics for Scientists. 4.

Introduces students to the behavior of the fundamental building blocks of modern electronic devices and the underlying scientific principles that make these devices work. Topics will be derived from analog and digital electronics and include resistance, capacitance, diodes, signal filtering, positive and negative feedback, operational amplifiers, Boolean logic, logic gates, and digital to analog conversion. This course is designed for students majoring or minoring in physics and is also appropriate for other math and science students with good quantitative skills who are interested in exploring the fundamentals of electronics.

Prerequisite: any one of the following courses: **CHEM 111**, MATH 121, MATH 123, **PHYS 112**, PHYS 117, **PHYS 121** or instructor permission. Spring. Fulfills natural science/mathematics requirement (1998 2019). Offered in alternate years.

PHYS 121. Classical and Modern Physics I. 4.

For physics majors and others interested in physics. This course is not a survey but an introduction to the thinking and analysis processes of physics, with classroom and laboratory topics chosen from modern and classical physics to emphasize the skills needed to think like a physicist. Corequisite: Math 220 or instructor permission. Fulfills natural science/mathematics requirement. Spring.

PHYS 122. Classical and Modern Physics II. 4.

For physics majors and others interested in physics. This course is not a survey but an introduction to the thinking and analysis processes of physics, with classroom and laboratory topics chosen from modern and classical physics to emphasize the skills needed to think like a physicist.

Prerequisite: **PHYS 121** and **MATH 220**. Corequisite: **PHYS 480** strongly recommended. Fulfills natural science and mathematics requirement. Spring.

PHYS 131. Experimental Expl. of Physics. 1-4.

Project-based introduction to experimental design, hypothesis testing, and data analysis. Students will develop guided inquiry questions and design experiments to test their hypotheses. (1)

PHYS 132. Intro. to Experimentation. 3-4.

PHYS 141. Light, Lasers and Lenses. 4.

This course serves as both a general education science course and as the first course for students interested in majoring in Physics. In this course, students will explore the nature of light, and the implications of the three major models of light for technology, art and perception. This course has no prerequisites, although the material does assume proficiency in Algebra, Trigonometry and Geometry at the high school level. Fulfills the natural science/mathematics requirement and the numeric/symbolic engagement requirement. Spring.

PHYS 150. Special Topics. 8.

May also be offered at 250, 350 and 450 levels.

PHYS 204. Electronics. 4.

Introduces students to the behavior of the fundamental building blocks of modern electronic devices and the underlying scientific principles that make these devices work. Topics will be derived from analog and digital electronics and include resistance, capacitance, diodes, signal filtering, positive and negative feedback, operational amplifiers, Boolean logic,

logic gates, and digital to analog conversion. This course is designed for students majoring or minoring in physics and those other students who have completed an introductory calculus-based course in electricity and magnetism and are interested in applying this background to electronics.

Prerequisite: **PHYS 223** or instructor permission. Spring.

Corequisite: **PHYS 480** strongly recommended. Fulfills natural science/mathematics requirement (1998 2019). Offered in alternate years.

PHYS 210. Observatory Practice. 4.

For physics majors and others interested in learning to use the J. Donald Cline Observatory at Guilford. The course includes astronomical background drawn from solar system, stellar and extra-galactic astronomy but the emphasis is on the use of the equipment, methods of data acquisition and analysis of results. Fulfills natural science/mathematics requirement (1998 & 2019).

PHYS 211. College Physics I. 4.

For science majors and other interested students whose mathematics background includes algebra and trigonometry. This sequence includes survey of physics with topics chosen from mechanics, energy, thermodynamics, electricity and magnetism, optics, wave motion, and modern physics. Algebra and trigonometry required which do not need not be on the college level. Sequence begins each fall. Fulfills the natural science/mathematics requirement (1998 & 2019). Numeric/symbolic engagement requirement (2019). Fall.

PHYS 212. College Physics II. 4.

For science majors and other interested students whose mathematics background includes algebra and trigonometry. This sequence includes survey of physics with topics chosen from mechanics, energy, thermodynamics, electricity and magnetism, optics, wave motion, and modern physics. Sequence begins each fall.

Prerequisite: **PHYS 211** or instructor permission. Fulfills the natural science/mathematics requirement (1998 2019). Numeric/symbolic engagement requirement (2019). Spring.

PHYS 220. Introduction to Machine Learning. 4.

More and more interactions in our lives are being shaped by so-called artificial intelligences. These computer programs have grown in sophistication to the point where they can classify and respond to complicated enough inputs such that their reactions can seem to indicate intelligent decision-making. In almost every field of inquiry or work, we are being surrounded by clouds of enormous data sets, and it is getting impossible for any human to be able to parse through the data and identify either patterns or interesting exceptions. This three-week, project-based course aims to give non-science students a sense of what machine learners do, what kinds of machine learning tools are out there, and how to choose what type of tool to use to handle a range of problems.

PHYS 223. Classical and Modern Physics III. 4.

The final semester of the introductory physics sequence. Topics are chosen from modern and classical physics to complement those discussed in **PHYS 121**.

Prerequisite: **PHYS 122** or instructor permission.
Corequisite: **PHYS 480** strongly recommended. Fall.

PHYS 224. Classical & Modern Physics IV. 4.

The thermal properties of matter are studied from the applied approach of thermodynamics and the theoretical analysis of statistical mechanics. Topics include the laws of thermodynamics, equations of state, first order

phase transitions, partition functions, entropy and the quantum statistics of particles.

Prerequisite: **MATH 224, PHYS 223** or instructor permission.
Corequisite: **PHYS 480** strongly recommended. Spring.

PHYS 231. Experimental Physics I. 2.

Intermediate-level laboratory course to develop experimental design and measurement techniques, data reduction and analysis methods, and oral and written presentation skills. Experiments vary as equipment and technologies evolve. Prerequisite **PHYS 122** or instructor permission. Fall.

PHYS 232. Experimental Physics II. 2-4.

Intermediate-level laboratory course to develop experimental design and measurement techniques, data reduction and analysis methods, and oral and written presentation skills. Experiments vary as equipment and technologies evolve.

Prerequisite: **PHYS 121** or instructor permission. Spring.

PHYS 241. Scientific Computing (MATH 241). 4.

Scientific Computing is a course designed jointly by Math & Physics faculty to serve students of the sciences. We will use spreadsheets (Excel, Numbers, Sheets) to analyze data using formula computation and representational graphics. We will use the programming language Python and a variety of the standard libraries (especially numpy, matplotlib, vpython) to do similar analyses and complex simulations. We will emphasize the documentation and presentation of results to peers. The course is to be taught in the three week.

PHYS 250. Special Topics. 8.

PHYS 260. Independent Study. 1-8.

May also be offered at 360 and 460 levels.

PHYS 290. Internship. 1-8.

May also be offered at the 390 level.

PHYS 320. Mathematical Physics (MATH 320). 4.

Introduces students to mathematical techniques of particular importance to scientists and engineers. Topics include: complex numbers, Fourier series and the solution of differential equations (with special emphasis on harmonic oscillators). Both analytical and numerical methods are studied.

Prerequisite: **MATH 225** or instructor permission; **PHYS 122** strongly recommended. Corequisite: **PHYS 480** strongly recommended. Spring. Fulfills quantitative literacy requirement.

PHYS 350. Special Topics. 1-8.

PHYS 360. Independent Study. 1-8.

PHYS 370. Physics Research. 1-4.

The presentation of independent research projects completed during summers (e.g. the National Science Foundation-sponsored Research Experience for Undergraduates) or industrial internships. Students who are unable to undertake research at other institutions may design and complete their research on campus under the guidance of Guilford faculty.