

PHYSICS (PHYS)

PHYS-100 Foundations of Physics

Fall. Credits: 4

This is an algebra-based first-semester physics course geared towards students intending on careers in health professions, though it is open to all. Topics are drawn from the MCAT syllabus, and include optics, motion, forces, energy, and fluids.

Applies to requirement(s): Math Sciences

S. Bassler

Coreq: PHYS-100L.

PHYS-104 Renewable Energy

Not Scheduled for This Year. Credits: 4

We will examine the feasibility of converting the entire energy infrastructure of the US from one that is dependent on fossil fuels to one that utilizes mostly renewable sources of energy. We will examine the potential scale of energy production and the associated costs, natural resource requirements and land usage needs for both renewables, such as solar, wind and biofuel, and non-renewables, such as coal, natural gas, petroleum and nuclear. By applying extensive use of basic algebra and an elementary understanding of the physical processes underpinning each energy technology, we will arrive at a number of urgent conclusions about the challenges facing our energy infrastructure.

Crosslisted as: ENVST-104

Applies to requirement(s): Math Sciences

A. Arango

PHYS-109 Science on Screen

Spring. Credits: 4

For our entire lives, movies have captured our attention, whether at the theater or on our phones. Filmmaking is a highly technical art, and scientific principles determine what is possible. Filmmakers develop creative solutions within these principles to trick the viewer into believing what they see. Advances in science also advance filmmaking, influencing photography, production design, and so on. Additionally, scientists use these techniques to carry out their research. This course will explore the many intersections of science and filmmaking. Students will use basic mathematics (algebra, geometry) to complete brief weekly homework assignments, and will prepare a final video project.

Applies to requirement(s): Math Sciences

K. Nordstrom

PHYS-110 Force, Motion, and Energy

Fall and Spring. Credits: 4

This a calculus-based physics course designed for students intending to major in physics, astronomy, or another physical science, though all are welcome. It also fulfills pre-health requirements. Students will learn how to apply fundamental physics concepts such as force, energy, momentum to a variety of mechanical situations, including projectile motion, human movement, fluid motion, and planetary motion.

Applies to requirement(s): Math Sciences

S. Marshall, K. Nordstrom

Prereq: MATH-101 or equivalent. Coreq: PHYS-110L.

PHYS-132 Engineering for Everyone

Not Scheduled for This Year. Credits: 4

Engineers change the world we live in every day by developing technologies that influence nearly every aspect of our lives. In this course, we will study how engineered things shape the world we live in. Students will engage in a team-based, hands-on engineering design project, from brainstorming solutions to a contemporary problem, to building, testing, and iterating design solutions. In the process, students will learn basic programming and fabrication skills. We will reflect together on the ethics of engineering design, and leave with a more nuanced understanding of the ways technology and society interact. Who decides what technologies matter? What is a "good" technological solution, and for whom is it "good"?

Crosslisted as: COMSC-132

Applies to requirement(s): Math Sciences

M. Su

Advisory: This course has no prerequisites and is recommended for all students interested in engineering and technology.

Notes: Students interested in continuing with the Engineering Nexus are strongly recommended to take the course.

PHYS-150 Phenomena of Physics

Spring. Credits: 4

This is an algebra-based second-semester physics course geared towards students intending on careers in health professions, though it is open to all. Topics are drawn from the MCAT syllabus, and include electricity, magnetism, waves (sound and light), and nuclear physics. This is the spring semester continuation of the Physics 100 course in the fall, but students who have taken Physics 110 (or any equivalent) are also eligible to join.

Applies to requirement(s): Math Sciences

S. Bassler

Prereq: PHYS-100 or PHYS-110. Coreq: PHYS-150L.

PHYS-201 Electromagnetism

Fall and Spring. Credits: 4

This a calculus-based physics course designed for students intending to major in physics, astronomy, or another physical science, though all are welcome. It also fulfills pre-health requirements. This is the second semester of the physics introductory sequence, with Physics 110 as a prerequisite. Students will use concepts learned in 110 such as force and energy, and learn new concepts such as charge, fields, and potentials. Students will apply these concepts to situations involving electromagnetic phenomena, including electric circuits, magnetism, induction, and radiation.

Applies to requirement(s): Math Sciences

S. Balasubramanian

Prereq: PHYS-110 and MATH-102. Coreq: PHYS-201L.

PHYS-205 Introduction to Mathematical Methods for Scientists

Fall. Credits: 4

Topics include Taylor series, complex numbers, partial differentiation, multiple integration, selected topics in linear algebra and vector calculus, ordinary differential equations, and Fourier series. The course includes a weekly computational lab using Python, in addition to a traditional emphasis on analytic solutions.

Applies to requirement(s): Math Sciences

A. Arango

Prereq: PHYS-201 (or concurrent enrollment with permission).

PHYS-210 Waves and Optics*Fall. Credits: 4*

A comprehensive treatment of wave phenomena, particularly light, leading to an introductory study of quantum mechanics. Topics include wave propagation, polarization, interference and interferometry, diffraction, and special relativity.

Applies to requirement(s): Math Sciences

A. Arango

Prereq: Electromagnetism (PHYS-201) and Intro to Math Methods (PHYS-205) or concurrent enrollment in PHYS-205 with permission.

PHYS-220 Intermediate Lab in Physics*Spring. Credits: 4*

This lab-based course is an introduction to modern, investigative, experimental physics. The course is intended as a bridge between the structured introductory lab experience and independent research. In addition to exploring key physical phenomena crucial to modern understandings and gaining familiarity with modern experimental apparatus and techniques, students complete exploratory projects of various sorts and then extended, multi-week experimental projects, participating in experimental design, construction, debugging and implementation. Students will present and interpret their experimental results and develop follow-up questions which they will answer experimentally. This course will introduce students to scientific communications skills and is speaking- and writing-intensive.

Applies to requirement(s): Meets No Distribution Requirement

Other Attribute(s): Speaking-Intensive, Writing-Intensive

K. Nordstrom

Prereq: PHYS-201.

PHYS-231 Techniques of Experimental Physics*Fall and Spring. Credits: 1*

Provides training in the techniques employed in the construction of scientific equipment.

Applies to requirement(s): Meets No Distribution Requirement

R. Higley

Restrictions: Course limited to sophomores, juniors and seniors

Advisory: Second-semester first-year students by permission.

Notes: 1 meeting (2 hours) for 3 weeks. Credit/no credit grading.

PHYS-250 Quantum Mechanical Phenomena*Spring. Credits: 4*

This course provides an introduction to quantum phenomena and quantum mechanics. Topics include relativistic dynamics, blackbody radiation, and wave properties of matter. The Uncertainty Principle, Schrodinger's Equation, simple harmonic oscillators and the hydrogen atom are studied in depth, with emphasis on angular momentum, electron spin and the Pauli Exclusion Principle.

Applies to requirement(s): Math Sciences

K. Aidala

Prereq: PHYS-205 and PHYS-210.

PHYS-290 Advanced Laboratory Practicum*Spring. Credits: 1 - 8*

This course is a hands-on practicum, intended to introduce students to the practice of modern physics research. Depending on student interest, topics include external research seminars by practitioners in the field, training in oral and written scientific communication, presentation and interpretation of research results, scientific modeling, and hands-on experimental skills. Research projects are an integral part of this course; credit will be apportioned in relation to the intensity of the project.

Applies to requirement(s): Meets No Distribution Requirement

Other Attribute(s): Speaking-Intensive, Writing-Intensive

A. Arango

Prereq: 8 credits in Physics.

Advisory: Student must be concurrently enrolled in PHYS-295 or PHYS-395 to register in this course.

Notes: Repeatable for credit.

PHYS-295 Independent Study*Fall and Spring. Credits: 1 - 4*

The department

Instructor permission required.

PHYS-295P Independent Study with Practicum*Fall and Spring. Credits: 1 - 4*

The department

Instructor permission required.

PHYS-308 Electronics*Not Scheduled for This Year. Credits: 4*

This course is a study of electrical circuits and components with emphasis on the underlying physical principles; solid-state active devices with applications to simple systems such as linear amplifiers; feedback-controlled instrumentation; and analog and digital computing devices.

Applies to requirement(s): Math Sciences

K. Aidala

Prereq: PHYS-150 or PHYS-201.

Notes: Meetings combine lecture and hands-on lab

PHYS-311 Computational Physics Laboratory*Fall. Credits: 4*

Computers bring a new dimension to the mathematical theories of physics, including new methods of visualization and new ways to explore theory through computer experiments. This laboratory course will combine mathematics, physics, and computation in projects that make essential use of all three together. Topics from various subfields of physics will be packaged into self-contained modules for exploration through the use of high-level computational tools.

Applies to requirement(s): Math Sciences

S. Marshall

Prereq: PHYS-201 and 205.

Advisory: Students who have completed PHYS 110, 201 (or equivalents), and have taken separate math courses including: i) multivariable calculus, ii) linear algebra, and iii) differential equations may also be qualified. Contact the instructor to discuss.

PHYS-315 Analytical Mechanics*Spring. Credits: 4*

Newton's great innovation was the description of the world by differential equations, the beginning of physics as we know it. This course studies Newtonian mechanics for a point particle in 1, 2, and 3 dimensions, systems of particles, rigid bodies, and the Lagrangian and Hamiltonian formulations.

Applies to requirement(s): Math Sciences

S. Marshall

Prereq: PHYS-205.

PHYS-325 Electromagnetic Theory*Spring. Credits: 4*

This course presents the development of mathematical descriptions of electric and magnetic fields; study of interactions of fields with matter in static and dynamic situations; mathematical description of waves; and development of Maxwell's equations with a few applications to the reflection and refraction of light and microwave cavities.

*Applies to requirement(s): Math Sciences**A. Arango**Prereq: PHYS-205 and PHYS-210.***PHYS-326 Statistical Mechanics and Thermodynamics***Fall. Credits: 4*

This course presents thermodynamic and statistical descriptions of many-particle systems. Topics include classical and quantum ideal gases with applications to paramagnetism; black-body radiation; Bose-Einstein condensation; and the Einstein and Debye solid; the specific heat of solids.

*Applies to requirement(s): Math Sciences**K. Nordstrom**Prereq: Quantum Mechanical Phenomena (PHYS-250) and Intro to Math Methods (PHYS-205) or permission from department.***PHYS-328 From Lilliput to Brobdingnag: Bridging the Scales Between Science and Engineering***Spring. Credits: 4*

The performance of many engineered devices is dependent on macroscopic factors (pressure, temperature, flow, conductivity). As a result, engineers often model devices macroscopically considering atomistic level details only through fixed parameters. These parameters do not always capture the full atomistic level picture. More accurate multi-scale approaches for modeling macroscopic properties use basic atomistic level chemistry at key points in larger scale simulations. This course is an introduction to such approaches focusing on fuel cells as a concrete example. Through project/case studies, basic scientific principles will be developed along side of basic engineering principles.

*Crosslisted as: CHEM-328**Applies to requirement(s): Math Sciences**Other Attribute(s): Writing-Intensive**M. Gomez**Prereq: MATH-102 and any chemistry or physics course.***PHYS-336 Quantum Mechanics***Fall. Credits: 4*

This course is an introduction to formal quantum theory: the wave function and its interpretation, observables and linear operators, matrix mechanics and the uncertainty principle; solutions of one-dimensional problems; solutions of three-dimensional problems and angular momentum; and perturbative methods.

*Applies to requirement(s): Math Sciences**S. Bassler**Prereq: PHYS-250.***PHYS-390 Advanced Laboratory Practicum***Spring. Credits: 1 - 8*

This course is a hands-on practicum, intended to introduce students to the practice of modern physics research. Depending on student interest, topics include external research seminars by practitioners in the field, training in oral and written scientific communication, presentation and interpretation of research results, scientific modeling, and hands-on experimental skills. Research projects are an integral part of this course; credit will be apportioned in relation to the intensity of the project.

*Applies to requirement(s): Meets No Distribution Requirement**Other Attribute(s): Speaking-Intensive, Writing-Intensive**A. Arango**Instructor permission required.**Prereq: 16 credits in Physics.**Advisory: Student must be concurrently enrolled in PHYS-295 or PHYS-395 to register in this course.**Notes: Repeatable for credit.***PHYS-395 Independent Study***Fall and Spring. Credits: 1 - 8**The department**Instructor permission required.***PHYS-395P Independent Study with Practicum***Fall and Spring. Credits: 1 - 8**The department**Instructor permission required.*