

Physics

Room 201B Optics Building (OPB)

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The Physics department offers the following undergraduate degrees:

- Physics, BS (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/physics-bs>)
- Physics, BS - Applied and Theoretical Physics Concentration (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/physics-bs-applied-theoretical-physics-concentration>)
- Physics, BS - Optics Concentration (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/physics-bs-optics-concentration>)
- Physics, BS - Astronomy and Astrophysics Concentration (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/physics-bs-astronomy-astrophysics-concentration>)
- Physics, BS - Engineering Physics Concentration (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/physics-bs-engineering-physics-concentration>)
- Physics, BS - Secondary Education Concentration (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/physics-bs-secondary-education-certification>)

Program Objectives

Our primary objective is to educate and train the next generation of physicists, perform cutting-edge and internationally-recognized research, and support the education of students in allied areas such as engineering, chemistry, atmospheric science, and the biological sciences. Our second objective is to prepare physics majors for employment in industrial research or for further graduate studies in physics or related fields, including astrophysics, optics, biophysics, engineering, or medicine.

Learning Outcomes

Physics students and majors will:

- Demonstrate an understanding of the basic principles and modern tools (viz., numerical methods) of physics
- Engage in service-based learning and public outreach related to physics and science
- Have a rigorous research experience prior to graduation

Majors in Physics

- Physics, BS (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/physics-bs>)
- Physics, BS - Applied and Theoretical Physics Concentration (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/physics-bs-applied-theoretical-physics-concentration>)
- Physics, BS - Optics Concentration (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/physics-bs-optics-concentration>)
- Physics, BS - Astronomy and Astrophysics Concentration (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/physics-bs-astronomy-astrophysics-concentration>)
- Physics, BS - Engineering Physics Concentration (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/physics-bs-engineering-physics-concentration>)
- Physics, BS - Secondary Education Concentration (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/physics-bs-secondary-education-certification>)

Students majoring in other academic areas may minor in physics. The Department of Physics offers three minors: Physics, Optics, and Astronomy & Astrophysics. An overall average of C or better is required for the courses in the minor.

Minors in Physics

- Physics (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/physics-minor>)
- Optics (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/optics-minor>)
- Astronomy and Astrophysics (<http://catalog.uah.edu/undergrad/colleges-departments/science/physics/astronomy-astrophysics-minor>)

UAH's Joint Undergraduate Master's Program (JUMP) allows undergraduate students to study at the graduate level. By taking graduate courses in your senior year you could reduce the time taken to get a graduate (MS) degree. Please visit JUMP (<http://catalog.uah.edu/undergrad/academic-information/jump>) page for general information.

Requirements For Admissions

1. Cumulative overall 3.5 GPA
2. Major GPA of 3.5
3. Student shall complete PH 110, PH 111, PH 112, PH 113, PH 114, PH 115, PH 116, PH 251, PH 301, PH 305, PH 351, PH 431, PH 432, MA 171, MA 172, MA 201, MA 238, MA 244 by Junior year

Additional Information

- Maximum of 12 credit hours count toward both degrees

Designated Faculty Contact/Advisor

Dr. James Miller james.miller@uah.edu 256.824.6156
PH 100 - CONCEPTUAL PHYSICS
Semester Hours: 4

Classical and modern physics survey course. Approach physical laws conceptually and intuitively, with minimal mathematics. Motion, gravitation, energy, electricity and magnetism, quantum mechanics, physics of everyday phenomena, philosophical and historical implications. Offered Spring.

PH 100L - CONCEPTUAL PHYSICS LAB
Semester Hours: 0

PH 101 - GENERAL PHYSICS I
Semester Hours: 4

Introductory non-calculus based course. The basic laws of physics and their application to specific problems: Newtonian mechanics, energy, conservation laws, and thermodynamics. Laboratory included. PH 101 and 102 satisfy the laboratory science requirement. Offered Fall.

PH 101L - GENERAL PHYSICS I LAB
Semester Hours: 0

PH 101R - RECITATION
Semester Hours: 0

PH 102 - GENERAL PHYSICS II
Semester Hours: 4

Continuation of PH 101. Electrostatics, currents, magnetic phenomena, relativity, waves, quantum nature of matter. Laboratory included. Offered Spring. Prerequisite: PH 101.

PH 102L - GENERAL PHYSICS LAB II
Semester Hours: 0

PH 102R - RECITATION
Semester Hours: 0

PH 110 - FRONTIERS IN SCIENCE
Semester Hours: 3

Introduces frontiers and problems of modern physical science. Physicist present the role of physics in diverse careers and physics fields. Introduction to physics applications and future employment opportunities motivates students to master skills required in undergraduate studies. Offered Fall. Prerequisite with concurrency: MA 171.

PH 111 - GEN PHYSICS W/CALCULUS I
Semester Hours: 3

For science and engineering students. Basic laws of physics and their application to specific problems: vectors, Newtonian mechanics, energy, conservation laws, simple harmonic motion, statics, fluids. Offered all terms. Prerequisite: MA 171 Corequisite: PH 114.

PH 111R - RECITATION
Semester Hours: 0

PH 112 - GEN PHYSICS W/CALC II
Semester Hours: 3-4

Continuation of PH 111. Heat and thermodynamics, basic electricity, electric and magnetic fields. Offered all terms. Prerequisite: MA 172, PH 111, PH 114. Corequisite: PH 115.

PH 112R - RECITATION

Semester Hours: 0

PH 113 - GEN PHYSICS W/CALC III

Semester Hours: 3

Continuation of PH 111 and 112. Wave motion, optics, relativity, quantum effects, atomic and nuclear structure, and elementary particles. Offered all terms. Prerequisite: MA 201 (or higher), PH 112, and PH 115. Corequisite: PH 116.

PH 113R - RECITATION

Semester Hours: 0

PH 114 - GENERAL PHYSICS LAB I

Semester Hour: 1

Laboratory instruction in support of material covered in PH 111. Offered all terms. Corequisite: PH 111.

PH 115 - GENERAL PHYSICS LAB II

Semester Hour: 1

Laboratory instruction in support of material covered in PH 112. Offered all terms. Corequisite: PH 112.

PH 116 - GENERAL PHYSICS LAB III

Semester Hour: 1

Laboratory instruction in support of material covered in PH 113. Offered all terms. Corequisite: PH 113.

PH 251 - SPECIAL RELATIVITY

Semester Hour: 1

Einstein's theory of special relativity. Invariance, geometry of Minkowski spacetime, non-Euclidean geometry; Principle of Relativity; clock synchronization; Lorentz transformations; counter-intuitive effects measured in relative motion; casualty and the speed of light; relativistic dynamics. Prerequisite: PH 112 and MA 172. Prerequisite with concurrency: PH 113.

PH 301 - INTERMEDIATE MECHANICS

Semester Hours: 3

Reviews Newtonian mechanics, natural and driven oscillations, variational calculus and Lagrange's equations, application to central force motion, rigid body rotation and coupled oscillators. Offered Spring. Prerequisite: PH 111 and either PH 305 or MA 238.

PH 305 - MATH METHODS IN PHYSICS

Semester Hours: 3

Applied analytical techniques to solve problems in physics. Complex analysis, Fourier series, linear algebra, differential equations and vector calculus. Applications to mechanics, electricity and magnetism, optics, and thermodynamics. Offered Spring. Prerequisite: PH 112.

PH 306 - APPLIED PHYSICS

Semester Hours: 3

Computational and numerical techniques for problem solving. Applications to classical mechanics, electrodynamics, quantum mechanics, optics, astrophysics. Offered Fall. Prerequisite: PH 305, (CS 102 or CPE 112 or CS 121) and (MA 238 or MA 244 or MA 324).

PH 310 - INTERMEDIATE LAB I

Semester Hours: 2

Experiments in classical physics. Introduction to statistical methods. Offered Fall. Prerequisites: PH 113 or 116.

PH 311 - INTERMEDIATE LAB II

Semester Hours: 2

Experiments in modern physics. Offered Spring. Prerequisite: PH 251 and PH 310.

PH 337 - ELECTRONICS

Semester Hours: 4

Introductory course for all science students. Basic AC and DC circuits, operational amplifier circuits, transistor circuits, power supplies, digital logic and their use in laboratory instruments. Laboratory included. Offered Fall, odd years. Prerequisite: PH 112.

PH 351 - INTRODUCTION TO MODERN PHYSICS

Semester Hours: 3

Kinetic theory, Blackbody radiation, Quantum physics: wave packets, the uncertainty principle, Schrodinger's equation and solutions for simple systems, application to atomic, nuclear, and solid-state physics. Offered Fall. Prerequisite: PH 113, and either MA 238 or 244. Prerequisite with concurrency: PH 251.

PH 416 - SENIOR LABORATORY

Semester Hours: 2

Advanced experimental techniques in various sub-fields of physics. Offered Fall, Spring. Prerequisite: PH 311.

PH 420 - SENIOR THESIS

Semester Hours: 3

Research performed under direction of a faculty member. Final research report required. Offered all terms.

PH 421 - THERMAL & STATISTICAL PHYSICS

Semester Hours: 3

States of model system, entropy and temperature, Boltzmann distribution, thermal radiation and Planck distribution, chemical potential and Gibbs distribution, ideal gas, Fermi and Bose gases, heat and work, semiconductor statistics, kinetic theory. Offered Spring, even years. Prerequisite: PH 351. Prerequisite with concurrency: PH 301 and PH 306.

PH 431 - INTERM ELECTRIC & MAGNETISM I

Semester Hours: 3

Electostatics: electric fields, electric potential, Poisson's equation. Electric fields in matter. Magnetostatics: currents, magnetic fields. Magnetic fields in matter. Prerequisite: PH 305 and MA 201. Prerequisite with concurrency: MA 238.

PH 432 - INTERM ELECTRIC & MAGNETISM II

Semester Hours: 3

Continuation of PH 431. Maxwell's equations for time-varying fields. Electromagnetic waves. AC circuits. Radiation. Relativistic electrodynamics. Offered Spring, odd years. Prerequisite: PH 431.

PH 451 - INTRO QUANTUM MECHANICS I

Semester Hours: 3

Waves and particles: deBroglie waves, wave-packets, and the uncertainty principle. Postulates of quantum mechanics. Schrodinger's equation: simple systems in one, two and three dimensions, the hydrogen atom. Angular momentum and spin. Offered Fall. Prerequisite: PH 305, PH 351, and (MA 244 or MA 238) and PH 306 with concurrency.

PH 452 - INTRO QUANTUM MECHANICS II

Semester Hours: 3

Multiparticle systems. Atomic structure. Approximation methods. Scattering. Applications to nuclear, atomic, and molecular systems. Offered Spring. Prerequisite: PH 451.

PH 453 - INTRO TO PARTICLE PHYSICS

Semester Hours: 3

Surveys elementary particle physics, Standard Model of quarks, leptons, and gauge bosons. Lorentz transformations, four-vectors and relativistic kinematics, angular momentum and spin. Lifetimes, cross-sections, and Feynman rules. Quantum electro and chromo-dynamics, Dirac equation, renormalization. Prerequisite with concurrency: PH 451.

PH 474 - INTRO TO GENERAL RELATIVITY

Semester Hours: 3

Introduces general relativity and gravitational physics as inferred from the behavior of particles and light rays for a selection of spacetimes. Major properties of black holes, wormholes, gravitational waves. Physics First approach, and introduces new math as required for discussion of physics. Prerequisite: PH 251 and PH 301.

PH 480 - SELECTED TOPICS

Semester Hours: 1-3

Offered upon demand. Topics include physics, optics, astrophysics, and space physics. Offered all terms. Prerequisite: PH 113 and MA 201.

PH 489 - SELECTED TOPICS

Semester Hours: 1-3

Offered upon demand. Topics include physics, optics, astrophysics, astronomy, computational physics, and space physics. Offered all terms.

Prerequisites: PH 113 or 116 and MA 201.

PH 499 - PHYSICS PRACTICUM

Semester Hours: 3

"Capstone" course designed to provide real-world research experience for graduation seniors. Students work individually with faculty members on projects. Requires oral presentation and final research report. Offered all terms. Required courses on the POS must be taken prior to, or concurrently with, this course.