Physics and Astronomy

Room 201C Optics Building
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Email: physics@uah.edu

Chair: Dr. James Miller, Professor (https://www.uah.edu/science/departments/physics/faculty-staff/dr-james-a-miller/)

The Physics and Astronomy 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

AST 100 - SURVEY OF ASTRONOMY
Semester Hours: 4

One semester survey of astronomy from visible phenomena in the sky to the latest astronomical discoveries. Topics include properties of solar system bodies, origin of the solar system, life cycles of stars and galaxies, exoplanets, cosmology, and life in the universe. Includes laboratory. May not be taken in combination with AST 106 or AST 107.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester Hours</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST 100L</td>
<td>SURVEY OF ASTRONOMY LAB</td>
<td>0</td>
<td>Laboratory instruction in support of material covered in AST 100.</td>
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<tr>
<td>AST 106</td>
<td>EXPLORING THE COSMOS I</td>
<td>4</td>
<td>Introduces astronomy emphasizing quantitative aspects of physical phenomena in the universe. Topics include motions of celestial bodies, development of astronomy, gravity and motion, light and telescopes, properties of gases and radiation, earth and moon, eclipses, and survey of the solar system. Laboratory included.</td>
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<tr>
<td>AST 106L</td>
<td>ASTRONOMY LABORATORY</td>
<td>0</td>
<td>Laboratory instruction in support of material covered in AST 106.</td>
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<tr>
<td>AST 107</td>
<td>EXPLORING THE COSMOS II</td>
<td>4</td>
<td>Continuation of AST 106. The sun, stars and stellar evolution, white dwarfs, neutron stars, black holes, binary stars, the Milky Way galaxy, galaxies, quasars and other active galaxies, cosmology, life in the universe. Laboratory included. Offered Spring. Prerequisite: AST 106.</td>
</tr>
<tr>
<td>AST 107L</td>
<td>GEN ASTRONOMY II LAB</td>
<td>0</td>
<td>Laboratory instruction in support of material covered in AST 107.</td>
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<tr>
<td>AST 210</td>
<td>INTRO TO ASTROBIOLOGY</td>
<td>3</td>
<td>Studies the origin and search for life in the universe, including topics in astronomy, physics, biology, chemistry, and atmospheric science. Introduces research in astrobiology; known requirements for life, the origin and evolution of life of Earth, and the search for extraterrestrial life. Prerequisites: MA 171 and either PH 111, CH 121, or BYS 119.</td>
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<tr>
<td>AST 371</td>
<td>INTRO TO ASTROPHYSICS</td>
<td>3</td>
<td>Gravitation: two-body problem, binary stars. Radiation theory. Spectral classification, Hertzsprung-Russell diagram, and introduction to stellar structure and evolution. Large-scale structure, and the evolution of the universe. Offered Spring. Prerequisites: PH 111 or PH 114, and MA 201.</td>
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<tr>
<td>AST 471</td>
<td>ASTROPHYSICS</td>
<td>3</td>
<td>Structure and physical processes of stars from the interior to the atmosphere: energy production and transfer, atmospheric properties, and observed spectral features. Models for stellar structure. Star formation and evolution, including the effects of a companion. Offered Fall. Prerequisites: AST 371 and PH 351.</td>
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<tr>
<td>PH 100</td>
<td>CONCEPTUAL PHYSICS</td>
<td>4</td>
<td>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.</td>
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<tr>
<td>PH 100L</td>
<td>CONCEPTUAL PHYSICS LAB</td>
<td>0</td>
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<tr>
<td>PH 101</td>
<td>GENERAL PHYSICS I</td>
<td>4</td>
<td>Introductory non-calculus based course using algebra and trigonometry. 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 Corequisite: PH 101L.</td>
</tr>
<tr>
<td>PH 101L</td>
<td>GENERAL PHYSICS I LAB</td>
<td>0</td>
<td>Laboratory for PH 101 Corequisite: PH 101.</td>
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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. Corequisite: PH 102L.

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

Laboratory for PH 102 Corequisite: PH 102.

PH 110 - FRONTIERS IN SCIENCE
Semester Hours: 3

Introduces frontiers and problems of modern physical science. Physicists 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. Freshmen physics majors (<30 credit hours), physics minors, and physics major transfers. All others by permission of chair.

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


PH 111R - RECITATION
Semester Hours: 0

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

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, and 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, Schroedinger'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.

PH 431 - INTERM ELECTRIC & MAGNETISM I
Semester Hours: 3

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, and 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).
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


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 graduating 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.