

# Physics

*Chair: [Andra Petrean](#)*

*Faculty: David Baker, David Whelan*

*Visiting Faculty: Homeira Faramarzi*

*Emeriti: Donald Salisbury*

The mission of the Physics Department at Austin College is to provide a positive, active learning environment for undergraduate students to explore physics and engineering. The department teaches a diverse group of students, including non-science majors, physics and engineering physics majors, physics minors, other science majors, and pre-professional students. Through course offerings, laboratory activities, and undergraduate research, the physics curriculum presents multiple opportunities for students to develop as scientists and engineers.

## Degrees Offered in Physics

Major in Physics

Major in Engineering Physics

Minor in Physics

## Considerations When Planning for the Major or Minor:

- Courses used as prerequisites for physics courses must be passed with grades of at least a C.
- Students planning to pursue the pre-engineering program should enroll in Physics 111 and Mathematics 151 in the fall term of their first year.
- Credit may not be received for both Physics 105 and 111, or both Physics 106 and 112.

A **major in physics** consists of:

## Required Core Courses (7 course credits)

- \_\_\_\_\_ PHY 111 Physics for Scientists and Engineers I
- \_\_\_\_\_ PHY 112 Physics for Scientists and Engineers II
- \_\_\_\_\_ PHY 211 Vibration, Waves, and Optics
- \_\_\_\_\_ PHY 212 Introduction to Modern Physics
- \_\_\_\_\_ PHY 261 Research Experience (0.5 credit course)
- \_\_\_\_\_ PHY 311 Classical Mechanics
- \_\_\_\_\_ PHY 312 Electromagnetism
- \_\_\_\_\_ PHY 361 Advanced Research Experience (0.5 credit course)

## Elective courses 200 level or above (2 course credits)

- \_\_\_\_\_ PHY 230 Electronics
- \_\_\_\_\_ PHY 250 Intermediate Topics in Physics
- \_\_\_\_\_ PHY 260 Intermediate Directed Study
- \_\_\_\_\_ PHY 281 Statics and Engineering Design
- \_\_\_\_\_ PHY 340 Atmospheric and Environmental Physics
- \_\_\_\_\_ PHY 350 Advanced Topics in Physics
- \_\_\_\_\_ PHY 351 Advanced Instrumentation and Robotics
- \_\_\_\_\_ PHY 431 Quantum Mechanics
- \_\_\_\_\_ PHY 451 Observational Astronomy
- \_\_\_\_\_ PHY 460 Advanced Directed Study
- \_\_\_\_\_ PHY 464 Teaching/Learning Participation

- \_\_\_\_\_ PHY 490 Independent Study in Physics
- \_\_\_\_\_ PHY 492 Independent Study Off-Campus

**Elective courses 300 level or higher (1 course credit)**

- \_\_\_\_\_ PHY 340 Atmospheric and Environmental Physics
- \_\_\_\_\_ PHY 350 Advanced Topics in Physics
- \_\_\_\_\_ PHY 351 Advanced Instrumentation and Robotics
- \_\_\_\_\_ PHY 431 Quantum Mechanics
- \_\_\_\_\_ PHY 451 Observational Astronomy
- \_\_\_\_\_ PHY 460 Advanced Directed Study
- \_\_\_\_\_ PHY 464 Teaching/Learning Participation
- \_\_\_\_\_ PHY 490 Independent Study in Physics
- \_\_\_\_\_ PHY 492 Independent Study Off-Campus

**Supporting Courses**

- \_\_\_\_\_ MATH 151 Calculus I
- \_\_\_\_\_ MATH 152 Calculus II
- \_\_\_\_\_ MATH 252 Calculus III
- \_\_\_\_\_ MATH 301 Ordinary Differential Equations

**Total Credits Requirement = 10 course credits**

**A major in engineering physics consists of:**

**Required Core Courses (7 course credits)**

- \_\_\_\_\_ PHY 111 Physics for Scientists and Engineers I
- \_\_\_\_\_ PHY 112 Physics for Scientists and Engineers II
- \_\_\_\_\_ PHY 211 Vibration, Waves, and Optics
- \_\_\_\_\_ PHY 212 Introduction to Modern Physics
- \_\_\_\_\_ PHY 261 Research Experience (0.5 credit course)
- \_\_\_\_\_ PHY 281 Statics and Engineering Design
- \_\_\_\_\_ PHY 311 Classical Mechanics
- \_\_\_\_\_ PHY 361 Advanced Research Experience (0.5 credit course)

**Engineering Physics Elective courses 200 level or above (1 course credit)**

- \_\_\_\_\_ PHY 230 Electronics
- \_\_\_\_\_ PHY 250 Intermediate Topics in Physics
- \_\_\_\_\_ PHY 260 Intermediate Directed Study
- \_\_\_\_\_ PHY 312 Electromagnetism
- \_\_\_\_\_ PHY 340 Atmospheric and Environmental Physics
- \_\_\_\_\_ PHY 350 Advanced Topics in Physics
- \_\_\_\_\_ PHY 351 Advanced Instrumentation and Robotics
- \_\_\_\_\_ PHY 431 Quantum Mechanics
- \_\_\_\_\_ PHY 451 Observational Astronomy
- \_\_\_\_\_ PHY 460 Advanced Directed Study
- \_\_\_\_\_ PHY 464 Teaching/Learning Participation
- \_\_\_\_\_ PHY 490 Independent Study in Physics
- \_\_\_\_\_ PHY 492 Independent Study Off-Campus
- \_\_\_\_\_ CHEM 342 Thermodynamics and Kinetics

### **Elective courses 300 level or higher (2 course credits)**

- \_\_\_\_\_ PHY 312 Electromagnetism
- \_\_\_\_\_ PHY 340 Atmospheric and Environmental Physics
- \_\_\_\_\_ PHY 350 Advanced Topics in Physics
- \_\_\_\_\_ PHY 351 Advanced Instrumentation and Robotics
- \_\_\_\_\_ PHY 431 Quantum Mechanics
- \_\_\_\_\_ PHY 451 Observational Astronomy
- \_\_\_\_\_ PHY 460 Advanced Directed Study
- \_\_\_\_\_ PHY 464 Teaching/Learning Participation
- \_\_\_\_\_ PHY 490 Independent Study in Physics
- \_\_\_\_\_ PHY 492 Independent Study Off-Campus
- \_\_\_\_\_ CHEM 342 Thermodynamics and Kinetics

### **Supporting Courses**

- \_\_\_\_\_ MATH 151 Calculus I
- \_\_\_\_\_ MATH 152 Calculus II
- \_\_\_\_\_ MATH 252 Calculus III
- \_\_\_\_\_ MATH 301 Ordinary Differential Equations
- \_\_\_\_\_ CS 110 Introduction to Computer Science or CS 111 Introduction to Scripting and Data Analytics with Python
- \_\_\_\_\_ CHEM 111 General Chemistry I

**Total Credits Requirement = 10 course credits**

A **minor in physics** consists of:

### **Required Core Courses (5.5 course credits)**

- \_\_\_\_\_ PHY 111 Physics for Scientists and Engineers I
- \_\_\_\_\_ PHY 112 Physics for Scientists and Engineers II
- \_\_\_\_\_ PHY 211 Vibration, Waves, and Optics
- \_\_\_\_\_ PHY 212 Introduction to Modern Physics
- \_\_\_\_\_ PHY 261 Research Experience (0.5 course credit)
- \_\_\_\_\_ PHY 311 Classical Mechanics

### **Supporting Courses**

- \_\_\_\_\_ MATH 151 Calculus I
- \_\_\_\_\_ MATH 152 Calculus II
- \_\_\_\_\_ MATH 252 Calculus III
- \_\_\_\_\_ MATH 301 Ordinary Differential Equations

**Total Credits Requirement = 5.5 course credits**

## **COURSES**

### **PHY 101 Explorations in Physics**

Introductory courses intended for the general audience; these courses do not count as prerequisite for other courses in physics or satisfy requirements for the major in physics. These courses introduce students to the process and product of scientific inquiry, and to ways that knowledge of physics affects our lives. Title and emphasis announced in term schedule of courses. Past topics have included astronomy, weather, cosmology,

and physics for teachers. These courses include a laboratory component. May be repeated when topic varies. Requirements met: Sciences Breadth/Discover. (Usually each fall and spring)

### **PHY 105 Physics for Health Sciences I (Algebra-Based)**

First semester of an algebra-based two-semester introductory sequence in physics. Topics treated include mechanics, vibratory motion, and sound with emphasis on both conceptual foundations and problem-solving techniques. Includes one three-hour lab per week. PREQ: High school algebra or equivalent. Requirements met: Sciences Breadth/Discover, Quantitative Competency (pre-Fall 2019), and Quantitative Competency (Fall 2019 & after). (Each fall)

### **PHY 106 Physics for Health Sciences II (Algebra-Based)**

Continues the study of physics begun in Physics 105. This algebra-based course explores conceptual foundations in electricity and magnetism, optics, and modern physics. Students will learn problem-solving techniques in these areas. Physics 106 is the appropriate second course for students who plan no further study in physics. Includes one three-hour lab per week. PREQ: Physics 105. Requirements met: Sciences Breadth/Discover, Quantitative Competency (pre-Fall 2019), and Quantitative Competency (Fall 2019 & after). (Each spring)

### **PHY 111 Physics for Scientists and Engineers I**

First semester of a calculus-based two-semester introductory sequence in physics using the Workshop Physics method. This approach combines inquiry-based cooperative learning with comprehensive use of computer tools. Topics include kinematics, Newton's Laws of motion, energy, and rotational motion. The laboratory component is integrated into the normal class period. COREQ: Mathematics 151. Requirements met: Sciences Breadth/Discover, Quantitative Competency (pre-Fall 2019), and Quantitative Competency (Fall 2019 & after). Previous course title Physics I (Calculus-Based). (Each fall)

### **PHY 112 Physics for Scientists and Engineers II**

Continues the study of physics begun in Physics 111 using the Workshop Physics method. This approach combines inquiry-based cooperative learning with comprehensive use of computer tools. Topics include electricity, electronics, magnetism, and thermodynamics. The laboratory component is integrated into the normal class period. Physics 112 is required for further study in physics. PREQ: Physics 111. COREQ: Mathematics 152. Requirements met: Sciences Breadth/Discover, Quantitative Competency (pre-Fall 2019), and Quantitative Competency (Fall 2019 & after). Previous course title Physics II (Calculus-Based). (Each spring)

### **PHY 131 Discovering the Cosmos**

Astronomy is one of the oldest and most influential of the observational sciences. From its modern inception over four hundred years ago, we are continually discovering anew how varied, complex, and mysterious is the Universe. This course will introduce a modern understanding of stars and galaxies, will address how observational evidence influences the ways in which humans view the night sky, and will incorporate new discoveries as they are published. Specific topics may include the nature of the stars, what lies between the stars, star birth and death, exoplanets, the Milky Way Galaxy and other galaxies, and modern cosmology. This course may not count toward a major or minor in physics. Requirements met: Non-Lab Science Breadth/Discover. (Every year either fall or spring)

### **PHY 135 Global Climate and Extreme Weather**

This course explores the science of global climate change and extreme weather. Through lectures and laboratory experiments, students will gain an understanding of Earth as a system of interacting components (atmosphere, ocean, Earth's interior, and biosphere). Students will use current weather observations and the scientific method to understand our changing weather. Extreme weather events such as tornadoes and hurricanes will be explored.

This course may not count toward a major or minor in physics. Requirements met: Science Breadth/Discover. (Each spring)

### **PHY 136 Explorations in Physics for Teachers**

This introductory course is designed for students in the Austin Teacher Program. It explores the process and product of scientific inquiry, and how that knowledge affects our lives. Specific topics may include mechanics, light, sound, electricity, magnetism, and modern physics. Inquiry-based learning approaches are emphasized, and a laboratory component is required. This course does not count as a prerequisite for other courses in physics or satisfy requirements for the major or minor in physics. Requirements met: Science Breadth/Discover. (Each spring)

### **PHY 211 Vibrations, Waves, and Optics**

The course begins with a study of simple harmonic motion, and proceeds through damped, driven oscillations and resonance. The course introduces mechanical waves and wave phenomena such as standing waves, interference, and diffraction of waves. Electromagnetic waves and their properties, including reflection, refraction, and polarization, are studied, as are interference and diffraction of light waves. Includes one three-hour lab per week. PREQ: Physics 112 and Mathematics 152. COREQ: Mathematics 252. (Each fall)

### **PHY 212 Introduction to Modern Physics**

An introduction to modern physics topics, including special relativity, introductory quantum mechanics, atomic physics, solid state physics, nuclear physics, and elementary particles. Includes one three-hour lab per week. PREQ: Physics 211 and Mathematics 252. COREQ: Mathematics 301. (Each spring)

### **PHY 230 Electronics**

This course examines the physics of electronic devices, introduces circuit analysis techniques, and provides practice in the design and use of basic circuits. This course emphasizes analog electronics, and elementary digital techniques also are explored. Includes one three-hour lab per week. PREQ: Physics 112 and Mathematics 152. (Spring of even-numbered years)

### **PHY 250 Intermediate Topics in Physics**

A study of selected topics for beginning students based on faculty and student interests. Offered on an occasional basis. Course may be repeated when topic varies. 1 course credit.

### **PHY 260 Intermediate Directed Study**

Student investigation of topic of interest working in collaboration with a faculty member resulting in significant oral and written work. See On-Campus Learning Opportunities for more information. PREQ: Freshman January term or Sophomore standing. Special permission required. Offered in variable course credit from 0.25-1.00.

### **PHY 261 Research Experience**

This course offers students the opportunity to work in small research groups on independent research projects. Students work closely with a faculty member in the Physics Department on topic selection, theoretical and experimental design, data analysis, and presentation of results. Topics vary on student background and faculty expertise. PREQ: Physics 112 and Mathematics 152. Requirements met: Half Writing Competency and Applied Learning Experience. 0.50 course credit unit. (Usually each fall and spring)

### **PHY 281 Statics and Engineering Design**

This course investigates the branch of mechanics concerned with bodies at rest and forces in equilibrium, with emphasis on engineering applications. Team projects introduce tools and techniques of engineering design, creative problem-solving, and collaborative learning. Topics include force systems, rigid bodies in equilibrium, structural analysis of trusses and frames, distributed forces, and friction. Integrated lecture and lab. PREQ: Physics 112 and Mathematics 152. (Fall of even-numbered years)

### **PHY 294 Intermediate Student Research**

Intended for less experienced students to develop and execute a research project in physics beyond the constraints of the normal classroom, suitable for public dissemination on or off campus under mentorship of a faculty member. Typically, this work results in a formal presentation, written work, or creative works. Course credit varies from 0.00 – 1.00. PREQ: Instructor permission.

### **PHY 311 Classical Mechanics**

This course examines an advanced study of Newtonian mechanics, oscillations, gravitation, nonlinear dynamics and chaos, and Lagrangian and Hamiltonian mechanics. PREQ: Physics 212 and Mathematics 301. (Each fall)

### **PHY 312 Electromagnetism**

This course examines static electric and magnetic fields, electric and magnetic properties of matter, boundary value problems in electrostatics. Maxwell's equations, electromagnetic waves. PREQ: Physics 212 and Mathematics 301. (Each spring)

### **PHY 340 Atmospheric and Environmental Physics**

This course offers a project-oriented approach to the study of atmospheric structure, atmospheric dynamics, thermodynamics, radiation, atmospheric instrumentation and observations, energy, climate, and severe weather. It serves as an approved science course for the environmental studies major. Includes one three-hour lab per week. PREQ: Physics 112 and Mathematics 152. (Spring of odd-numbered years)

### **PHY 350/450 Advanced Topics in Physics**

An investigation of selected topics for more advanced students based on faculty and student interests. Offered on an occasional basis. Course may be repeated when topic varies. Prerequisites vary. 1 course credit.

### **PHY 351 Advanced Instrumentation and Robotics**

This course introduces students to advanced instrumentation and robotics through the use of sensors and actuators. Any robotics system needs to sense its environment (through the use of sensors) and act on its environment (through the use of actuators). Students will investigate, measure, analyze, and control complex systems in an engineering design environment. Includes one three-hour lab per week. (Fall of even-numbered years)

### **PHY 360/460 Advanced Directed Study**

Student investigation of topic of interest related to the major or minor working in collaboration with a faculty member resulting in significant oral and written work. See On-Campus Learning Opportunities for more information. PREQ: Junior or Senior standing. Special permission required. Offered for variable course credit from 0.25-1.00.

### **PHY 361 Advanced Research Experience**

This advanced course offers students the opportunity to work in small research groups on independent research projects. Students work closely with a faculty member in the Physics Department on topic selection, theoretical and experimental design, data analysis, and presentation of results. Topics vary on student background and faculty expertise. PREQ: Physics 261, Physics 212, and Mathematics 301. Requirements met: Half Writing Competency. 0.50 course credit unit. (Usually each fall and spring)

### **PHY 394 Advanced Student Research**

Intended for advanced students to develop and execute a research project in physics suitable for public dissemination under mentorship of a faculty member. Students are expected to present the results of their research in a public forum. Typically, this work results in a formal presentation, written work, or creative works. Offered for variable course credit from 0.00 – 1.00. PREQ: Instructor permission.

**PHY 431 Quantum Mechanics**

A comprehensive course that includes Schrodinger's equation in three dimensions (free particle, harmonic oscillator, central force), correspondence limit, wave packets, spin, interaction of electromagnetic waves with atoms. PREQ: Physics 311 and Mathematics 301. (Usually each spring)

**PHY 451 Observational Astronomy**

This course introduces observational techniques in an astrophysical context. Students will engage in geometry, optics, materials, quantum physics, and astronomical software in order to gain a scientific understanding of the night sky, telescope use, and data reduction. Additionally, students will apply physics in the study of astronomical phenomena. Integrated lab and lecture course. PREQ: Physics 212 and Mathematic 301. (Fall of odd-numbered years)

**PHY 464 Teaching/Learning Participation**

An individualized study that includes sharing in the instructional process for a particular physics course under the supervision of the faculty member teaching the course. Open only to certain highly qualified juniors and seniors by invitation. See On-Campus Learning Opportunities for more information.

**PHY 490 Independent Study**

Student-driven independent work to produce a high quality body of work such as paper, report, art project, etc. See On-Campus Learning Opportunities for more information. PREQ: Junior or Senior standing. Special permission required. Offered in variable course credit from 0.25-1.00.

**PHY 491 Honors Thesis in Physics**

Extensive independent study in the major in a topic of special interest culminating in a bachelor's thesis with oral examination by thesis committee resulting in a bachelor's degree with Honors upon completion. See Departmental Honors Program for more information. Completed in last three semesters before graduation. Offered for variable course credit from 1.00-2.00.

**PHY 492 Independent Study Off-Campus/NSOC**

Student-driven independent study in a topic related to the major completed at an off-campus site. See Off-Campus Learning Opportunities for more information. PREQ: Junior or Senior standing. Special permission required. Offered in variable course credit from 0.25-1.00.