



# Physics

Physics is a fundamental science from which nearly all of modern engineering and technology has emerged, and its perspectives on theory and experimentation continue to influence profoundly the evolution of all sciences. It addresses all domains, from the submicroscopic worlds of atoms and quarks to the vast realms of space, from the esoteric to the mundane. It requires imagination and persistence from those who would participate.

The Department of Physics offers a flexible assortment of course work, laboratories, and guided research. Its laboratories are complemented by a variety of general and specialized apparatus; computers are employed in most aspects of experimentation and analysis, at all levels.

## Programs

- Science Education, B.S. (Physics Specialty (Teacher Licensure)) *major*
- Physics, B.A. *minor*
- Physics, B.S. *minor*

## Career Directions

Government Laboratories  
 High School Teaching  
 Industry Laboratories  
 Post-Secondary Teaching  
 Also: Graduate and Professional Schools

## Preparation

### Recommended High School Courses

- Advanced Mathematics
- Physics
- Chemistry
- Computer Programming

## Science Education, B.S. *major*

### Physics Specialty (Teacher Licensure)

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Required Credits: 90  
 Required GPA: 2.50

## CORE COURSES

COMPLETE THE FOLLOWING COURSES:

- BIOL 1211 Introductory Biology I (4 credits)
- BIOL 1212 Introductory Biology II (4 credits)
- CHEM 2211 Principles of Chemistry I (4 credits)
- CHEM 2212 Principles of Chemistry II (4 credits)
- PHYS 2101 Physics I (5 credits)
- SCI 3100 Integrative Science for Teachers (4 credits)
- SCI 3450 Science Methods For Grades 5-8 (4 credits)

SELECT 1 OF THE FOLLOWING COURSES:

- GEOL 1110 Physical Geology (4 credits)
- GEOL 1120 Historical Geology (4 credits)

## REQUIRED PROFESSIONAL EDUCATION COURSES

COMPLETE THE FOLLOWING COURSES:

- ED 3100 Introduction to the Foundations of Public School Education (3 credits)
- ED 3110 Educational Psychology (3 credits)
- ED 3140 Human Relations In Education (3 credits)
- ED 3350 Pedagogy: Planning for Instruction (3 credits)
- ED 3780 Adaptation and Management: Designing the Learning Environment (3 credits)
- ED 4737 Content Area Reading (3 credits)
- ED 4799 The Professional Teacher (1 credit)
- HLTH 3400 Health and Drugs in Society (2 credits)

Complete 12 credits of student teaching:

- ED 4830 Student Teaching - Secondary (1-12 credits)

## PHYSICS SPECIALTY

COMPLETE THE FOLLOWING COURSES:

(Select PHYS 2101 from the core for this specialty)

- MATH 2471 Calculus I (5 credits)
- PHYS 2102 Physics II (5 credits)
- PHYS 2500 Electronics I (4 credits)
- PHYS 3600 Modern Physics (4 credits)
- PHYS 4580 Optics (4 credits)

COMPLETE THE FOLLOWING COURSE:

- PHYS 4980 Research (3 credits)

## SUGGESTED SEMESTER SCHEDULE FOR PHYSICS SPECIALTY, SCIENCE EDUCATION MAJOR, B.S. (TEACHER LICENSURE)

The following suggested schedule includes the courses required in the Science (Physics) Major, B.S., arranged by year. There is some flexibility, but because of the sequential nature of Physics courses, it is very important that Calculus I and Physics I be taken as early as possible.

### Freshman

- MATH 2471 Calculus I (5 credits)
- MATH 2472 Calculus II (5 credits)
- PHYS 2101 Physics I (5 credits)
- PHYS 2102 Physics II (5 credits)
- Liberal Education requirements
- \*Students not scoring sufficiently high on the Mathematics Placement Exam should complete Precalculus (MATH 1470) before taking Calculus I and Physics I. This may delay taking other required Physics courses. Consult your Physics advisor.

### Sophomore

- PHYS 2500 Electronics I (4 credits)
- PHYS 3600 Modern Physics (4 credits)
- Required Biology, Chemistry, or Geology core courses
- Liberal Education requirements

Junior

- PHYS 4580 Optics (4 credits)
- PHYS 4980 Research (3 credits)
- Required Biology, Chemistry, or Geology core courses
- Liberal Education requirements

Senior

- Physics courses not completed previously
- SCI 3100 Integrative Science for Teachers (4 credits)
- SCI 3450 Science Methods For Grades 5-8 (4 credits)
- Liberal Education requirements
- Complete Professional Education requirements

### Physics, B.A. *minor*

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#### PHYSICS MINOR, B.A. REQUIREMENTS

MUST COMPLETE ALL AREAS WITH A TOTAL OF AT LEAST 33 SEMESTER CREDITS AND A 2.00 GPA

#### I REQUIRED COURSES

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#### I REQUIRED COURSES

COMPLETE THE FOLLOWING COURSES:

- MATH 2471 Calculus I (5 credits)
- MATH 2472 Calculus II (5 credits)
- PHYS 2101 Physics I (5 credits)
- PHYS 2102 Physics II (5 credits)

#### II REQUIRED ELECTIVES

SELECT 13 SEMESTER CREDITS FROM PHYSICS COURSES

### Physics, B.S. *minor*

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#### PHYSICS MINOR, B.S. REQUIREMENTS

MUST COMPLETE ALL AREAS WITH A TOTAL OF AT LEAST 34 SEMESTER CREDITS AND A 2.00 GPA

#### I REQUIRED COURSES

#### I REQUIRED COURSES

COMPLETE THE FOLLOWING COURSES:

- MATH 2471 Calculus I (5 credits)
- MATH 2472 Calculus II (5 credits)
- PHYS 2101 Physics I (5 credits)
- PHYS 2102 Physics II (5 credits)
- PHYS 2500 Electronics I (4 credits)
- PHYS 3600 Modern Physics (4 credits)

#### II REQUIRED ELECTIVES

SELECT 6 SEMESTER CREDITS FROM PHYSICS COURSES

## Physics Courses

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#### PHYS 1101 General Physics I (4 credits)

A survey of introductory physics, with laboratory. Topics include mechanics, vibrations, fluids, waves, heat, electricity, magnetism, dc circuits, optics. Elementary algebra and trigonometry are employed as needed. (Not for Physics or Engineering majors.) Liberal Education Goal Area 3 (LC).

#### PHYS 1102 General Physics II (4 credits)

Continuation of a survey of introductory physics, with laboratory. Topics include mechanics, vibrations, fluids, waves, heat, electricity, magnetism, DC circuits, optics. Elementary algebra and trigonometry are employed as needed. (Not for Physics or Engineering majors.) Liberal Education Goal Area 3 (LC).

#### PHYS 1230 Introduction to Engineering (2 credits)

Overview of career prospects and issues in engineering. Students research career paths in light of their own personal inventories and prepare plans for professional development. Employment statistics, qualifications, disciplinary tools, the design process, team building, professional associations, licensure, ethics. Visits to industrial engineering departments provide a first-hand look and networking/internship opportunities.

#### PHYS 2101 Physics I (5 credits)

A calculus-based introductory physics sequence, with laboratory. Topics include mechanics, vibrations, waves, fluids, thermodynamics, electricity, magnetism, DC and AC circuits, optics. Prerequisite/corequisite: MATH 2471. Liberal Education Goal Area 3 (LC).

#### PHYS 2102 Physics II (5 credits)

Continuation of a calculus-based introductory physics sequence, with laboratory. Topics include mechanics, vibrations, waves, fluids, thermodynamics, electricity, magnetism, DC and AC circuits, optics. Prerequisite/corequisite: MATH 2472. Liberal Education Goal Area 3 (LC).

#### PHYS 2150 Acquisition and Control with G Programming (3 credits)

In-depth introduction to laboratory electronics and computer data acquisition/process control using National Instruments' LabVIEW programming language. Measurement transducers, instrumentation, interface hardware and communications protocols, A/D and D/A conversion, signal conditioning, and data analysis covered in hands-on laboratory format. Prerequisite: One or more basic science courses.

#### PHYS 2210 Statics and Strength of Materials (3 credits)

Analysis of loads and moments borne by non-accelerating bodies and structures, considering distribution of forces and moments, material deformation, and prediction of material failure. Prerequisite: PHYS 2101.

#### PHYS 2220 Dynamics (3 credits)

Dynamics force and moment systems, including applications to systems of particles and rigid bodies, with an engineering emphasis. Prerequisite: PHYS 2101.

#### PHYS 2500 Electronics I (4 credits)

Use and analysis of digital ICs, with application to computer circuitry and interfacing. Intensive laboratory. Corequisite: PHYS 1101 or PHYS 2101, or consent of instructor.

#### PHYS 2951 Study Travel Physics (1-6 credits)

Study Travel course in Physics for Lib Ed Goal Area 3.

#### PHYS 3150 Circuit Analysis (4 credits)

A study of electrical systems and their responses to excitations, Two-port networks, and Bode Plots; Laplace and Fourier Transforms are employed as needed. Register for separate laboratory. For Physics majors - Prerequisites: PHYS 2102. For non-Physics majors - Prerequisites: PHYS 1102; Corequisite: MATH 2472.

#### PHYS 3230 Fluid Mechanics (3 credits)

The dynamics of fluid flow, emphasizing energy and momentum methods. Prerequisite: PHYS 2220. (Might not be offered every year.)

**PHYS 3250 Acoustics and Vibrations (3 credits)**

An introduction to vibrations, with applications to engineering and acoustics. Lecture and laboratory. Prerequisites: PHYS 2102, PHYS 2220 and MATH 2490 or PHYS 3400. (Might not be offered every year.)

**PHYS 3270 Systems and Controls (4 credits)**

Modeling and analysis of dynamic systems, with control applications. Register for separate laboratory. Prerequisites: PHYS 2220, PHYS 2530, and MATH 2490 or PHYS 3400, or consent of instructor.

**PHYS 3300 Thermodynamics and Heat Transfer (3 credits)**

Study of the theory and application of the laws of thermodynamics to control volumes, including an introduction to thermodynamic cycles for power generation, refrigeration, and heat pumps. Also, a study of the transfer of energy via heat, work, and mass, and of applications for the law of entropy. Prerequisites: MATH 2472 and PHYS 2102. (Might not be offered every year.)

**PHYS 3400 Math Methods for Engineering (3 credits)**

Introduction to ordinary and partial differential equations with emphasis on engineering applications; Laplace and Fourier transforms, series solutions, systems of ordinary differential equations, and phasor analysis. Prerequisites: MATH 2472, PHYS 1102 or PHYS 2102 (Might not be offered every year.)

**PHYS 3500 Electronics II (4 credits)**

Application of op-amps and other linear ICs and devices to instrumentation, measurement, interfacing, and control. Intensive laboratory. Prerequisite: PHYS 1102 or PHYS 2102 or consent of instructor.

**PHYS 3600 Modern Physics (4 credits)**

A first course in quantum systems. Topics include historical perspectives, classic experiments, an introduction to quantum mechanics, and applications in atomic and nuclear structure and spectroscopy. Lecture and Laboratory. Prerequisites: PHYS 2102, MATH 2472, or consent of instructor.

**PHYS 3720 Advanced Laboratory (1 credit)**

A laboratory designed to supplement various pre-engineering and other advanced courses that currently have no laboratory component. Content varies with term, may be subtitled, and may be repeated. Prerequisite: PHYS 2102.

**PHYS 4120 Engineering Simulation and Design (2 credits)**

Engineering design and analysis with commercial and customized software. A project is required. Prerequisite: PHYS 2102. (Might not be offered every year.)

**PHYS 4310 Mathematical Methods in Applied Physics (3 credits)**

Advanced topics in mathematical physics and engineering, including vector calculus, partial differential equations, Sturm-Liouville theory of orthogonal functions, and eigenfunction expansions. Prerequisite: PHYS 2102, and MATH 2490 or PHYS 3400. (Might not be offered every year.)

**PHYS 4540 Electromagnetic Fields and Waves (4 credits)**

A study of applied electromagnetics. Topics include Maxwell's Equations boundary value problems, static fields, media, waves, waveguides, and antennas. Prerequisites: PHYS 2102, MATH 2490 (or PHYS 3400), PHYS 3600, and PHYS 4310 (or consent of instructor). (Might not be offered every year.)

**PHYS 4580 Optics (4 credits)**

Geometrical and Physical Optics, including Fraunhofer and Fresnel diffraction, coherence, and holography. Fourier analysis is employed as needed. Lecture and laboratory. Prerequisites: PHYS 2102, and MATH 2490 or PHYS 3400. (Might not be offered every year.)

**PHYS 4610 Quantum Mechanics (3 credits)**

Development and formulation of quantum mechanics, with selected applications in spectroscopy, atomic/nuclear structure, lasers, solid state. Prerequisites: PHYS 2102, PHYS 3600, MATH 2490 or PHYS 3400, and PHYS 4310. (Might not be offered every year.)

**PHYS 4660 Solid State Physics (3 credits)**

Fundamentals of condensed matter physics, emphasizing crystalline solids. Includes transport mechanisms, band theory, semiconductors, lasers. Prerequisites: PHYS 2102, MATH 2472, and PHYS 3600. PHYS 4610 is strongly recommended. (Might not be offered every year.)

**PHYS 4680 Theoretical Physics (4 credits)**

Advanced topics in electromagnetism, classical mechanics, and quantum mechanics. Prerequisites: PHYS 2220, PHYS 4310, PHYS 4540, and PHYS 4610. (Might not be offered every year.)

**PHYS 4720 Applied Controls (2 credits)**

Calculus-based theory of feedback control systems with applications to industrial and experimental research automation systems. Includes laboratory component. Prerequisite: PHYS 1102 or PHYS 2102, and MATH 2490 or PHYS 3400.

**PHYS 4751 Engineering Design Project I (2 credits)**

Advanced computer-based measurement and control techniques, transducers, interfacing, signal conditioning. Prerequisites: PHYS 2102, senior status or consent of instructor.

**PHYS 4752 Engineering Design Project II (2 credits)**

Continuation of advanced computer-based measurement and control techniques, transducers, interfacing, signal conditioning. Prerequisites: PHYS 2102, senior status or consent of instructor.

**PHYS 4980 Research (3 credits)**

Research carried out by the student that is based on appropriate methodology and scholarship.

**All-University Courses**

The course numbers listed below, not always included in the semester class schedule, may be registered for by consent of the advisor, instructor, or department chair, or may be assigned by the department when warranted. Individual registration requires previous arrangement by the student and the completion of any required form or planning outline as well as any prerequisites.

1910, 2910, 3910, 4910 DIRECTED INDEPENDENT STUDY  
 1920, 2920, 3920, 4920 DIRECTED GROUP STUDY  
 1930, 2930, 3930, 4930 EXPERIMENTAL COURSE  
 1940, 2940, 3940, 4940 IN-SERVICE COURSE  
 1950, 2950, 3950, 4950 WORKSHOP, INSTITUTE, TOUR  
 1960, 2960, 3960, 4960 SPECIAL PURPOSE INSTRUCTION  
 1970, 2970, 3970, 4970 INTERNSHIP  
 1980, 2980, 3980, 4980 RESEARCH  
 1990, 2990, 3990, 4990 THESIS