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 *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)

A total of 120 semester credits are needed for the **Science Education, Physics specialty (Teacher Licensure) B.S.** degree and include the following:

- Completion of a minimum of 40 upper division credits (level 3000/4000)
- Completion of all required major credits
- Completion of Core Curriculum credits (Minnesota Transfer Curriculum [MnTC] Goal Areas 1-10 with a minimum of 40 credits) required for all baccalaureate degrees
- Completion of BSU Focus and Nisidotaading Course Requirements

Dual Degrees
Students wishing to complete two degrees concurrently, (example: Bachelor of Science and Bachelor of Arts) must complete a minimum of an additional 30 credits above the required 120 credits.

Multiple Credentials
Any additional major, minor or certificate in a degree must have at least 6 credits of course work not used to meet the requirements of another major, minor or certificate in the degree.

Required Credits: 82
Required GPA: 2.50

Core Courses for Science Teaching in Grades 5-8

COMPLETE THE FOLLOWING COURSES:

- BIOL 1400 Cellular Principles (4 credits)
  or BIOL 1110 Human Biology (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
  or BIOL 1120 General Biology: Evolution And Ecology (3 credits)
- CHEM 2211 Principles of Chemistry I (4 credits)
  or CHEM 1111 General Chemistry I (4 credits)
- CHEM 2212 Principles of Chemistry II (4 credits)
  or CHEM 1112 General Chemistry II (4 credits)
- GEOL 1110 Physical Geology (4 credits)
- SCI 3100 Integrative Science for Teachers (4 credits)
- SCI 3450 Science Methods For Grades 5-8 (4 credits)
  or ED 3410 Secondary Science Methods (4 credits)

REQUIRED PROFESSIONAL EDUCATION COURSES

Complete the following courses with a minimum 2.50 GPA:

- ED 3100 Introduction to the Foundations of Public School Education (3 credits)
- ED 3110 Educational Psychology (3 credits)
- ED 3140 Human Diversity and Educational Equity (3 credits)
- ED 3350 Principles and Strategies of Teaching (3 credits)
- ED 3780 Inclusive Teaching and Classrooms (3 credits)
- ED 4737 Content Area Reading (3 credits)
- ED 4799 The Professional Teacher (1 credit)

Complete the following course:

- HLTH 3400 Drug Education, Stress and the Mind (2 credits)

Complete 12 credits of student teaching:

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

PHYSICS SPECIALTY

Complete the following courses:

MATH 2471 is recommended (required for PHYS 2101)

- PHYS 2101 University Physics I (4 credits)
  or PHYS 1101 General Physics I (4 credits)
- PHYS 2102 University Physics II (4 credits)
  or PHYS 1102 General Physics II (4 credits)
- PHYS 3103 University Physics III (4 credits)
- PHYS 3300 Thermal and Statistical Physics (3 credits)
  or CHEM 4711 Physical Chemistry I (3 credits)
- PHYS 4300 Optics (4 credits)

Complete the following course:

- PHYS4980

Physics *minor*

Multiple Credentials

Any additional major, minor or certificate in a degree must have at least 6 credits of course work not used to meet the requirements of another major, minor or certificate in the degree.

Required Credits: 28
Required GPA: 2.00

I REQUIRED COURSES

Complete the following courses:

- MATH 2471 Calculus I (5 credits)
- MATH 2472 Calculus II (5 credits)
- PHYS 2101 University Physics I (4 credits)
- PHYS 2102 University Physics II (4 credits)
- PHYS 3103 University Physics III (4 credits)

II REQUIRED ELECTIVES

Select 6 semester credits from physics courses

OR Complete CHEM 4711, CHEM 4712 and any Physics course numbered 3300 or higher:
(Some courses in this section require pre-requisites that are not part of this program)

Physics Courses

PHYS 1101 General Physics I (4 credits)
First course of a survey of introductory physics, suitable for students who are not familiar with calculus. Topics include Newton¿s laws of motion, energy conservation, momentum, fluids, vibrations, and waves. Elementary algebra and trigonometry are used frequently. Includes lecture and laboratory. Prerequisites: none; MATH 1170 recommended. [Core Curriculum Goal Area 3 (LC)]

PHYS 1102 General Physics II (4 credits)
Second course of a survey of introductory physics suitable for students who are not familiar with calculus. Topics include heat, electricity, magnetism, electronic circuits, light, and optics. Elementary algebra and trigonometry are employed as needed. Includes lecture and laboratory. Prerequisite(s): none; MATH 1470 recommended. [Core Curriculum Goal Area 3 (LC)]

PHYS 1200 Ideas of Modern Physics (3 credits)
An introduction to modern physics concepts at a level suitable for all students. Topics of discussion may include Einstein's theory of relativity, quantum mechanics, lasers, nuclear energy, black holes, and dark matter. This course will be mostly non-mathematical, with only trace amounts of math used as needed. [Core Curriculum Goal Area 3 (LL)]

PHYS 2000 Astronomy (3 credits)
A one-semester survey of introductory astronomy. Topics include the history of astronomy, the formation and composition of our solar system, the evolution of stars and galaxies, the Big Bang model, the search for extraterrestrial life, and the fate of the universe. [Core Curriculum Goal Area 3 (LL).]

PHYS 2101 University Physics I (4 credits)
First course of a calculus-based introductory physics sequence. Topics include Newton's laws of motion, gravitation, energy conservation, momentum, fluids, vibrations and waves. Includes lecture and laboratory. Prerequisite(s): MATH 2471 or consent of instructor. [Core Curriculum Goal Area 3 (LC)]

PHYS 2102 University Physics II (4 credits)
Second course of a calculus-based introductory physics sequence. Topics include electricity, magnetism, electrical circuits, light, and optics. Includes lecture and laboratory. Prerequisite: PHYS 2101 and MATH 2472 or consent of instructor. [Core Curriculum Goal Area 3 (LC)]

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 (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 3103 University Physics III (4 credits)
Final course of a calculus-based introductory physics sequence, with a focus on modern physics. Topics include special relativity, quantum mechanics, atomic physics and radiation, elementary particles, astrophysics, and cosmology. Includes lecture and laboratory. Prerequisite(s): PHYS 2102 or consent of instructor.

PHYS 3300 Thermal and Statistical Physics (3 credits)
Principles of thermodynamics and statistical mechanics. Topics include temperature, the laws of thermodynamics, entropy, heat engines and refrigerators, free energy, and Boltzmann and quantum statistics. Prerequisites: PHYS 2102, PHYS 3103, MATH 2472, or consent of instructor.

PHYS 3400 Mathematical Physics (3 credits)
Introduction to mathematical techniques used to solve problems in the physical sciences. Topics include complex numbers, Fourier series, ordinary and partial differential equations, and series solutions including Legendre polynomials and Bessel functions. Prerequisites: PHYS 2102, MATH 2472, or consent of instructor.

PHYS 3700 Classical Mechanics (3 credits)
Newton's laws applied to systems of particles and rigid bodies. Topics includes energy and momentum conservation, non-inertial reference frames, Lagrangian and Hamiltonian mechanics. Prerequisites: PHYS 2101, PHYS 3400 or MATH 2490.

PHYS 3720 Advanced Laboratory (1 credit)
A laboratory designed to supplement various advanced courses that currently have no laboratory component. Content varies with term and may be repeated. Prerequisite: PHYS 2102.

PHYS 4100 Solid-State Physics (3 credits)
Fundamentals of condensed matter physics, emphasizing crystalline solids. Includes transport mechanisms, band theory, lattice vibrations, insulators and semiconductors. Prerequisites: PHYS 2102, PHYS 3103, MATH 2472.

PHYS 4300 Optics (4 credits)
Electromagnetic wave phenomena, including Fraunhofer and Fresnel diffraction, interference, coherence, dispersion, and polarization. Lecture and laboratory. Prerequisites: PHYS 2102, PHYS 3400 or MATH 2490, or consent of instructor.

PHYS 4500 Electromagnetism (4 credits)
Classical theory of electric and magnetic fields. Topics include Maxwell's equations, boundary value problems, static fields, dielectric materials, waves, waveguides, and antennas. Prerequisites: PHYS 2102, PHYS 3400, or consent of instructor.

PHYS 4700 Quantum Mechanics (3 credits)
Development and formulation of quantum mechanics, with selected applications in spectroscopy, atomic/nuclear structure, and lasers. Prerequisites: PHYS 3103, PHYS 3400.

PHYS 4800 Special Topics in Theoretical Physics (4 credits)
Advanced topics in electromagnetism, classical mechanics, and quantum mechanics. Prerequisites: PHYS 3103, PHYS 3400, and consent of instructor.

PHYS 4917 DIS Tchg Assoc | (1-2 credits)
Directed Independent Study | Teaching Associate

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