Physics

College of Science, Engineering & Technology
Department of Physics & Astronomy
141 Trafton Science Center N • 507-389-5743
Website: cset.mnsu.edu/pa/

Chair: Thomas R. Brown

Faculty: Paul Eskridge, Analia Dall'Asen, Steven Kipp, Igor Kogoutiouk, Russell L Palma, Andrew D Roberts, Hai-Sheng Wu, Youwen Xu, Mark A Pickar

---

Physics is a science concerned with understanding the fundamental laws of nature. It explains physical phenomena in everyday life, such as motion, heat, electricity, magnetism and light. It studies the origin of the universe, the behavior of atoms and subatomic particles, and everything in between. Physics is the foundation of all fields of science and engineering.

The physics curriculum consists of sequences of interrelated courses that must be taken in the appropriate order. Mathematics is an important tool for physics. The courses taken by physics majors cover a variety of topics in classical and modern physics, and require significant preparations in mathematics. Well prepared students should complete the physics major in four years. The physics B.S. program prepares students for:

1. Further study in physics, engineering, or other fields for advanced degrees,
2. Entry into work in the public or private sectors,
3. Teaching physics in high schools if the B.S. in physics teaching degrees is earned.

Training in physics gives students strong abilities in critical thinking and problem solving, the two skills that are essential in any occupations.

Academic Map/Degree Plan at www.mnsu.edu/programs/#All

POLICIES/INFORMATION

Admission to the major is granted by the department. To be admitted to the major, a student must have a minimum of 32 earned credit hours and a minimum cumulative GPA of 2.00 ("C").

Contact the College of Science, Engineering and Technology Advising Center for application procedures.

GPA policy. A minimum GPA of 2.0 in physics courses is required for graduation.
P/N grading policy. All physics courses except PHYS 105 and PHYS 480 are open to P/N grading. However, a student majoring or minoring in physics must elect the grade option for all of the required courses except where P/N grading is mandatory.

A minimum of 25 percent of the required credits in physics must be taken at Minnesota State University, Mankato for both the major and the minor. Testing for credit by examination is available on a case-by-case basis as determined by the chairperson of the Physics and Astronomy department.

BS degree, Double major. Students majoring in physics often find a second major in mathematics to be an attractive option. If the BS degree in physics is combined with a BS degree in mathematics, then the following math courses are recommended: MATH 345, MATH 422, MATH 425, and MATH 447.

PHYSICS BS

Degree completion = 120 credits

Students interested in physics preparation leading to professional opportunities or graduate study are encouraged to select this major.

Required General Education

MATH	121	Calculus I (4)
PHYS	221	General Physics I (4)

Major Common Core

CS	110	Computer Science I (4)
EE	230	Circuit Analysis I (3)
EE	240	Evaluation of Circuits (1)
MATH	122	Calculus II (4)
MATH	223	Calculus III (4)
MATH	247	Linear Algebra I (4)
MATH	321	Ordinary Differential Equations (4)
PHYS	150	Explorations in Physics (1)
PHYS	222	General Physics II (3)
PHYS	223	General Physics III (3)
PHYS	232	General Physics II Laboratory (1)
PHYS	233	General Physics III Laboratory (1)
PHYS	335	Modern Physics I (3)
PHYS	336	Modern Physics II (3)
PHYS	441	Mechanics (4)
PHYS	447	Electricity & Magnetism I (3)
PHYS	448	Electricity & Magnetism II (3)
PHYS	457	Optics (3)
PHYS	461	Quantum Mechanics (4)
PHYS	465	Computer Applications in Physics (3)
PHYS	473	Statistical Physics (3)
PHYS	475W	Advanced Laboratory (3)
PHYS	492	Seminar (1)

Major Unrestricted Electives

Required Electives (choose 4 credits)

AST	351	Telescope Operations (2)
AST	353	Photometry I (2)
AST	355	Astrometry (2)
AST	357	Spectroscopy (2)
AST	420	Stellar Astrophysics (3)
AST	430	Galactic Structure (3)
EE	303	Introduction to Solid State Devices (3)
EE	304	Lab: Introduction to Solid State Devices (1)
MATH	354	Concepts of Probability & Statistics (4)
MATH	411	Introduction to Complex Variables (4)
MATH	422	Partial Differential Equations (4)
MATH	470	Numerical Analysis I (4)
PHYS	417	Biophysics (2)
PHYS	453	Solid State Physics (3)
PHYS	493	Undergraduate Research (1-6)
PHYS	499	Individual Study (1-8)
STAT	354	Concepts of Probability & Statistics (4)

Required Minor: None.

PHYSICS MINOR

Required General Education

MATH	121	Calculus I (4)
PHYS	221	General Physics I (4)

Required Support Course

MATH	122	Calculus II (4)

Required for Minor

PHYS	222	General Physics II (3)
PHYS	223	General Physics III (3)
PHYS	335	Modern Physics I (3)
PHYS	336	Modern Physics II (3)

Required Elective (2-4 credits)

Choose a minimum of one course from the following courses:

PHYS	441	Mechanics (4)
PHYS	447	Electricity & Magnetism I (3)
PHYS	457	Optics (3)
PHYS	465	Computer Applications in Physics (3)
PHYS	473	Statistical Physics (3)
PHYS	475	Advanced Laboratory (3)

PHYSICS SCIENCE TEACHING BS

Degree completion = 120 credits

Other Graduation Requirements

See the SECONDARY EDUCATION section for admission requirements to Professional Education and a list of required professional education courses.

Required General Education (3 credits)

Recommended General Education (22-23 credits) Including MATH 121

Required General Science Core (31-33 credits)

Required for Major

MATH	122	Calculus II (4)
PHYS	335	Modern Physics I (3)
PHYS	336	Modern Physics II (3)
PHYS	381	Tutoring Physics (2)
PHYS	465	Computer Applications in Physics (3)
PHYS	482	Teaching Methods & Materials in Physical Science (4)
PHYS	493	Undergraduate Research (1-6) (2 credits required)

Electives (Minimum of 8 Credits)*
Students may use PHYS 221, PHYS 222, PHYS 223, PHYS 232 and PHYS 233 to fulfill their Physics Electives requirement **only if** PHYS 211 and PHYS 212 are completed successfully.

Alternatively, students with a strong interest in applying advanced mathematical skills to problems in physics are encouraged to choose a minimum of 8 credits* of higher level Physics or Mathematics as approved by the student's advisor to fulfill the Physics Elective requirement.

*This is reduced to 4 credits if PHYS 221, PHYS 222, PHYS 223, PHYS 232 and PHYS 233 have been taken in place of PHYS 211 and PHYS 212 in partial fulfillment of the General Science Core requirements.

Students intending to teach physics in states other than Minnesota are advised to select the BS Physics major and use elective credits to satisfy the professional education course requirements. For additional information confer with the science teaching advisor.

COURSE DESCRIPTIONS

PHYS 100 (3) Cultural Physics
Self-paced format, open laboratory component. Includes the history, philosophy and growth of science from myth to the present. Included are readings on Galileo, Newton, the Industrial Revolution, and the modern scientific revolution. The relationship of science to art, archaeology, politics, weapons, medicine, technology, research and development, and the universe are discussed. Lab included.
Fall, Spring
GE-3

PHYS 101 (3) Introductory Physics
A one semester course which covers the basic principles of physics on a conceptual level and with a minimal amount of math. The course provides an understanding of natural processes and their applications. Topics generally include mechanics, simple machines, atomic structure, heat, light and sound. Lecture and laboratory components.
Fall, Spring
GE-3

PHYS 102 (3) Physics in the World Around Us
A one semester course which covers the basic principles of physics on a conceptual level. The course provides an understanding of natural processes and their applications to technology (or how things work!), including the greenhouse effect and nuclear power. Lecture only.
Variable
GE-3

PHYS 105 (3) Time, Atomic Clocks, and Relativity
Self-paced format. Includes readings on time; telling time from sundials to atomic clocks; Albert Einstein (a biography of the primary developer of the Theory of Relativity); and the Theory of Relativity. All the readings are written to be understood by non-scientists.
Fall, Spring
GE-3

PHYS 150 (1) Explorations in Physics
This course offers an introduction to the field of physics, and prepares students for academic success in the program. Students will become familiar with current topics of physics research within the department, and better understand the career paths available with a physics major.
Fall

PHYS 211 (4) Principles of Physics I
General background in physical concepts for those who do not plan advanced study in physics or engineering. Topics include mechanics, fluids, heat and thermodynamics. Lecture and laboratory.
Prerequisite: Either MATH 112 and MATH 113, or MATH 115; and high school physics or PHYS 101.
Fall, Spring
GE-2, GE-3

PHYS 212 (4) Principles of Physics II
Includes waves and sound, electricity and magnetism, light and optics, and topics in modern physics. Lecture and laboratory.
Prerequisite: PHYS 211
Fall, Spring

PHYS 221 (4) General Physics I
Designed for science and engineering students. Caculus-based physics. Covers elementary mechanics including kinematics, statics, equilibrium and dynamics of particles, work and energy, rotational motion, gravitation, and oscillation. Lecture and laboratory.
Prerequisite: MATH 121 with a "C" or better; and high school physics or PHYS 101 Fall, Spring
GE-2, GE-3

PHYS 222 (3) General Physics II
Designed for science and engineering students. Calculus-based physics. Covers electrical charge and field; magnetic field and its sources; current and resistance; simple DC and AC circuits; and electromagnetic induction. Lecture only. (Associated laboratory course is PHYS 232.)
Prerequisite: MATH 122 with a "C" or better; and PHYS 221 with a "C" or better.
Fall, Spring

PHYS 223 (3) General Physics III
Designed for science and engineering students. Calculus-based physics. Covers fluids, thermodynamics, mechanical and sound waves, geometrical optics, physical optics, and modern physics. Lecture only. (Associated laboratory course is PHYS 233.)
Prerequisite: MATH 122 with a "C" or better; and PHYS 221 with a "C" or better.
Spring

PHYS 232 (1) General Physics II Laboratory
Designed for science and engineering students. Laboratory course accompanying PHYS 222. Experiments involving electric and magnetic fields, electric potential, electric and magnetic forces, and simple circuits. Laboratory only.
Prerequisite: PHYS 221 with a "C" or better; and PHYS 222 or concurrent.
Fall, Spring

PHYS 233 (1) General Physics III Laboratory
Designed for science and engineering students. Laboratory course accompanying PHYS 223. Experiments involving fluids, thermodynamics, mechanical waves, geometrical optics, and physical optics. Laboratory only.
Prerequisite: PHYS 221 with a "C" or better; and PHYS 223 or concurrent.
Spring

PHYS 335 (3) Modern Physics I
Special Theory of Relativity. Quantum nature of waves and particles: photons, de Broglie wavelength of matter and wave packet description of particles, Bohr model of hydrogen. Schrodinger wave equation in one-dimension: energy quantization, potential barriers, simple harmonic oscillator. One-electron atoms. X-ray and optical excitation of multielectron atoms. Lecture and laboratory.
Prerequisite: MATH 122; (PHYS 222 and concurrently with PHYS 223) or PHYS 212.
Spring

PHYS 336 (3) Modern Physics II
Topics include the basics of molecular structure and spectra, classical and quantum statistical physics, solid state physics, nuclear physics,and particle physics. The lab component will teach the operation of various radiation detectors, and use them to study the interaction of radiation with matter.
Prerequisite: PHYS 335
Fall

PHYS 381 (1-3) Tutoring Physics
Supervised experience as an instructional assistant. Must demonstrate ability in basic physics.
Prerequisite: Consent
Variable

PHYS 417 (2) Biophysics
This course bridges the gap between introductory physics and its application to the life and biomedical sciences. Topics include fluid flow, membrane transport, nerve conduction, imaging methods including MRI, CT, and nuclear imaging, radiotherapy, and health physics.
Prerequisite: MATH 121, PHYS 212 or PHYS 222
Variable

PHYS 441 (4) Mechanics
Rectilinear motion of a particle, general motion of a particle in three dimensions, Newtonian mechanics including harmonic oscillations, forced oscillations, central forces and orbital motion, collisions, noninertial reference systems, dynamics of a system of particles, rigid body motion, Lagrangian and Hamiltonian mechanics, normal coordinates.
Prerequisite: PHYS 222 or PHYS 223; and MATH 321 or consent.
Fall

PHYS 447 (3) Electricity & Magnetism I
Electrostatic fields, magnetostatic fields, steady currents, electromagnetic induction. Review of vector algebra.
Prerequisite: MATH 223 and MATH 321 and PHYS 222
Fall

PHYS 448 (3) Electricity & Magnetism II
Electromagnetic waves, propagation and radiation of waves, electrodynamics and relativity.
Prerequisite: PHYS 223 and PHYS 447
Spring

PHYS 453 (3) Solid State Physics
Atoms in crystals, wave in crystals, thermal vibrations of the crystal lattice, free electron model, band theory of solids, semiconductors and PN junctions, magnetism, and superconductivity.
Prerequisite: PHYS 335
Variable

PHYS 457 (3) Optics
Geometric optics, wave optics, properties of light and matter, optics of transformations, and quantum optics. Lecture and laboratory.
Prerequisite: MATH 122 and PHYS 223
ODD-Spring

PHYS 461 (4) Quantum Mechanics
A systematic development of foundations of quantum mechanics. Observables, operators, state functions, expectation values. Matrix formulation of eigenvalue problems. The hydrogen atom, electron spin, angular momentum, and perturbation theory.
Prerequisite: PHYS 335, PHYS 441, MATH 247, MATH 321
Fall

PHYS 465 (3) Computer Applications in Physics
Numerical solutions of physics problems and computer simulations of physical systems. Lecture and laboratory.
Prerequisite: MATH 122, CS 110 and PHYS 222 or PHYS 223.
Fall

PHYS 473 (3) Statistical Physics
Fundamental principles of statistical physics, including theory of probability, kinetic theory of transport process, entropy, classical and quantum statistical ensembles, Bose and Fermi systems. Applications to thermodynamics and magnetic properties of solids.
Prerequisite: MATH 321 and PHYS 223
Alt-Spring

PHYS 475 (3) Advanced Laboratory
Experiments in modern physics, including solid-state physics and optics. Requires more independent work than introductory laboratories.
Prerequisite: PHYS 336 or consent
Spring

PHYS 475W (3) Advanced Laboratory
Experiments in modern physics, including solid-state physics and optics. Requires more independent work than introductory laboratories.
Prerequisite: PHYS 336 or consent
Spring
WI

PHYS 480 (3) Lab Experiences in Physical Science
For prospective teachers in elementary schools. Topics include weather, weather forecasting and record keeping, simple machines, electricity, chemistry, sound, light, and others. May not count as a physics elective. Not available for P/N grading.
Fall, Spring

PHYS 482 (4) Teaching Methods and Materials in Physical Science
Current methods of teaching all physical sciences with emphasis on physics and chemistry. For students planning to teach at a middle school, secondary school, college, or a university.
Prerequisite: one year of chemistry and one year of physics, or consent
Spring

PHYS 490 (2-4) Workshop
A short course devoted to a specific topic in physics. May be repeated for credit on each new topic.
Variable

PHYS 491 (1-8) In-Service
A course designed to upgrade the qualifications of persons on-the-job.
Variable

PHYS 492 (1) Seminar
Students will attend research seminars presented by faculty in the department, or speakers from other institutions. Students also make and critique presentations made by themselves and other students. May be repeated for credit.
Prerequisite: Completed at least two upper division physics courses.
Spring

PHYS 493 (1-6) Undergraduate Research
Prerequisite: Consent
Variable

PHYS 495 (1-2) Selected Topics
A course in an area of physics not regularly offered. Topic and credit assigned by department each time offered.
Prerequisite: PHYS 335 and PHYS 336
Variable

PHYS 497 (1-16) Internship
Provides a student with the opportunity to gain expertise and experience in a special field under the supervision of a qualified person.
Prerequisite: Usually Sr. standing
Variable

PHYS 499 (1-8) Individual Study
Special arrangements must be made with an appropriate faculty member of the department office. May be repeated for credit on each new topic.
Prerequisite: Consent
Variable