Physics

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

Chair: Mark A. Pickar

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The physics programs available to the student are designed to prepare the student for graduate work, for a career in industry or government, or for high school teaching. Degree requirements provide graduates with laboratory skills useful both in graduate work and in industry and business.

Admission to Major is granted by the department. Minimum University admission requirements are:
- a minimum of 32 earned semester credit hours.
- a minimum cumulative GPA of 2.00 ("C")

Contact the department for application procedures.

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

Required General Education (9 credits):
MATH 121 Calculus I (4)
PHYS 221 General Physics I (5)

Recommended Support Courses (18 credits):
CHEM 201 General Chemistry I (5)
CHEM 202 General Chemistry II (5)
ENG 271 Technical Communication (4)
MATH 422 Partial Differential Equations (4)

Required for Major (53 credits):
EE 230 Circuit Analysis I (3)
EE 240 Evaluation of Circuits (1)
MATH 122 Calculus II (4)
MATH 223 Calculus III (4)
MATH 321 Ordinary Differential Equations (4)
PHYS 222 General Physics II (5)
PHYS 335 Modern Physics I (3)
PHYS 336 Modern Physics II (3)
PHYS 441 Mechanics (4)
PHYS 447 Electricity and Magnetism I (3)
PHYS 448 Electricity and 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 475 Advanced Laboratory (2)
PHYS 492 Seminar (1)

Required Minor: None.

PHYSICS MINOR

Required Support Courses (8 credits):
MATH 121 Calculus I (4)
MATH 122 Calculus II (4)

Required for Minor (14-16 credits):
Choose one of the following sequences of introductory physics courses:
PHYS 221 General Physics I (5) AND
PHYS 222 General Physics II (5) OR
PHYS 211 Principles of Physics I (4) AND
PHYS 212 Principles of Physics II (4)

Also Required:
PHYS 335 Modern Physics I (3)
PHYS 336 Modern Physics II (3)

Required Elective
Choose a minimum of one course from the following courses:
PHYS 441 PHYS 447 PHYS 461 PHYS 465 PHYS 453
PHYS 457 PHYS 473 PHYS 475

PHYSICS SCIENCE TEACHING BS
General requirements for programs in teaching the sciences can be found in the SCIENCE TEACHING section of this bulletin.

Required General Education (3 credits)

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

Required General Science Core (31-33 credits)

Required Professional Education (30 credits)

Required for Major (Core, 21 credits)
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)

Electives (Minimum of 8 Credits)*
Students may use PHYS 221 and PHYS 222 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 6 credits if PHYS 221 and PHYS 222 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.

POLICIES/INFORMATION

GPA Policy. A minimum GPA of 2.0 in physics courses is required for graduation.

Refer to the College regarding required advising for students on academic probation.

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.

A minimum of 25 percent of the required credits in physics must be taken at Minnesota State 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 Physics and Astronomy Department chairperson.

Electives in physics may include AST 420 and/or AST 421. Four credits of 100-level courses may be allowed toward the BS (teaching) major, provided they are completed before PHYS 211 (PHYS 221). PHYS 482 counts only toward
the BS teaching degree.

BS Degree, Double Major. Students majoring in physics often find a second major in mathematics or astronomy 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 321, MATH 422, MATH 425, and MATH 447.

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.
Fall, Spring
GE-3 CD-Related

**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 107 (3) Physics of Flight**
A one semester course which covers the basic principles of physics and flying on a conceptual level. Minimal math will be required. The course provides an understanding of physics and how it applies to the technology of flight. Topics include lift and drag; power plants and propulsion; stability; control; aircraft performance and history; subsonic and supersonic aerodynamics. Intended for students interested in aviation. Lecture, discussion, guided experiences at the University and at the Mankato airport.
Variable
GE-3

**PHYS 110 (3) Physics and Our Audio Environment**
A one semester course which covers the basic principles of physics as they apply to audio systems, their specifications, and our audio environment. Presented at a conceptual level. Lecture and laboratory.
Variable
GE-3

**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.
Pre: Either MATH 112 and MATH 113, or MATH 115; and high school physics or PHYS 101.
Fall, Spring
GE-2, 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.
Pre: PHYS 211
Fall, Spring

**PHYS 221 (5) General Physics I**
Designed for science and engineering students. Covers elementary mechanics including dynamics of particles, work and energy, rotational motion, and gravitation. Also discusses oscillations and thermodynamics. Lecture and laboratory.
Pre: MATH 121 with a "C" or above; and high school physics or PHYS 101
Fall, Spring
GE-2, 3

**PHYS 222 (5) General Physics II**
Designed for science and engineering students. Covers waves and sound, electricity and magnetism, simple circuits, electromagnetic waves, and geometrical wave optics. Lecture and laboratory.
Pre: MATH 122 with a "C" or above and PHYS 221 with a "C" or above.
Fall, Spring

**PHYS 335 (3) Modern Physics I**
Pre: PHYS 212 or PHYS 222 and MATH 122
Spring

**PHYS 336 (3) Modern Physics II**
Topics include nuclear force, interactions of nuclear particles with matter, radioactive decay, nuclear structure, nuclear reactions, fission, fusion, elementary particles, and the quark model. Lecture and laboratory.
Pre: PHYS 335
Fall

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

**PHYS 404 (2) Physics and Society**
Relations between physics and other intellectual communities: e.g., philosophy, humanities, social sciences, the arts.
Pre: Consent
Variable

**PHYS 417 (2) Biophysics**
Thermodynamic relationships; energy flow in living systems; metabolic heat generation and loss; homeostasis; atomic and molecular bonds in nucleic acids, proteins, and carbohydrates; hormonal regulation; cell metabolism; negative feedback control in living systems; cancer therapy; imaging; disease states; new theories and paradigms.
Pre: PHYS 212 or PHYS 222 and MATH 122
Variable

**PHYS 423 (4) Neuroscience**
The goal of neuroscience is to understand the human mind. This goal is approached by revealing the brain processes involved in how we perceive, think, remember, and move. Brain development, communication, and plasticity at the neural level are all described.
Pre: PSYC 421
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<tr>
<th>COURSE</th>
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<tr>
<td>PHYS 447 (3)</td>
<td>Electricity &amp; Magnetism I</td>
<td></td>
<td>Electrostatic fields, magnetostatic fields, steady currents, electromagnetic induction. Review of vector algebra. Pre: PHYS 212 or PHYS 222 and MATH 223, MATH 321, or MATH 422. Fall.</td>
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<tr>
<td>PHYS 453 (3)</td>
<td>Solid State Physics</td>
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<td>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. Pre: PHYS 335. ODD-Spring.</td>
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<tr>
<td>PHYS 457 (3)</td>
<td>Optics</td>
<td></td>
<td>Geometric optics, wave optics, properties of light and matter, optics of transformations, and quantum optics. Lecture and laboratory. Pre: PHYS 212 or PHYS 222 and MATH 122. ODD-Spring.</td>
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<td>PHYS 465 (3)</td>
<td>Computer Applications in Physics</td>
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<td>Numerical solutions of physics problems and computer simulations of physical systems. Lecture and laboratory. Pre: Familiarity with some programming language and PHYS 212 or PHYS 222, and MATH 122; or consent. Fall.</td>
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<td>PHYS 473 (3)</td>
<td>Statistical Physics</td>
<td></td>
<td>Statistical mechanics, kinetic theory, thermodynamics. Pre: PHYS 212 or PHYS 222 and MATH 223 and MATH 321. EVEN-Spring.</td>
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<tr>
<td>PHYS 475 (2)</td>
<td>Advanced Laboratory</td>
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<td>Experiments in modern physics, including solid-state physics and optics. Requires more independent work than introductory laboratories. Pre: PHYS 336 or consent. Spring.</td>
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<td>PHYS 480 (2)</td>
<td>Lab Experiences in Physical Science</td>
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<td>For prospective teachers in elementary schools. Topics include 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. Pre: PHYS 101. Fall, Spring.</td>
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<tr>
<td>PHYS 482 (4)</td>
<td>Teaching Methods and Materials in Physical Science</td>
<td></td>
<td>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. Pre: KSP 420, one year of chemistry and one year of physics, or consent. Spring.</td>
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<tr>
<td>PHYS 484 (2)</td>
<td>Middle/Junior High Science Teaching</td>
<td></td>
<td>Current methods of teaching all sciences with emphasis on physical science, physics, chemistry, and earth science. Pre: Majority of required courses completed, or consent. Variable.</td>
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<td>PHYS 490 (2-4)</td>
<td>Workshop</td>
<td></td>
<td>A short course devoted to a specific topic in physics. May be repeated for credit on each new topic. Variable.</td>
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<td>PHYS 491 (1-8)</td>
<td>In-Service</td>
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<td>A course designed to upgrade the qualifications of persons on-the-job. Variable.</td>
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<td>PHYS 492 (1-3)</td>
<td>Seminar</td>
<td></td>
<td>May be repeated for credit on each new topic. Pre: Sr. standing. Variable.</td>
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<td>PHYS 493 (1-6)</td>
<td>Undergraduate Research</td>
<td></td>
<td>Pre: Consent. Variable.</td>
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<td>PHYS 495 (1-2)</td>
<td>Selected Topics</td>
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<td>A course in an area of physics not regularly offered. Topic and credit assigned by department each time offered. Pre: PHYS 335 and PHYS 336. Variable.</td>
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<td>PHYS 497 (1-16)</td>
<td>Internship</td>
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<td>Provides a student with the opportunity to gain expertise and experience in a special field under the supervision of a qualified person. Pre: Usually Sr. standing. Variable.</td>
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<td>PHYS 499 (1-8)</td>
<td>Individual Study</td>
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<td>Special arrangements must be made with an appropriate faculty member of the department office. May be repeated for credit on each new topic. Pre: Consent. Variable.</td>
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