



Twin Cities Campus

Physics B.S. Phys.

School of Physics & Astronomy

College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Spring 2012
- Required credits to graduate with this degree: 120
- Required credits within the major: 38 to 41
- Degree: Bachelor of Science in Physics

The physics program prepares students for employment, often in industrial or governmental laboratories, or for further study at graduate or professional schools in physics, engineering, biophysics, medicine, education, law, or business.

The program integrates a broad foundation in physics that can be flexibly combined with coursework in other technical disciplines or used to specialize in physics. Students should consult a physics adviser to help formulate objectives for study.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

Students must complete 8 courses before admission to the program.

Freshman and transfer students are usually admitted to pre-major status before admission to this major

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

Required prerequisites

Core Coursework

All of the sub-plans start with a common foundation in physics and mathematics. This basic core of physics and math, taken during the first two years, provides the necessary tools to move into one of the sub-plans within physics.

The freshman and sophomore years give students a broad introduction to the fundamental ideas of physics. During this same period students learn the mathematical techniques that they will need for advanced work in physics and other sciences.

Introductory Physics Core Requirement

PHYS 1301W - Introductory Physics for Science and Engineering I [PHYS, WI] (4.0 cr)

or **PHYS 1401V** - Honors Physics I [PHYS, WI] (4.0 cr)

PHYS 1302W - Introductory Physics for Science and Engineering II [PHYS, WI] (4.0 cr)

or **PHYS 1402V** - Honors Physics II [PHYS, WI] (4.0 cr)

Note: PHYS 2503 & 2403H only offered fall semester

PHYS 2503 - Physics III: Intro to Waves, Optics, and Special Relativity (4.0 cr)

or **PHYS 2403H** *{Inactive}* (4.0 cr)

PHYS 2201 - Introductory Thermodynamics and Statistical Physics (4.0 cr)

PHYS 2601 - Quantum Physics (4.0 cr)

PHYS 2605 *{Inactive}* (3.0 cr)

Mathematics Requirements

MATH 1271 - Calculus I [MATH] (4.0 cr)

or **MATH 1371** - CSE Calculus I [MATH] (4.0 cr)

or **MATH 1571H** - Honors Calculus I [MATH] (4.0 cr)

MATH 1272 - Calculus II (4.0 cr)

or **MATH 1372** - CSE Calculus II (4.0 cr)

or **MATH 1572H** - Honors Calculus II (4.0 cr)

MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)

or **MATH 2373** - CSE Linear Algebra and Differential Equations (4.0 cr)

or **MATH 2573H** - Honors Calculus III (4.0 cr)

MATH 2263 - Multivariable Calculus (4.0 cr)

or **MATH 2374** - CSE Multivariable Calculus and Vector Analysis (4.0 cr)

or **MATH 2574H** - Honors Calculus IV (4.0 cr)



General Requirements

All students are required to complete general University and college requirements including writing and liberal education courses. For more information about University-wide requirements, see the [liberal education requirements](#). Required courses for the major or minor in which a student receives a D grade (with or without plus or minus) do not count toward the major or minor (including transfer courses).

Program Requirements

In addition to the core coursework, students must select one of the five sub-plans (professional, biological, computational, engineering, teaching) and complete the respective additional programmatic requirements (48-52 cr). These requirements are subject to departmental review for each student. Requirements for each sub-plan are detailed below.

Students intending to pursue graduate study in physics are strongly encouraged to take PHYS 4303.

Program Sub-plans

A sub-plan is not required for this program.

Professional

This sub-plan is ideal for those students who want the strongest possible grounding in physics. It is designed to suit the needs of students who are interested in fundamental physics or astrophysics, applying physics to the workplace, or who are planning on continuing their physics education in graduate school.

Professional Physics Sub-Plan: Additional Programmatic Requirements (50 - 52 cr)

- PHYS 4001 - Analytical Mechanics (4.0 cr)
- PHYS 4002 - Electricity and Magnetism (4.0 cr)
- PHYS 4101 - Quantum Mechanics (4.0 cr)
- PHYS 4201 - Statistical and Thermal Physics (3.0 cr)
- PHYS 4051 - Methods of Experimental Physics I (5.0 cr)
- PHYS 4052W - Methods of Experimental Physics II [WI] (5.0 cr)

Technical Electives (25 cr)

Technical electives must include at least one upper division physics elective (3-4 cr) and at least one upper division math elective (3-4 cr).

A physics elective is any course with a PHYS designator at the 3XXX-level and above. PHYS 4303 is strongly recommended for those intending to pursue graduate study. A technical elective is any course in CSE or CBS at the 3XXX-level and above. The 1XXX CSCI programming courses in java and C++ are also accepted.

Technical electives with approval of adviser. These are in addition to any courses listed above.

Biological

Students who are interested in entering the biological sciences or medicine will find this sub-plan an attractive option. Physics applies to biology at all levels, from the basics of biosystems to biomedical engineering. This option can be very useful to students who want to pursue a career in biomedical industry. It also provides a strong foundation for students interested in pursuing an advanced degree in biophysics, molecular biology, physiology, medical physics, biomedical engineering, or medical school. Combined with the physics core curriculum this biological sub-plan gives students powerful tools to achieve their goals.

Biological Sub-Plan: Additional Programmatic Requirements (48 - 50 cr)

Chemistry Requirements

- CHEM 1021 *{Inactive}*[PHYS] (4.0 cr)
- CHEM 1022 *{Inactive}*[PHYS] (4.0 cr)
- CHEM 2301 - Organic Chemistry I (3.0 cr)

Biochemistry Requirements

- BIOC 3021 - Biochemistry (3.0 cr)

Biology Requirements

- Counted in the CLE requirement
- BIOL 1009 - General Biology [BIOL] (4.0 cr)

Upper Division Physics Requirements

Up to 2 of these may be replaced by similar courses in other departments with adviser approval

- PHYS 4001 - Analytical Mechanics (4.0 cr)
- PHYS 4002 - Electricity and Magnetism (4.0 cr)
- PHYS 4101 - Quantum Mechanics (4.0 cr)
- PHYS 4201 - Statistical and Thermal Physics (3.0 cr)

Methods of Experimental Physics

- PHYS 4051 - Methods of Experimental Physics I (5.0 cr)
- PHYS 4052W - Methods of Experimental Physics II [WI] (5.0 cr)



Technical Electives (11 cr)

When choosing the appropriate courses for the biology requirement students should consult with faculty who have expertise in these areas. PHYS 5401 and PHYS 5402 might be of particular interest to students interested in the direct application of physics to biology.

It is strongly recommended that the technical electives include PHYS 4911.

Technical electives in biology & related areas with approval of adviser. These are in addition to the courses listed above.

Computational

This sub-plan is ideal for students who seek a strong grounding in physics and the computational techniques used in physics research. Computational physics connects physics, computer science and applied mathematics to provide scientific solutions to realistic and often complex problems. Students who are interested in moving directly into industry as well as those who want to pursue a graduate degree in physics will find this program valuable.

Computational Sub-Plan: Additional Programmatic Requirements (50 - 52 cr)

Upper Division Physics Requirements

PHYS 4001 - Analytical Mechanics (4.0 cr)

PHYS 4002 - Electricity and Magnetism (4.0 cr)

PHYS 4101 - Quantum Mechanics (4.0 cr)

PHYS 4201 - Statistical and Thermal Physics (3.0 cr)

Methods of Experimental Physics

PHYS 4051 - Methods of Experimental Physics I (5.0 cr)

Approved PHYS4994 (3+cr) project w/ significant computational component may be substituted for 4052W

PHYS 4052W - Methods of Experimental Physics II [WI] (5.0 cr)

or PHYS 4994 - Directed Research (1.0 - 5.0 cr)

Computer Programming

CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)

or A comparable computer language course may be substituted for CSCI 1113.

CSCI 1901 ~~(Inactive)~~ (4.0 cr)

Technical Electives (19 cr)

A technical elective is any course in CSE or CBS at the 3XXX level and above. The 1XXX CSCI programming courses in java and C++ are also accepted. AST 4101/PHYS 4041 is strongly recommended. At least one of the electives must be a course emphasizing the application of computational methods. For example: CHEM 4021 and AEM 5251.

Technical electives with approval of adviser. These are in addition to the courses listed above.

Teaching

For students who are interested in teaching secondary school physics, this program offers a versatile broad-based education. It is particularly useful to students who are planning on teaching in Minnesota, as it has been optimized to fit well with the new state licensure procedures. And, should a student's needs or plans change, this program combined with the physics core curriculum also prepares him or her for a variety of other career tracks, including graduate study in physics.

Teaching Sub-Plan: Additional Programmatic Requirements (50 - 52 cr)

Upper Division Physics Requirements

Take 2 or more course(s) from the following:

•PHYS 4001 - Analytical Mechanics (4.0 cr)

•PHYS 4002 - Electricity and Magnetism (4.0 cr)

•PHYS 4101 - Quantum Mechanics (4.0 cr)

Methods of Experimental Physics

PHYS 4051 - Methods of Experimental Physics I (5.0 cr)

PHYS 4052W - Methods of Experimental Physics II [WI] (5.0 cr)

Historical and Social Perspectives of Science

Take 1 or more course(s) from the following:

•PHYS 4111 ~~(Inactive)~~ (3.0 cr)

•PHYS 4121W - History of 20th-Century Physics [WI] (3.0 cr)

•HSCI 3814 - Revolutions in Science: The Babylonians to Newton [HIS, GP] (3.0 - 4.0 cr)

•HSCI 3815 - Making Modern Science: Atoms, Genes and Quanta [HIS, GP] (3.0 - 4.0 cr)

General Psychology

Meets Lib Ed req of Social Sciences, and therefore credits do not count towards major

Take 1 or more course(s) from the following:

•PSTL 1281 ~~(Inactive)~~ [SOCS] (4.0 cr)

•PSY 1001 - Introduction to Psychology [SOCS] (4.0 cr)

Philosophical Foundations

Take 1 or more course(s) from the following:

•PHIL 1005 - Scientific Reasoning (4.0 cr)

•PHIL 3601W - Scientific Thought [WI] (4.0 cr)

Technical Electives (26 cr)

Students who follow this sub-plan with the intent of continuing in physics graduate school are strongly encouraged to take all four of



the upper division core courses: PHYS 4001, 4002, 4101, 4201.

Up to 8 credits will be counted for completion of the intro chemistry or biology requirements for the general science teaching license and one computer programming course at the CSI 1XXX level will be counted. Note that courses used to satisfy lib ed requirements cannot be counted as tech electives.

Technical electives in physics and related areas with approval of the adviser. These are in addition to the courses listed above.

Engineering

Students who are interested in the practical application of physics to the engineering fields, but who would like a less specialized education than they would find in an engineering department, will find that this sub-plan provides them with a solid education. In addition to the strong physics core curriculum, students can either focus on one area of engineering or explore a broad range of interests across a number of engineering fields. Students who are interested in moving directly into industry as well as those who want to pursue a graduate degree in either engineering or physics will find this program valuable.

Engineering Sub-Plan: Additional Programmatic Requirements (48 - 50 cr)

Note that CHEM 1021, which is required for several of the engineering majors, is strongly recommended.

Upper Division Physics Requirements

Up to 2 of these may be replaced by courses covering related material in other CSE depts w/ approval

PHYS 4001 - Analytical Mechanics (4.0 cr)

PHYS 4002 - Electricity and Magnetism (4.0 cr)

PHYS 4101 - Quantum Mechanics (4.0 cr)

PHYS 4201 - Statistical and Thermal Physics (3.0 cr)

Methods of Experimental Physics

PHYS 4051 - Methods of Experimental Physics I (5.0 cr)

PHYS 4052W - Methods of Experimental Physics II [WI] (5.0 cr)

Technical Electives (25 cr)

A technical elective is any course in CSE or CBS at the 3XXX level and above. The 1XXX CSCI programming courses in java and C++ are also accepted. In filling the engineering portion of the technical electives, credits can be taken in a single area or distributed across several engineering fields, depending on a student's interest.

Technical electives in engineering and related areas with approval of adviser. These are in addition to the courses listed above.

Honors UHP

This is an honors sub-plan.

Students admitted to the University Honors Program (UHP) must fulfill UHP requirements in addition to degree program requirements. Honors courses used to fulfill degree program requirements will also fulfill UHP requirements.

Current departmental honors course offerings are listed at:

http://www.honors.umn.edu/academics/curriculum/dept_courses_current.html

Honors students complete an honors thesis project in the final year, most often in conjunction with an honors thesis course, or with an honors directed studies or honors directed research course. Students select honors courses and plan for a thesis project in consultation with their UHP adviser and their departmental faculty adviser.

Honors

PHYS 4960H - Honors Seminar (1.0 cr)