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 Fall 2018
- Required credits to graduate with this degree: 120
- Required credits within the major: 89 to 99
- 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 7 courses before admission to the program.

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

Physics I

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)
or PHYS 1501V *{Inactive}*[PHYS, WI] (4.0 cr)

Physics II

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)
or PHYS 1502V *{Inactive}*[PHYS, WI] (4.0 cr)

Note: PHYS 2503 and 2503H offered only fall semester.

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

Lower Division Core Physics Requirement

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

Mathematics Requirements

Calculus I

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)

Calculus II

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)

Calculus III

MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
or MATH 2373 - CSE Linear Algebra and Differential Equations (4.0 cr)
or MATH 2574H - Honors Calculus IV (4.0 cr)

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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

All freshmen in the College of Science and Engineering must complete CSE 1001: First-Year Experience.

In addition to the core coursework, students must select one of the five sub-plans (professional, biological, computational, teaching, engineering) and complete the respective additional programmatic requirements (47-54 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.

Core Coursework

Common Core Physics Requirements

PHYS 2601 - Quantum Physics (4.0 cr)
PHYS 3041 - Mathematical Methods for Physicists (3.0 cr)
PHYS 3605W - Modern Physics Laboratory [WI] (3.0 cr)
MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2374 - CSE Multivariable Calculus and Vector Analysis (4.0 cr)
or MATH 2573H - Honors Calculus III (4.0 cr)

Upper Division Writing Intensive within the major

Students are required to take one upper division writing intensive course within the major. If that requirement has not been satisfied within the core major requirements, students must choose one course from the following list. Some of these courses may also fulfill other major requirements.

Take 0 or more course(s) from the following:

- PHIL 3601W - Scientific Thought [WI] (4.0 cr)
- PHYS 4052W - Methods of Experimental Physics II [WI] (5.0 cr)
- PHYS 4121W - History of 20th-Century Physics [WI] (3.0 cr)

Program Sub-plans

Students are required to complete one of the following sub-plans.

Professional

This sub-plan is ideal for 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 (47-49 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)
PHYS 4303 - Electrodynamics and Waves (3.0 cr)

Technical Electives

Technical electives include any mathematics, science, or engineering course of technical nature by departmental advisor approval. Only one course may be an directed research or directed study course. Students are encouraged to discuss options for technical electives with their departmental advisor, as additional courses are frequently approved for inclusion in a student's technical electives based on individual interests and goals.

Take 19 or more credit(s) from the following:

Upper Level Physics Elective

Take 1 or more course(s) totaling 3 or more credit(s) from the following:

- PHYS 3022 - Introduction to Cosmology (3.0 cr)
- PHYS 4041 - Computational Methods in the Physical Sciences (4.0 cr)
- PHYS 4121W - History of 20th-Century Physics [WI] (3.0 cr)
- PHYS 4211 - Introduction to Solid-State Physics (3.0 cr)
- PHYS 4511 - Introduction to Nuclear and Particle Physics (3.0 cr)

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•PHYS 4611 - Introduction to Space Physics (3.0 cr)
•PHYS 4621 - Introduction to Plasma Physics (3.0 cr)
•PHYS 5041 - Mathematical Methods for Physics (4.0 cr)
•PHYS 4911 - Introduction to Biopolymer Physics (3.0 cr)
or PHYS 5081 - Introduction to Biopolymer Physics (3.0 cr)

•Other Technical Electives

Take at most 16 credit(s) from the following:
•AST 4001 - Astrophysics I (4.0 cr)
•AST 4002 - Astrophysics II (4.0 cr)
•AST 5201 - Methods of Experimental Astrophysics (4.0 cr)
•EE 3005 - Fundamentals of Electrical Engineering (4.0 cr)
•MATH 3283W - Sequences, Series, and Foundations: Writing Intensive [WI] (4.0 cr)
•MATH 4242 - Applied Linear Algebra (4.0 cr)
•MATH 4281 - Introduction to Modern Algebra (4.0 cr)
•MATH 4428 - Mathematical Modeling (4.0 cr)
•MATH 4512 - Differential Equations with Applications (3.0 cr)
•MATH 4567 - Applied Fourier Analysis (4.0 cr)
•MATH 5285H - Honors: Fundamental Structures of Algebra I (4.0 cr)
•MATH 5525 - Introduction to Ordinary Differential Equations (4.0 cr)
•MATH 5583 - Complex Analysis (4.0 cr)
•MATH 5587 - Elementary Partial Differential Equations I (4.0 cr)
•MATH 5588 - Elementary Partial Differential Equations II (4.0 cr)
•MATH 5615H - Honors: Introduction to Analysis I (4.0 cr)
•MATH 5616H - Honors: Introduction to Analysis II (4.0 cr)
•MATS 3011 - Introduction to Materials Science and Engineering (3.0 cr)
•CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)
or CSCI 1133 - Introduction to Computing and Programming Concepts (4.0 cr)
•STAT 3011 - Introduction to Statistical Analysis [MATH] (4.0 cr)
or STAT 3021 - Introduction to Probability and Statistics (3.0 cr)
or MATH 5651 - Basic Theory of Probability and Statistics (4.0 cr)
or IE 3521 - Statistics, Quality, and Reliability (4.0 cr)

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 (51 cr)

Chemistry Requirements

CHEM 1065 - Chemical Principles I Laboratory [PHYS] (1.0 cr)
CHEM 1061 - Chemical Principles I [PHYS] (3.0 cr)
or CHEM 1081 - Chemistry for the Life Sciences I [PHYS] (3.0 cr)
CHEM 1062 - Chemical Principles II [PHYS] (3.0 cr)
CHEM 1066 - Chemical Principles II Laboratory [PHYS] (1.0 cr)
or CHEM 1082 - Chemistry for the Life Sciences II (3.0 cr)
CHEM 1086 - Chemistry for the Life Sciences II Laboratory (1.0 cr)
CHEM 2301 - Organic Chemistry I (3.0 cr)
or CHEM 2081 - Chemistry for the Life Sciences III (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 advisor 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

Technical electives include any mathematics, science, or engineering course of technical nature by departmental advisor approval.

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Only one course may be a directed research/study course. PHYS4911 is strongly recommended for students interested in biological physics. Students are encouraged to discuss options for technical electives with their departmental advisor, as additional courses are often approved for inclusion in a student's technical electives based on individual interests and goals.
Take 8 or more credit(s) from the following:
•MATH 4242 - Applied Linear Algebra (4.0 cr)
•MATH 4428 - Mathematical Modeling (4.0 cr)
•MATH 4512 - Differential Equations with Applications (3.0 cr)
•MATH 4567 - Applied Fourier Analysis (4.0 cr)
•PHYS 3022 - Introduction to Cosmology (3.0 cr)
•PHYS 4121W - History of 20th-Century Physics [WI] (3.0 cr)
•PHYS 4211 - Introduction to Solid-State Physics (3.0 cr)
•PHYS 4303 - Electrodynamics and Waves (3.0 cr)
•PHYS 4511 - Introduction to Nuclear and Particle Physics (3.0 cr)
•PHYS 4611 - Introduction to Space Physics (3.0 cr)
•PHYS 4621 - Introduction to Plasma Physics (3.0 cr)
•PHYS 4911 - Introduction to Biopolymer Physics (3.0 cr)
•PHYS 5041 - Mathematical Methods for Physics (4.0 cr)
•CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)
or CSCI 1133 - Introduction to Computing and Programming Concepts (4.0 cr)
•STAT 3011 - Introduction to Statistical Analysis [MATH] (4.0 cr)
or STAT 3021 - Introduction to Probability and Statistics (3.0 cr)
or MATH 5651 - Basic Theory of Probability and Statistics (4.0 cr)
or IE 3521 - Statistics, Quality, and Reliability (4.0 cr)

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 (48-49 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)
PHYS 4052W - Methods of Experimental Physics II [WI] (5.0 cr)

Computer Programming

Intro to C/C++

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.

Structure of Computer Programming

CSCI 1913 - Introduction to Algorithms, Data Structures, and Program Development (4.0 cr)
or CSCI 1933 - Introduction to Algorithms and Data Structures (4.0 cr)

Computational Elective

A minimum of one elective course with a computational focus must be taken as part of this subplan.
AST 4041 - Computational Methods in the Physical Sciences (4.0 cr)
or PHYS 4041 - Computational Methods in the Physical Sciences (4.0 cr)
or CHEM 4021 - Computational Chemistry (3.0 cr)
or AEM 5253 - Computational Fluid Mechanics (3.0 cr)

Technical Electives

Technical electives include any mathematics, science, or engineering course of technical nature by departmental advisor approval. Only one course may be a directed research or directed study course. Students are encouraged to discuss options for technical electives with their departmental advisor, as additional courses are frequently approved for inclusion in a student's technical electives based on individual interests and goals.
Take 12 or more credit(s) from the following:
•AST 4001 - Astrophysics I (4.0 cr)
•AST 4002 - Astrophysics II (4.0 cr)
•AST 5201 - Methods of Experimental Astrophysics (4.0 cr)
•CSCI 3081W - Program Design and Development [WI] (4.0 cr)
•CSCI 4041 - Algorithms and Data Structures (4.0 cr)
•CSCI 4061 - Introduction to Operating Systems (4.0 cr)
•CSCI 4211 - Introduction to Computer Networks (3.0 cr)
•CSCI 5304 - Computational Aspects of Matrix Theory (3.0 cr)

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•CSCI 5523 - Introduction to Data Mining (3.0 cr)
•EE 3005 - Fundamentals of Electrical Engineering (4.0 cr)
•MATH 3283W - Sequences, Series, and Foundations: Writing Intensive [WI] (4.0 cr)
•MATH 4242 - Applied Linear Algebra (4.0 cr)
•MATH 4428 - Mathematical Modeling (4.0 cr)
•MATH 4512 - Differential Equations with Applications (3.0 cr)
•MATH 4567 - Applied Fourier Analysis (4.0 cr)
•PHYS 3022 - Introduction to Cosmology (3.0 cr)
•PHYS 4121W - History of 20th-Century Physics [WI] (3.0 cr)
•PHYS 4211 - Introduction to Solid-State Physics (3.0 cr)
•PHYS 4303 - Electrodynamics and Waves (3.0 cr)
•PHYS 4511 - Introduction to Nuclear and Particle Physics (3.0 cr)
•PHYS 4611 - Introduction to Space Physics (3.0 cr)
•PHYS 4621 - Introduction to Plasma Physics (3.0 cr)
•PHYS 4911 - Introduction to Biopolymer Physics (3.0 cr)
•PHYS 5041 - Mathematical Methods for Physics (4.0 cr)
•IE 3521 - Statistics, Quality, and Reliability (4.0 cr)
or MATH 5651 - Basic Theory of Probability and Statistics (4.0 cr)
or STAT 3011 - Introduction to Statistical Analysis [MATH] (4.0 cr)
or STAT 3021 - Introduction to Probability and Statistics (3.0 cr)

Secondary Education

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.

Secondary Education Sub-plan: Additional Programmatic Requirements (52-53 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 and Philosophical Foundations

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

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

Technical electives include any math, science, or engineering course of technical nature by departmental advisor approval. Students with the intent of continuing in physics graduate school are strongly encouraged to take PHYS 4001, 4002, 4101, and 4201. Only one course may be a directed research or directed study course. Students are encouraged to discuss options with their departmental advisor, as additional courses are frequently approved for inclusion based on individual interests and goals.

Take 23 or more credit(s) from the following:
•AST 4001 - Astrophysics I (4.0 cr)
•AST 4002 - Astrophysics II (4.0 cr)
•AST 5201 - Methods of Experimental Astrophysics (4.0 cr)
•EE 3005 - Fundamentals of Electrical Engineering (4.0 cr)
•ESCI 3006 - Rocks and Stars: Introduction to Planetary Science (3.0 cr)
•ESCI 3303W - Geochemical Principles [WI] (4.0 cr)
•ESCI 3402 - Science and Politics of Global Warming [ENV] (3.0 cr)
•MATH 3283W - Sequences, Series, and Foundations: Writing Intensive [WI] (4.0 cr)
•MATH 4242 - Applied Linear Algebra (4.0 cr)
•MATH 4281 - Introduction to Modern Algebra (4.0 cr)
•MATH 4428 - Mathematical Modeling (4.0 cr)
•MATH 4512 - Differential Equations with Applications (3.0 cr)

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- MATH 4567 - Applied Fourier Analysis (4.0 cr)
- MATS 3011 - Introduction to Materials Science and Engineering (3.0 cr)
- MM 3305 - Advanced 3D Printing for Innovative Business Practices (3.0 cr)
- PHYS 3022 - Introduction to Cosmology (3.0 cr)
- PHYS 4002 - Electricity and Magnetism (4.0 cr)
- PHYS 4101 - Quantum Mechanics (4.0 cr)
- PHYS 4121W - History of 20th-Century Physics [WI] (3.0 cr)
- PHYS 4201 - Statistical and Thermal Physics (3.0 cr)
- PHYS 4211 - Introduction to Solid-State Physics (3.0 cr)
- PHYS 4303 - Electrodynamics and Waves (3.0 cr)
- PHYS 4511 - Introduction to Nuclear and Particle Physics (3.0 cr)
- PHYS 4611 - Introduction to Space Physics (3.0 cr)
- PHYS 4621 - Introduction to Plasma Physics (3.0 cr)
- PHYS 4911 - Introduction to Biopolymer Physics (3.0 cr)
- PHYS 5041 - Mathematical Methods for Physics (4.0 cr)
- CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)
  or CSCI 1133 - Introduction to Computing and Programming Concepts (4.0 cr)
- IE 3521 - Statistics, Quality, and Reliability (4.0 cr)
  or MATH 5651 - Basic Theory of Probability and Statistics (4.0 cr)
  or STAT 3011 - Introduction to Statistical Analysis [MATH] (4.0 cr)
  or STAT 3021 - Introduction to Probability and Statistics (3.0 cr)
- Take at most 8 credit(s) from the following:
  - AST 1001 - Exploring the Universe [PHYS, ENV] (4.0 cr)
  - BIOL 1009 - General Biology [BIOL] (4.0 cr)
  - ESCI 1001 - Earth and Its Environments [PHYS, ENV] (4.0 cr)
  - ESCI 1006 - Oceanography [PHYS, ENV] (4.0 cr)
  - CHEM 1061 - Chemical Principles I [PHYS] (3.0 cr)
    CHEM 1065 - Chemical Principles I Laboratory [PHYS] (1.0 cr)
  - CHEM 1062 - Chemical Principles II [PHYS] (3.0 cr)
    CHEM 1066 - Chemical Principles II Laboratory [PHYS] (1.0 cr)

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 (47 cr)

Note that CHEM 1061 and 1065, which are required for several of the engineering majors, are strongly recommended.

Upper Division Physics Requirements

Up to 2 of these may be replaced by courses covering related material in other CSE departments with advisor 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

Technical electives include any mathematics, science, or engineering course of technical nature by departmental advisor approval. Only one course may be an directed research or directed study course. Students are encouraged to discuss options for technical electives with their departmental advisor, as additional courses are frequently approved for inclusion in a student's technical electives based on individual interests and goals.

Take 22 or more credit(s) from the following:

Upper Level Math Electives

Take at most 19 credit(s) from the following:

- MATH 4242 - Applied Linear Algebra (4.0 cr)
- MATH 4428 - Mathematical Modeling (4.0 cr)
- MATH 4567 - Applied Fourier Analysis (4.0 cr)
- MATH 5285H - Honors: Fundamental Structures of Algebra I (4.0 cr)
- MATH 5525 - Introduction to Ordinary Differential Equations (4.0 cr)
- MATH 5583 - Complex Analysis (4.0 cr)
- MATH 5587 - Elementary Partial Differential Equations I (4.0 cr)
- MATH 5615H - Honors: Introduction to Analysis I (4.0 cr)

- **Upper Level Physics Electives**

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Take 1 or more course(s) totaling 3 or more credit(s) from the following:
- PHYS 3022 - Introduction to Cosmology (3.0 cr)
- PHYS 4041 - Computational Methods in the Physical Sciences (4.0 cr)
- PHYS 4121W - History of 20th-Century Physics [WI] (3.0 cr)
- PHYS 4211 - Introduction to Solid-State Physics (3.0 cr)
- PHYS 4511 - Introduction to Nuclear and Particle Physics (3.0 cr)
- PHYS 4611 - Introduction to Space Physics (3.0 cr)
- PHYS 4621 - Introduction to Plasma Physics (3.0 cr)
- PHYS 5041 - Mathematical Methods for Physics (4.0 cr)
- PHYS 4911 - Introduction to Biopolymer Physics (3.0 cr)
  or PHYS 5081 - Introduction to Biopolymer Physics (3.0 cr)

- **Other Technical Electives**

Take at most 19 credit(s) from the following:
- AST 4001 - Astrophysics I (4.0 cr)
- AST 4002 - Astrophysics II (4.0 cr)
- AST 5201 - Methods of Experimental Astrophysics (4.0 cr)
- EE 3005 - Fundamentals of Electrical Engineering (4.0 cr)
- MATH 3283W - Sequences, Series, and Foundations: Writing Intensive [WI] (4.0 cr)
- MATH 4512 - Differential Equations with Applications (3.0 cr)
- MATH 5588 - Elementary Partial Differential Equations II (4.0 cr)
- MATH 5616H - Honors: Introduction to Analysis II (4.0 cr)
- MATS 3011 - Introduction to Materials Science and Engineering (3.0 cr)
- CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)
  or CSCI 1133 - Introduction to Computing and Programming Concepts (4.0 cr)
- STAT 3011 - Introduction to Statistical Analysis [MATH] (4.0 cr)
  or STAT 3021 - Introduction to Probability and Statistics (3.0 cr)
  or MATH 5651 - Basic Theory of Probability and Statistics (4.0 cr)
  or IE 3521 - Statistics, Quality, and Reliability (4.0 cr)

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