Physics

Physics is the scientific study of the fundamental principles governing the behavior of matter and the interaction of matter and energy. Mathematics is used to describe fundamental physical principles, the behavior of matter, and the interactions of matter and energy. As the most fundamental of sciences, physics provides a foundation for other scientific fields as well as the underpinnings of modern technology. The Physics department is unique because of the breadth of its faculty expertise and research, and the relatively intimate size of its classes above the introductory level. Physics concentrators may choose to pursue either the A.B. or the more intensive Sc.B. degree. Course work on either path covers a broad base of topics (for example, electricity and magnetism, classical and quantum mechanics, thermodynamics, and statistical mechanics). The Sc.B. degree requires additional advanced topics as well as a senior thesis project.

Standard concentration for the A.B. degree

Select one of the following Series:

- PHYS 0030 Basic Physics A
- or PHYS 0050 Foundations of Mechanics
- or PHYS 0070 Analytical Mechanics
- PHYS 0040 Basic Physics B
- or PHYS 0060 Foundations of Electromagnetism and Modern Physics
- or PHYS 0160 Introduction to Relativity, Waves and Quantum Physics

Take each of the following:

- PHYS 0470 Electricity and Magnetism
- PHYS 0500 Advanced Classical Mechanics
- PHYS 0560 Experiments in Modern Physics
- PHYS 1410 Quantum Mechanics A
- PHYS 1530 Thermodynamics and Statistical Mechanics (One additional 1000-level course or a mathematics course beyond the introductory level.)

One additional 1000-level course or a mathematics course beyond the introductory level.

Total Credits 8

Standard program for the Sc.B. degree

Prerequisites:

- Select one of each:
  - PHYS 0050 Foundations of Mechanics
  - or PHYS 0070 Analytical Mechanics
  - PHYS 0060 Foundations of Electromagnetism and Modern Physics
  - or PHYS 0160 Introduction to Relativity, Waves and Quantum Physics

Select one of the following:

- MATH 0190 Single Variable Calculus, Part II (Physics/Engineering) (Accelerated) and Multivariable Calculus
- MATH 0200 Single Variable Calculus, Part II (Physics/Engineering) and Multivariable Calculus (Physics/Engineering)
- MATH 0350 Multivariable Calculus With Theory (or equivalent)

Program:

- PHYS 0470 Electricity and Magnetism
- PHYS 0500 Advanced Classical Mechanics
- PHYS 0560 Experiments in Modern Physics
- PHYS 1410 Quantum Mechanics A
- PHYS 1420 Quantum Mechanics B
- PHYS 1510 Advanced Electromagnetic Theory
- PHYS 1530 Thermodynamics and Statistical Mechanics

Three of the following:

- PHYS 1100 General Relativity
- PHYS 1250 Stellar Structure and the Interstellar Medium
- PHYS 1270 Extragalactic Astronomy and High-Energy Astrophysics
- PHYS 1280 Introduction to Cosmology

Two additional 1000- or 2000-level courses in physics or a related field which are not listed as requirements.

Astrophysics Track for the Sc.B. degree

Prerequisites:

- Select one of each:
  - PHYS 0050 Foundations of Mechanics
  - or PHYS 0070 Analytical Mechanics
  - PHYS 0060 Foundations of Electromagnetism and Modern Physics
  - or PHYS 0160 Introduction to Relativity, Waves and Quantum Physics

Take each of the following:

- MATH 0170 Single Variable Calculus, Part I
- & MATH 0190 Single Variable Calculus, Part II (Physics/Engineering) and Multivariable Calculus

Program:

- MATH 0520 Linear Algebra
- or MATH 0540 Linear Algebra With Theory
- or PHYS 0720 Methods of Mathematical Physics

Select one of the following Math courses:

- APMA 0330 Methods of Applied Mathematics I
- APMA 0340 Methods of Applied Mathematics II
- APMA 0350 Applied Ordinary Differential Equations
- APMA 0360 Applied Partial Differential Equations I
- MATH 1110 Ordinary Differential Equations
- MATH 1120 Partial Differential Equations
- PHYS 0500 Advanced Classical Mechanics
- PHYS 0560 Experiments in Modern Physics
- PHYS 1410 Quantum Mechanics A
- PHYS 1530 Thermodynamics and Statistical Mechanics

One additional 1000-level course or equivalent

Dissertation must be submitted.

1 In addition, courses in computer programming are recommended.
2 A senior thesis is required. This is to be prepared in connection with PHYS 1990 under the direction of a faculty supervisor. The topic may be in related department or of interdisciplinary nature. In any event, a dissertation must be submitted.
Biological Physics Track for the Sc.B. degree

- **Foundations of Physics**
  - PHYS 0070: Analytical Mechanics 1
  - or PHYS 0050: Foundations of Mechanics 1
  - or ENGN 0040: Engineering Statics and Dynamics 1
  - PHYS 0160: Introduction to Relativity, Waves and Quantum Physics 1
  - or PHYS 0060: Foundations of Electromagnetism and Modern Physics 1
  - PHYS 0470: Electricity and Magnetism 1
  - PHYS 0500: Advanced Classical Mechanics 1
  - PHYS 1410: Quantum Mechanics A 1
  - PHYS 1530: Thermodynamics and Statistical Mechanics 1

Select one of the following Series: 1

**Series A**
- PHYS 0720: Methods of Mathematical Physics 1-2

**Series B**
- Select one of the following:
  - APMA 0330: Methods of Applied Mathematics I 1
  - APMA 0350: Applied Ordinary Differential Equations 1
  - MATH 1110: Ordinary Differential Equations 1
  - And select one of the following:
  - MATH 0180: Multivariable Calculus 1
  - MATH 0200: Multivariable Calculus (Physics/Engineering) 1
  - MATH 0350: Multivariable Calculus With Theory 1
  - MATH 0520: Linear Algebra 1
  - MATH 0540: Linear Algebra With Theory 1

**Basic Biology and Chemistry**
- BIOL 0200: The Foundation of Living Systems (or placement out of BIOL 0200) 1
- BIOL 0500: Cell and Molecular Biology 1
- CHEM 0330: Equilibrium, Rate, and Structure 1

**Advanced Biophysical Topics and Techniques**
- PHYS 1610: Biological Physics 1
- PHYS 1990: Senior Conference Course 1

**Elective Courses** (four chosen from the following list, with at least two 1000-level courses, or additional courses approved by the concentration advisor):
- APMA 0360: Applied Partial Differential Equations I 1
- APMA 0410: Mathematical Methods in the Brain Sciences 1
- APMA 0650: Essential Statistics 1
- APMA 1070: Quantitative Models of Biological Systems 1
- APMA 1080: Inference in Genomics and Molecular Biology 1
- BIOL 0280: Biochemistry 1
- BIOL 0470: Genetics 1
- BIOL 1050: Biology of the Eukaryotic Cell 1
- BIOL 1200: Protein Biophysics and Structure 1
- BIOL 1270: Advanced Biochemistry 1

Mathematical Physics Track for the A.B. degree

**Prerequisites:**
- MATH 0090: Single Variable Calculus, Part I 1
  - or MATH 0100: Single Variable Calculus, Part II 1
  - or MATH 0190: Single Variable Calculus, Part II (Physics/Engineering) 1
- PHYS 0050: Foundations of Mechanics 1
  - or PHYS 0070: Analytical Mechanics 1

**Mathematics Courses**

- MATH 0180: Multivariable Calculus 1
  - or MATH 0200: Multivariable Calculus (Physics/Engineering) 1
  - or MATH 0350: Multivariable Calculus With Theory 1
- MATH 0520: Linear Algebra 1
  - or MATH 0540: Linear Algebra With Theory 1
- MATH 1110: Ordinary Differential Equations 1

Select at least one of the following:

- MATH 1060: Differential Geometry 1
- MATH 1120: Partial Differential Equations 1
- MATH 1210: Probability 1

**Physics Courses**

- PHYS 0060: Foundations of Electromagnetism and Modern Physics 1
  - or PHYS 0160: Introduction to Relativity, Waves and Quantum Physics 1
- PHYS 0470: Electricity and Magnetism 1
- PHYS 0500: Advanced Classical Mechanics 1
- PHYS 0560: Experiments in Modern Physics 1

Select at least two of the following:

- PHYS 1410: Quantum Mechanics A 1
- PHYS 1420: Quantum Mechanics B 1
- PHYS 1510: Advanced Electromagnetic Theory 1
- PHYS 1530: Thermodynamics and Statistical Mechanics 1
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<tr>
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<tr>
<td>PHYS 1560</td>
<td>Modern Physics Laboratory</td>
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</table>

1 Concentrators are required to take at least one course in mathematics and one in physics in each of their last two semesters.

**Mathematical Physics Track for the Sc.B. degree**

**Prerequisites:**
Select one of the following series:

<table>
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<tr>
<th>Course</th>
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<tr>
<td>PHYS 0050</td>
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<tr>
<td>or PHYS 0070</td>
<td>Analytical Mechanics</td>
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<td>PHYS 0060</td>
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<td>or PHYS 0160</td>
<td>Introduction to Relativity, Waves and Quantum Physics</td>
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Select one of the following:

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<tr>
<td>MATH 0190</td>
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<tr>
<td>MATH 0090</td>
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<td>&amp; MATH 0100</td>
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**Required courses:**

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<td>PHYS 0500</td>
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<td>PHYS 1410</td>
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<td>PHYS 1530</td>
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<td>MATH 0180</td>
<td>Multivariable Calculus</td>
<td>1-2</td>
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<tr>
<td>&amp; MATH 0200</td>
<td>and Multivariable Calculus (Physics/Engineering)</td>
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<tr>
<td>or MATH 0350</td>
<td>Multivariable Calculus With Theory</td>
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<tr>
<td>MATH 0520</td>
<td>Linear Algebra</td>
<td>1</td>
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<td>or MATH 0540</td>
<td>Linear Algebra With Theory</td>
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<tr>
<td>or PHYS 0720</td>
<td>Methods of Mathematical Physics</td>
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<td>PHYS 1990</td>
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**Total Credits** 18-20

1 A senior thesis is required. This is to be prepared in connection with under the direction of a faculty supervisor.