

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: 2

| | |
|--------------|---|
| 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: 5

| | |
|-----------|--|
| 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. 1

Total Credits 8

Standard program for the Sc.B. degree

Prerequisites:

Select one of each: 2

| | |
|--------------|---|
| 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: 1

| | |
|--------------|---|
| MATH 0190 | Single Variable Calculus, Part II (Physics/Engineering) |
| or MATH 0090 | Single Variable Calculus, Part I |
| or MATH 0100 | Single Variable Calculus, Part II |

Program: 8

| | |
|-----------|--|
| 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 |
| PHYS 1560 | Modern Physics Laboratory |

Take one additional 1000 or 2000 level Physics course or upper level course in related fields of science chosen by the student with the agreement of his or her advisor. 1

Four Mathematics courses beyond MATH 0190 or 0090, 0100 including choices from Applied Mathematics 4

PHYS 1990 Senior Conference Course 2 1

Total Credits 17

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.

Astrophysics Track for the Sc.B. degree

Prerequisites:

Select one of each: 2

| | |
|--------------|---|
| 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 |

PHYS 0270 Astronomy and Astrophysics 1

Select one of the following Series: 2

MATH 0170 Single Variable Calculus, Part II (Accelerated) and Multivariable Calculus & MATH 0180

MATH 0190 Single Variable Calculus, Part II (Physics/Engineering) and Multivariable Calculus (Physics/Engineering) & MATH 0200

MATH 0350 Multivariable Calculus With Theory (or equivalent)

PHYS 0470 Electricity and Magnetism 1

Program:

MATH 0520 Linear Algebra 1

or MATH 0540 Linear Algebra With Theory

or PHYS 0720 Methods of Mathematical Physics

Select one of the following Math courses: 1

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 1

PHYS 0560 Experiments in Modern Physics 1

PHYS 1410 Quantum Mechanics A 1

PHYS 1530 Thermodynamics and Statistical Mechanics 1

Three of the following: 3

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. 2

| | | |
|----------------------|---------------------------------------|-----------|
| PHYS 1990 | Senior Conference Course ¹ | 1 |
| Total Credits | | 18 |

¹ A senior thesis is required. This is to be prepared in connection with under the direction of a faculty supervisor. The topic may be in a 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 | |
| or ENGN 0040 | Engineering Statics and Dynamics | |
| PHYS 0160 | Introduction to Relativity, Waves and Quantum Physics | 1 |
| or PHYS 0060 | Foundations of Electromagnetism and Modern Physics | |
| 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 1-2

Series A

PHYS 0720 Methods of Mathematical Physics

Series B

Select one of the following:

APMA 0330 Methods of Applied Mathematics I
 APMA 0350 Applied Ordinary Differential Equations
 MATH 1110 Ordinary Differential Equations

And select one of the following:

MATH 0180 Multivariable Calculus
 MATH 0200 Multivariable Calculus (Physics/Engineering)
 MATH 0350 Multivariable Calculus With Theory
 MATH 0520 Linear Algebra
 MATH 0540 Linear Algebra With Theory

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): 4

| | | |
|-----------|---|--|
| APMA 0360 | Applied Partial Differential Equations I | |
| APMA 0410 | Mathematical Methods in the Brain Sciences | |
| APMA 0650 | Introduction to Probability and Statistics | |
| APMA 1070 | Quantitative Models of Biological Systems | |
| APMA 1080 | Inference in Genomics and Molecular Biology | |
| BIOL 0280 | Biochemistry | |
| BIOL 0470 | Genetics | |
| BIOL 1050 | Biology of the Eukaryotic Cell | |
| BIOL 1200 | Protein Biophysics and Structure | |
| BIOL 1270 | Advanced Biochemistry | |

| | | |
|----------------------|---|--------------|
| BIOL 1870 | Techniques and Clinical Applications in Pathobiology | |
| CHEM 0350 | Organic Chemistry I | |
| CHEM 0360 | Organic Chemistry II | |
| MATH 0090 | Single Variable Calculus, Part I | |
| MATH 0170 | Single Variable Calculus, Part II (Accelerated) | |
| MATH 0190 | Single Variable Calculus, Part II (Physics/Engineering) | |
| MATH 1620 | Mathematical Statistics | |
| MATH 1210 | Probability | |
| PHYS 0560 | Experiments in Modern Physics | |
| PHYS 1510 | Advanced Electromagnetic Theory | |
| PHYS 1560 | Modern Physics Laboratory | |
| PHYS 2620F | Selected Topics in Molecular Biophysics | |
| PHYS 1990 | Senior Conference Course ² | 1 |
| Total Credits | | 17-18 |

¹ Select Series A alone or two from Series B as indicated.

² A senior thesis is required. This is to be prepared in connection with under the direction of a faculty supervisor. The topic may be in a related department or of interdisciplinary nature. In any event, a dissertation must be submitted.

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 | |
| or MATH 0190 | Single Variable Calculus, Part II (Physics/Engineering) | |
| PHYS 0050 | Foundations of Mechanics | 1 |
| or PHYS 0070 | Analytical Mechanics | |

Mathematics Courses ¹

| | | |
|---------------------------------------|--|---|
| MATH 0180 | Multivariable Calculus | 1 |
| or MATH 0200 | Multivariable Calculus (Physics/Engineering) | |
| or MATH 0350 | Multivariable Calculus With Theory | |
| MATH 0520 | Linear Algebra | 1 |
| or MATH 0540 | Linear Algebra With Theory | |
| MATH 1110 | Ordinary Differential Equations | 1 |
| Select at least one of the following: | | 1 |
| MATH 1060 | Differential Geometry | |
| MATH 1120 | Partial Differential Equations | |
| MATH 1210 | Probability | |

Physics Courses ¹

| | | |
|---------------------------------------|---|---|
| PHYS 0060 | Foundations of Electromagnetism and Modern Physics | 1 |
| or PHYS 0160 | Introduction to Relativity, Waves and Quantum Physics | |
| 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: | | 2 |
| PHYS 1410 | Quantum Mechanics A | |
| PHYS 1420 | Quantum Mechanics B | |
| PHYS 1510 | Advanced Electromagnetic Theory | |
| PHYS 1530 | Thermodynamics and Statistical Mechanics | |

| | | |
|----------------------|---------------------------|-----------|
| PHYS 1560 | Modern Physics Laboratory | |
| Total Credits | | 12 |

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: 2

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: 1-2

MATH 0190 Single Variable Calculus, Part II (Physics/Engineering)

MATH 0090 Single Variable Calculus, Part I and Single Variable Calculus, Part II

Required courses:

| | | |
|--|---|--------------|
| PHYS 0470 | Electricity and Magnetism | 1 |
| PHYS 0500 | Advanced Classical Mechanics | 1 |
| PHYS 0560 | Experiments in Modern Physics | 1 |
| PHYS 1410 | Quantum Mechanics A | 1 |
| PHYS 1530 | Thermodynamics and Statistical Mechanics | 1 |
| MATH 0180 & MATH 0200 | Multivariable Calculus and Multivariable Calculus (Physics/Engineering) | 1-2 |
| or MATH 0350 | Multivariable Calculus With Theory | |
| MATH 0520 | Linear Algebra | 1 |
| or MATH 0540 | Linear Algebra With Theory | |
| or PHYS 0720 | Methods of Mathematical Physics | |
| MATH 1460 | Complex Analysis | 1 |
| Four additional 1000 or 2000 level Physics courses | | 4 |
| Two additional 1000 or 2000 level Math courses | | 2 |
| PHYS 1990 | Senior Conference Course ¹ | 1 |
| 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.