PHYSICS (BS)

CIP: 40.0801

Program Description

Physics is a broad discipline, ranging from fundamental scientific questions to sophisticated technological applications. At its most basic, it is the study of matter and energy and their manifold interactions. Physicists study topics as wide-ranging as the underlying nature of space and time; the origins, large-scale structure, and future evolution of the universe; the behavior of stars and galaxies; the fundamental constituents of matter; the many different patterns in which matter is organized, including superconductivity, liquid crystals, or the various forms of magnetism in solids; the workings of biological matter, whether in molecules such as DNA, or cellular structures, or the transport of matter and energy in and across cells. Basic physics research has led to myriad technological advances. A small list of these advances includes: radio and television; computers; lasers; X-rays; magnetic resonance imaging and CAT scans; and the World Wide Web.

Physics is a hands-on discipline, and students gain expertise not only in the classroom but also in the laboratory. Those trained in physics are found in many occupations, such as various fields of engineering, computer technology, health, environmental and earth sciences, communications, and science writing. They participate in activities ranging from the writing of realistic computer games to the modeling of financial activities, as well as the more traditional activities of physicists. A higher degree opens the possibility of creative research in industry, or teaching and research in colleges and universities. Outstanding and highly motivated students are offered special opportunities for independent study, summer laboratory research, internships, and other enhancements.

In addition to Foundations of Science 1-6 and six required courses in physics, the major requires four mathematics courses and one physics elective. Although not required, Complex Analysis and Partial Differential Equations are especially relevant to physics, and students are encouraged to complete one or both. At least one additional physics elective is strongly recommended.

Study Away

The study away pathway for the Physics major can be found on the NYUAD Student Portal at students.nyuad.nyu.edu/pathways/). Students with questions should contact the Office of Global Education.

The program recommends that not more than one physics elective be taken while studying away.

Specializations

The program offers the following specializations:

Astrophysics

For Physics majors only.

The Physics major offers a specialization in Astrophysics. Astrophysics employs the principles of physics and chemistry to explain the nature of astronomical objects. The objects studied cover the entire spectrum of celestial bodies, including the Sun and its planets, extrasolar planets, stars, galaxies, the interstellar and intergalactic medium and the cosmos as a whole.

Emission from these objects are examined across all parts of the electromagnetic spectrum, and the properties examined include luminosity, density, temperature, and chemical composition. Because astrophysics is a very broad subject, astrophysicists apply concepts and methods from many disciplines of physics, including mechanics, electromagnetism, statistical mechanics, thermodynamics, quantum mechanics, relativity, nuclear and particle physics, and atomic and molecular physics.

Physics majors who elect to complete the Astrophysics specialization must complete all courses required for the Physics majors and four astrophysics electives selected from the list below. One of these courses can be used to satisfy the elective requirement for the Physics major. The other three would be in addition to the minimum elective requirements for the major. At least one of the astrophysics electives must be a lab requirement. Additionally, note that PHYS-UH 3220 Imaging and Spectroscopy Lab and PHYS-UH 3221 Radio Imaging and Time Series Lab are half courses and both would be needed to satisfy one of the requirements for the specialization (or the major).

Biophysics

For Natural Science majors.

The Biology, Chemistry, and Physics majors offer a specialization in Biophysics which emphasizes the crosstalk between these three disciplines in understanding biological function.

Everything obeys the laws of physics, and biological systems are no exception. The complexity of biological systems, however, is compounded by the fact that they span a broad range of interacting spatial scales from a few atoms to global ecosystems, and that life inherently functions far from the equilibrium. This complexity poses problems for physicists, chemists, and biologists that are at once interesting and challenging. Biophysics addresses these problems through an interdisciplinary approach that builds on strengths in physics, chemistry, and biology.

Physics majors who elect to complete the Biophysics specialization must complete all courses required for the Physics majors, three required Biophysics courses, and one elective selected from the list below. No more than two of these courses can be used to satisfy the elective requirement for the Chemistry major. The other two would be in addition to the minimum elective requirements for the major.

Admissions

New York University's Office of Undergraduate Admissions supports the application process for all undergraduate programs at NYU. For additional information about undergraduate admissions, including application requirements, see How to Apply (https://www.nyu.edu/admissions/undergraduate-admissions/how-to-apply.html).

Program Requirements

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<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td>General Education Requirements</td>
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</tr>
<tr>
<td>Colloquia</td>
<td></td>
<td>4</td>
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<tr>
<td>First-Year Seminar</td>
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<td>4</td>
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<tr>
<td>Arts, Design, and Technology</td>
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<td>4</td>
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<tr>
<td>Cultural Exploration Analysis</td>
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</table>
Data and Discovery 4
Structures of Thought and Society 4
J-Term Field Colloquia (2 courses) 6
Physical Education (2 courses) 0

Foundations of Science
Complete 6.5 courses from SCIEN-UH 1101EQ–1603 Foundations of Science 1-6

Required Courses
PHYS-UH 2010 Electromagnetism and Special Relativity (half course) 2
PHYS-UH 3010 Mechanics 4
PHYS-UH 3011 Electricity and Magnetism 4
PHYS-UH 3012 Quantum Mechanics 1 4
PHYS-UH 3013 Advanced Physics Laboratory 4
PHYS-UH 3014 Statistical Mechanics and Thermodynamics 4

Mathematics Courses
MATH-UH 1012Q Calculus with Applications to Science and Engineering 4
MATH-UH 1020Q Multivariable Calculus with Applications to Science and Engineering 4
MATH-UH 1022Q Linear Algebra 4
MATH-UH 2010Q Ordinary Differential Equations 4

Major Elective
Select 1 Physics elective 4

Research Seminar
PHYS-UH 3090 Research Seminar in Physics (half course) 2

Capstone
PHYS-UH 4001 Capstone Project in Physics 1 4
PHYS-UH 4002 Capstone Project in Physics 2 4

Other Electives
Other Elective Credits 20

Total Credits 128

Specializations
Astrophysics
For Physics majors only

Course Title Credits
PHYS-UH 3211 General Relativity 4
PHYS-UH 3213 Computational Physics 4
PHYS-UH 3214 Astrophysics 4
PHYS-UH 3217 Multi-wavelength Astronomy 4
PHYS-UH 4216 Nuclear Astrophysics 4
PHYS-UH 3220 Imaging and Spectroscopy Lab (2 credits–Lab class) 2
PHYS-UH 3222 X Ray Astronomy Lab (2 credits–Lab class) 2
PHYS-UH 3221 Radio Imaging and Time Series Lab (2 credits–Lab class) 2
PHYS-UH 3215 Introduction to Detector Electronics (2 credits–Lab class) 2

Note: At least 4 credits must be obtained from classes marked as Lab. The physics electives from this list will also count towards the one elective needed to satisfy the physics major requirements.

Biophysics
For Natural Science majors only

Required Courses
Course Title Credits
BIOL-UH 3130 Biophysics 4
PHYS-UH 3219 Biological Physics: From single molecules to the cell (can be used towards major elective) 4
CHEM-UH 3130 Computational Biology & Biophysics 4

Electives
Select four of the following: 16
Course Title Credits
BIOL-UH 2010 Human Physiology 4
BIOL-UH 2114 Genetics 4
BIOL-UH 3115 Genome Biology 4
BIOL-UH 3116 Immunology 4
BIOL-UH 3218 Synthetic Biology 4
BIOL-UH 3220 Experimental Systems Biology 4
CHEM-UH 3020 Biochemistry: Macromolecular Structure and Function 4
CHEM-UH 3011 Physical Chemistry: Thermodynamics and Kinetics 4
CHEM-UH 3016 Analytical Chemistry 4
CHEM-UH 3260 Special Topics in Chemistry (NMR only) 4

Sample Plan of Study

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1st Semester/Term</td>
<td>Colloquia</td>
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<tr>
<td>2nd Semester/Term</td>
<td>J-Term Field Colloquia</td>
<td>3</td>
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<tr>
<td>3rd Semester/Term</td>
<td>Elective</td>
<td>2</td>
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<tr>
<td>4th Semester/Term</td>
<td>Elective</td>
<td>2</td>
</tr>
<tr>
<td>5th Semester/Term</td>
<td>Elective</td>
<td>2</td>
</tr>
<tr>
<td>6th Semester/Term</td>
<td>Elective</td>
<td>2</td>
</tr>
</tbody>
</table>
PHYS-UH 3012  Quantum Mechanics 1  4
PHYS-UH 3013  Advanced Physics Laboratory  4

**7th Semester/Term**

Foundations of Science  4
Foundations of Science  2
PHYS-UH 3014  Statistical Mechanics and Thermodynamics  4
MATH-UH 1012Q  Calculus with Applications to Science and Engineering  4
PHYS-UH 3090  Research Seminar in Physics  2

**Credits**  16

**8th Semester/Term**

MATH-UH 1020Q  Multivariable Calculus with Applications to Science and Engineering  4
MATH-UH 1022Q  Linear Algebra  4
MATH-UH 2010Q  Ordinary Differential Equations  4
Major Elective  4

**Credits**  16

**9th Semester/Term**

PHYS-UH 4001  Capstone Project in Physics 1  4
Elective Course  4
Elective Course  4
Elective Course  2

**Credits**  14

**10th Semester/Term**

PHYS-UH 4002  Capstone Project in Physics 2  4
Elective Course  4
Elective Course  4

**Credits**  12

**Total Credits**  128

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**Learning Outcomes**

Upon graduation, NYU Abu Dhabi students who major in Physics will have acquired:

1. **Knowledge of Physics, Mathematics, and foundational Biology and Chemistry.** Graduates who major in this program will possess advanced theoretical knowledge of the fundamental physical concepts believed to govern the behavior of everything in the universe, as well as the basic mathematical tools needed to understand and communicate physics, plus how they relate to basic biology and chemistry.

2. **Knowledge of specific areas of scientific research.** Graduates who major in this program will possess knowledge on one or more contemporary advanced research topics in Physics.

3. **Analytical and Computer Aided Problem solving.** Graduates who major in this program will have the capability of assess problems in physics and mathematics making use of scaling relations, symmetries, dimensional analysis, and estimation, and eventually get to an analytical or numerical solution using mathematical tools or computer calculations.

4. **Experimental Research skills.** Graduates who major in this program will possess the skills to operate research grade experimental equipment. They will be able to get data out of the equipment, and analyse their significance using error theory and statistical tools. They will learn how to work in a collaborative environment.

5. **Scientific communication.** Graduates who major in this program will be able to communicate their (or others') findings in oral (public presentation) and written (peer reviewed journals) form.

6. **Critical thinking and analysis.** Graduates who major in this program will be able to critically analyse and fruitfully discuss a scientific topic in physics. In particular, in the area of expertise mastered with PLO 2 they will be able to propose paths (either experimental or theoretical) for the advancement of that sector.

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**Policies**

**NYU Policies**

University-wide policies can be found on the New York University Policy pages (https://bulletins.nyu.edu/nyu/policies/).

**NYU Abu Dhabi Policies**

A full list of relevant policies can be found on NYU Abu Dhabi’s undergraduate academic policies page (https://bulletins.nyu.edu/undergraduate/abu-dhabi/academic-policies/).