PHYSICS (BS)

Department Website (https://nyuad.nyu.edu/en/academics/undergraduate/majors-and-minors/physics-major.html)

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 (http://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 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

Course	Title	Credits
General Education Requirements		
Physical Education (2 courses)		
Quantitative Reasoning (1 course)		
Experimental Inquiry (1 course)		

Islamic Studies (1 course)		
First-Year Writing Seminar		4
Colloquia		4
Field Colloquia (2 J-Term courses)		6
Core Competencies		
Arts, Design, and Technology		4
Cultural Exploration Analysis		4
Data and Discovery		4
Structures of Thought and Society		4
Foundations of Science Courses		
Foundations of Science 1-6 (see list below)		26
Major Required 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
PHYS-UH 2010	Electromagnetism and Special Relativity	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
PHYS-UH 3090	Research Seminar in Physics	2
Major Elective [1]		
Complete 1 Physics elective (see list below)		4
Capstone		
PHYS-UH 4001	Capstone Project in Physics 1	4
PHYS-UH 4002	Capstone Project in Physics 2	4
Other Electives		
Complete enough courses to reach the minimum overall required 128 credits		20
Total Credits		**128**

[1]
- Students pursuing the **Astrophysics Specialization** must complete an additional 16 credits of Astrophysics electives (at least 4 credits must be Lab electives), in place of the 1 Physics major elective.
- Students pursuing the **Biophysics Specialization** complete an additional 3 Biophysics required courses and 1 Biophysics elective, in place of the 1 Physics major elective.

Foundations of Science 1-6 Courses

Code	Title	Credits
SCIEN-UH 1121EQ	Foundations of Science 1-2: Physics	1.5
SCIEN-UH 1122EQ	Foundations of Science 1-2: Chemistry	3
SCIEN-UH 1123EQ	Foundations of Science 1-2: Biology	1.5
SCIEN-UH 1124C	Foundations of Science 2 Lab: Chemistry	1
SCIEN-UH 1124P	Foundations of Science 1 Lab: Physics	1
SCIEN-UH 1341Q	Foundations of Science 3-4: Physics	3
SCIEN-UH 1342Q	Foundations of Science 3-4: Chemistry	3
SCIEN-UH 1343	Foundations of Science 3-4: Biology	2
SCIEN-UH 1344BE	Foundations of Science 4 Lab: Biology	1
SCIEN-UH 1344CE	Foundations of Science 3 Lab: Chemistry	1
SCIEN-UH 1561Q	Foundations of Science 5-6: Physics	3
SCIEN-UH 1563	Foundations of Science 5-6: Biology	3
SCIEN-UH 1564BE	Foundations of Science 5 Lab: Biology	1
SCIEN-UH 1564EP	Foundations of Science 6 Lab: Physics	1

Physics Electives

Code	Title	Credits
ENGR-UH 3611	Electronics	4
MATH-UH 2011Q	Probability and Statistics	4
MATH-UH 3411	Dynamical Systems	4
MATH-UH 3413	Numerical Methods	4
MATH-UH 3414	Partial Differential Equations	4
MATH-UH 3610	Complex Analysis	4
PHYS-GA 9007	Fluid Mechanics	4
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 3219	Biological Physics: From single molecules to the cell	4
PHYS-UH 3220	Imaging and Spectroscopy Lab	2
PHYS-UH 3223	Data Analysis with Python	2
PHYS-UH 3260	Special Topics in Physics	4-5
PHYS-UH 4212	Quantum Mechanics 2	4
PHYS-UH 4215	Particle Physics	4

Specialization Requirements Astrophysics

Complete 16 credits of Astrophysics electives (at least 4 credits must be Lab electives), in place of the 1 Physics major elective.

Course	Title	Credits
Astrophysics Electives		
Complete at least 12 credits of Astrophysics electives from the following:		
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		4
Astrophysics Lab Electives		
Complete at least 4 credits of Astrophysics Lab electives from the following:		
PHYS-UH 3215	Introduction to Detector Electronics	2
PHYS-UH 3220	Imaging and Spectroscopy Lab	2

PHYS-UH 3221		2
PHYS-UH 3222	X Ray Astronomy Lab	2
PHYS-UH 3223	Data Analysis with Python (can be used toward Physics major elective)	2

Biophysics (for Physics majors)

Complete 3 Biophysics required courses and 1 Biophysics elective, in place of the 1 Physics major elective.

Course	Title	Credits
Biophysics Required Courses		
BIOL-UH 3130	Biophysics	4
CHEM-UH 3130		4
PHYS-UH 3219	Biological Physics: From single molecules to the cell (can be used toward Physics major elective)	4
Biophysics Electives		
Complete 1 Biophysics elective from the following:		4
BIOL-UH 2010	Human Physiology	4
BIOL-UH 2114	Genetics	4
BIOL-UH 3116	Immunology	4
BIOL-UH 3218	Synthetic Biology	4
BIOL-UH 3220	Experimental Systems Biology & Complex Human Disorders	4
CHEM-UH 3011	Physical Chemistry: Thermodynamics and Kinetics	4
CHEM-UH 3016	Analytical Chemistry	4
CHEM-UH 3020	Biochemistry: Macromolecular Structure and Function	4
CHEM-UH 3201	Interdisciplinary Magnetic Resonance	4
CHEM-UH 3022	Biochemistry: Experimental Biochemistry	4

Sample Plan of Study

Course	Title	Credits
1st Semester/Term		
First-Year Writing Seminar		4
Core Competency		4
Core Competency		4
General Elective		4
Physical Education		
	Credits	**16**
2nd Semester/Term		
Field Colloquia (J-Term)		3
	Credits	**3**
3rd Semester/Term		
SCIEN-UH 1121EQ	Foundations of Science 1-2: Physics	1.5
SCIEN-UH 1122EQ	Foundations of Science 1-2: Chemistry	3
SCIEN-UH 1123EQ	Foundations of Science 1-2: Biology	1.5
SCIEN-UH 1124C	Foundations of Science 2 Lab: Chemistry	1
SCIEN-UH 1124P	Foundations of Science 1 Lab: Physics	1
MATH-UH 1012Q	Calculus with Applications to Science and Engineering	4
Colloquia		4
	Credits	**16**
4th Semester/Term		
SCIEN-UH 1341Q	Foundations of Science 3-4: Physics	3
SCIEN-UH 1342Q	Foundations of Science 3-4: Chemistry	3
SCIEN-UH 1343	Foundations of Science 3-4: Biology	2
SCIEN-UH 1344BE	Foundations of Science 4 Lab: Biology	1
SCIEN-UH 1344CE	Foundations of Science 3 Lab: Chemistry	1
MATH-UH 1020Q	Multivariable Calculus with Applications to Science and Engineering	4
Physical Education		
	Credits	**14**
5th Semester/Term		
Field Colloquia (J-Term)		3
	Credits	**3**
6th Semester/Term		
SCIEN-UH 1561Q	Foundations of Science 5-6: Physics	3
SCIEN-UH 1563	Foundations of Science 5-6: Biology	3
SCIEN-UH 1564BE	Foundations of Science 5 Lab: Biology	1
SCIEN-UH 1564EP	Foundations of Science 6 Lab: Physics	1
MATH-UH 1022Q	Linear Algebra	4
Core Competency		4
	Credits	**16**
7th Semester/Term		
MATH-UH 2010Q	Ordinary Differential Equations	4
PHYS-UH 3010	Mechanics	4
PHYS-UH 3014	Statistical Mechanics and Thermodynamics	4
Core Competency		4
	Credits	**16**
8th Semester/Term		
PHYS-UH 3011	Electricity and Magnetism	4
PHYS-UH 3012	Quantum Mechanics 1	4
PHYS-UH 3013	Advanced Physics Laboratory	4
PHYS-UH 3090	Research Seminar in Physics	2
General Elective		2
	Credits	**16**
9th Semester/Term		
PHYS-UH 4001	Capstone Project in Physics 1	4
Major Elective		4
General Elective		4
General Elective		4
	Credits	**16**
10th Semester/Term		
PHYS-UH 4002	Capstone Project in Physics 2	4
General Elective		4
General Elective		4
	Credits	**12**
	Total Credits	**128**

Learning Outcomes

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

PLO 1 Demonstrate 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 (Knowledge).

PLO 2 Demonstrate knowledge of one or more contemporary advanced research topics in Physics (Knowledge, Role in Context).

PLO 3 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 (Knowledge, Skill).

PLO 4 Operate research grade experimental equipment. They will be able to get data out of the equipment, and analyze their significance using error theory and statistical tools. They will learn how to work in

a collaborative environment (Skill, Autonomy & Responsibility, Self-development).

PLO 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 (Self-development).

PLO 6 Critically analyze and fruitfully discuss a scientific topic in physics (Knowledge, Skill, Autonomy & Responsibility, Self-development).

Policies

Program Policies

Foundations of Science Grading Policy

While each level of Foundations of Science is an integrated course, separate grades are provided for various components as a means to allow students to document their completion of the specific disciplinary and laboratory content that makes up these courses. Consistent with this integrated approach, students must earn an average grade of C for the components of each level of Foundations of Science to continue into the next level or to use the course to satisfy the prerequisites for other courses outside of Foundations of Science. Additionally, students majoring in biology, chemistry, or physics, must have grades of at least C in all Foundations of Science components in their specific, respective major fields. Finally, although continuation into other courses is based on the average performance in each level of Foundations of Science, students earn academic credits only for those graded components they pass or, for students subject to the transcript policy (see Academic Policies), only for those components with grades of at least C−. The number of earned credits for Foundations of Science components is particularly important for all engineering majors who must earn at least 16 credits in science.

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/).

NYU Policies

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