

PHYSICS (BS)

Department Website (<http://as.nyu.edu/physics/>)

NYSED: 08332 HEGIS: 1902.00 CIP: 40.0801

Program Description

Physics is the most basic of the natural sciences. It is concerned with understanding the world on all scales of length, time, and energy. The methods of physics are diverse, but they share a common objective to develop and refine fundamental models that quantitatively explain observations and the results of experiments. The discoveries of physics rank among the most important achievements of human inquiry and have had an enormous impact on human culture and civilization. Members of the department conduct research in the fields of astrophysics, biophysics, cosmology, elementary particle physics, gravitation, hard and soft condensed matter physics, and statistical physics, carrying out experimental work in state-of-the-art laboratories in the department and at such national and international facilities as the Large Hadron Collider at CERN and large astronomical observatories.

The educational programs of the department are aimed at providing a range of courses to meet the needs of different student groups. For undergraduate physics majors, there is a rigorous core program, exposure to current frontiers, and opportunities for research. For science majors outside of physics, there are technical courses that emphasize the fundamental physical laws that underpin other sciences; and for other majors, nontechnical courses introduce some of the most important concepts of physics and their impact on the contemporary world.

Departmental Objectives

The BA and BS programs for the major provide good preparation for graduate school and develop a range of technical skills relating to building quantitative theoretical models and making precise measurements of physical phenomena. The programs are also designed to satisfy curiosity about the fundamental laws that govern every aspect of the world, from the interactions of subatomic particles to the origin and behavior of the entire universe. They are simultaneously very deep and very broad. Course work includes both theoretical subjects and experimental activity in laboratories. The programs are designed to give students flexibility in years three and four to pursue interdisciplinary activities, spend time abroad, or delve into greater depth in a subject or into original research.

The department is a collegial place where faculty and students get to know one another well. There are regular formal and informal seminars, as well as a thriving Society of Physics Students, and students and faculty often collaborate on original research problems. Many majors participate in original research and coauthor scientific publications. Our students are extremely well prepared for a wide range of activities—not just in scientific research, but also in professional and engineering pursuits, or any area where abstract thinking and quantitative modeling of real systems are necessary and rewarded.

For non-majors, the department offers non-technical courses that introduce some of the concepts and events that are most important to understanding physics and its impact. For science majors outside of physics, there are technical courses on the fundamental laws that underpin the other sciences. The department also provides courses designed to meet the preprofessional goals of prehealth students and students in engineering disciplines. In addition, students who are

interested in obtaining significant exposure to the ideas of physics without committing to the major or without obtaining a comprehensive mathematical background can minor in physics or astronomy.

Physics and Engineering

The College of Arts and Science offers a joint BS/BS program with the NYU Tandon School of Engineering. The program leads to the BS degree in physics from CAS and the BS degree in one of the following areas from the NYU Tandon School of Engineering: civil engineering; computer engineering; electrical engineering; or mechanical engineering. Further information is available from the College Advising Center, 726 Broadway, 7th floor; 212-998-8130.

Policy on School of Engineering courses: This option is open only to students with declared majors in the Department of Physics. They may seek prior permission of the director of undergraduate studies to take advanced electives in the School of Engineering and apply them to the major. This is reviewed on a case-by-case basis. These courses count against each student's 16-point allowance in the other divisions of NYU and cannot be applied to the 64-credit UA residency requirement.

Honors Program

Students who have completed at least 64 credits of graded work in the College may be awarded degrees with departmental honors in physics if they complete all requirements of the major as well as the designated honors requirements, and also maintain the requisite grade point average of 3.65 both in the major and overall.

The honors program must minimally be a two-term (for credit) research experience that includes a capstone research project. The capstone project, which typically culminates in a thesis, should reflect sustained original research over two semesters. A committee of three faculty members of the Department of Physics is created for each honors student. The honors thesis must be approved by the committee, who will judge if the research is of sufficient quality. Publication in a recognized research journal of an article reporting research done primarily by the student is prima facie evidence that the research is deserving of honors. Because of inevitable delay in publication, an article submitted for publication may not be published in the time available, and the thesis committee may express its opinion that the thesis is of publishable quality.

All students completing departmental honors must make public presentations of their work, which may be at the CAS Undergraduate Research Conference (URC) held at the end of the academic year, or in a departmental forum (e.g., oral defenses or presentations), or at a recognized physics conference.

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

The program requires the completion of 128 credits, comprised of the following:

Course	Title	Credits
General Education Requirements		
First-Year Seminar		4
EXPOS-UA 1	Writing The Essay:	4
Foreign Language ¹		16
Texts and Ideas		4
Cultures and Contexts		4
Societies and the Social Sciences		4
Expressive Culture		4
Major Requirements		
MATH-UA 121	Calculus I	4
MATH-UA 122	Calculus II	4
PHYS-UA 91 & PHYS-UA 71	Physics I and Introductory Experimental Physics I	5
PHYS-UA 93 & PHYS-UA 72	Physics II and Introductory Experimental Physics II	5
MATH-UA 123	Calculus III	4
PHYS-UA 95 & PHYS-UA 73	Physics III and Intermediate Experimental Physics I	5
PHYS-UA 120	Dynamics	3
PHYS-UA 74	Intermediate Experimental Physics II	2
PHYS-UA 106	Mathematical Physics	3
PHYS-UA 112	Advanced Experimental Physics	3
PHYS-UA 123	Quantum Mechanics I	3
PHYS-UA 131	Electricity & Magnet I	3
PHYS-UA 140	Thermal & Statistical Physics	3
Select one advanced physics elective		4
PHYS-UA 210	Computational Physics	4
Select one of the following:		10
CHEM-UA 125 & CHEM-UA 126	General Chemistry I & Laboratory and General Chemistry II & Laboratory	
CHEM-UA 129	Accelerated General Chemistry	
Select one biology or chemistry course ²		4
Electives		
Other Elective Credits		16-25
Total Credits		128

1

The foreign language requirement is satisfied upon successful completion through the Intermediate level of a language. This may be accomplished in fewer than 16 credits, but those credits must then be completed as elective credit.

2

In biology at or above the level of BIOL-UA 11 Principles of Biology I, or in chemistry above the level of CHEM-UA 126 General Chemistry II & Laboratory

Acceptable Advanced Electives in Physics for the B.A. and B.S. Majors

The courses below are offered in either the fall or spring term (not both), and some are not offered every year. Please see course descriptions in this Bulletin for prerequisites and frequency of offering. Additional

electives may be available; majors should contact the Department of Physics for more information.

- PHYS-UA 110 Electronics for Scientists I
- PHYS-UA 115 Advanced Mathematical Physics
- PHYS-UA 124 Quantum Mechanics II
- PHYS-UA 132 Electricity & Magnet II
- PHYS-UA 133
- PHYS-UA 135 Condensed Matter Physics
- PHYS-UA 136 Readings in Particle Physics
- PHYS-UA 138 Quantum Information and Quantum Computing
- PHYS-UA 150 Astrophysics
- PHYS-UA 160
- PHYS-UA 170 General Relativity
- PHYS-UA 180 Introduction to Fluid Dynamics
- PHYS-UA 190
- PHYS-UA 210 Computational Physics
- PHYS-UA 800 Special Topics in Physics:

Sample Plan of Study

Course	Title	Credits
1st Semester/Term		
PHYS-UA 91	Physics I	3
PHYS-UA 71	Introductory Experimental Physics I	2
MATH-UA 121	Calculus I	4
Texts and Ideas		4
First-Year Seminar		4
Credits		17
2nd Semester/Term		
PHYS-UA 93	Physics II	3
PHYS-UA 72	Introductory Experimental Physics II	2
MATH-UA 122	Calculus II	4
EXPOS-UA 1	Writing The Essay:	4
Cultures and Contexts		4
Credits		17
3rd Semester/Term		
PHYS-UA 95	Physics III	3
PHYS-UA 73	Intermediate Experimental Physics I	2
MATH-UA 123	Calculus III	4
Foreign Language		4
Expressive Culture		4
Credits		17
4th Semester/Term		
PHYS-UA 106	Mathematical Physics	3
PHYS-UA 120	Dynamics	3
PHYS-UA 74	Intermediate Experimental Physics II	2
Foreign Language		4
Societies and the Social Sciences		4
Credits		16
5th Semester/Term		
PHYS-UA 123	Quantum Mechanics I	3
PHYS-UA 131	Electricity & Magnet I	3
CHEM-UA 125	General Chemistry I & Laboratory	5
Foreign Language		4
Credits		15
6th Semester/Term		
PHYS-UA 112	Advanced Experimental Physics	3
PHYS-UA 140	Thermal & Statistical Physics	3
CHEM-UA 126	General Chemistry II & Laboratory	5

Foreign Language		4
Credits		15
7th Semester/Term		
PHYS-UA XXX	Advanced Physics Elective ¹	3
BIOL-UA 11	Principles of Biology I ²	4
Elective		4
Elective		4
Credits		15
8th Semester/Term		
PHYS-UA 210	Computational Physics	4
Elective		4
Elective		4
Elective		4
Credits		16
Total Credits		128

1

From a list of approved elective courses.

2

Students may substitute this course for one course above CHEM-UA 126 General Chemistry II & Laboratory.

Learning Outcomes

Upon completion of program requirements, students are expected to have acquired:

1. A fundamental command of physics, as well as of the subdisciplines of classical mechanics and electromagnetism, special relativity, quantum mechanics, and statistical and thermal physics.
2. Facility in advanced topics (chosen from among general relativity, condensed matter physics, biophysics, and others) relevant to modern research.
3. The mathematical skills required to describe and predict the behavior of physical systems from first principles.
4. The experimental and analytical skills needed to test the application of physical laws to real systems.
5. Facility in advanced topics in mathematics, chemistry, and/or biology, and an understanding of their relation to concepts in physics.

Policies

Advanced Placement Policy

In the summer before their freshman year, students considering a major in physics may consult with the department about possibly counting credit for AP Physics C: Mechanics and/or AP Physics C: Electricity and Magnetism toward the major and placing out of Physics I (PHYS-UA 91) and/or Physics II (PHYS-UA 93), respectively. Students are usually advised, however, to take Physics I and II at NYU as a foundation for doing well in the major curriculum. If majors are granted permission to place out of PHYS-UA 91 and 93, they must still complete the laboratory classes that are taken with those lectures (Introductory Experimental Physics I and II, PHYS-UA 71 and 72). They are also required to take (with departmental advisement) one or two additional advanced PHYS-UA electives (beyond the basic major requirement of two advanced electives in this department). Finally, physics majors who are prehealth must be sure to present a year of physics with labs to meet admissions requirements of health professional schools; they cannot rely on their Physics AP C exams to meet the requirements of these schools. No other

AP credit in physics (or from similar international exams) can be applied to the requirements of the physics major.

Although Physics I and Physics II have a number of topics that are nominally included in the AP Physics C curriculum, they are all treated in greater depth and with more rigor in our courses, which use differential and integral calculus. In addition, Physics I and Physics II cover several topics that are not included in a high school AP course. These include approximately two weeks on Einstein's theory of special relativity in Physics I, and AC circuits, phasors, electromagnetic radiation, Maxwell's equations, and Poynting's theorem in Physics II. Students with credit for either or both of the AP Physics C exams will not find Physics I and II to be redundant.

Mathematics Requirement

Potential physics majors should begin their calculus sequence in the fall semester of their freshman year. Students are advised to take advanced mathematics courses—such as Linear Algebra (MATH-UA 140)—as they proceed in the major.

Double Major with Physics

The major offers flexibility to complete the requirements for a second major in the College. Students should consult the director of undergraduate studies in their freshman year to outline a program that is best tailored to their needs.

NYU Policies

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

College of Arts and Science Policies

A full list of relevant academic policies can be found on the CAS Academic Policies page (<https://bulletins.nyu.edu/undergraduate/arts-science/academic-policies/>).