

PHYSICS MAJOR, B.A.

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Department of Physics and Astronomy

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The goal of physics and astronomy is a unified description of the properties of matter and energy. The study of matter and energy encompasses a range of phenomena, from the subnuclear to the cosmological. Physics seeks to understand the way the universe “works,” from the very small scale (quarks and neutrinos) to the human scale (materials encountered in daily life) to the very large (the structure of the cosmos). Different approaches and technologies are used in these different regimes.

Department Programs

Majors

- Physics Major, B.A. (p. 1)
- Physics Major, B.S. (<http://catalog.unc.edu/undergraduate/programs-study/physics-major-bs/>)

Minors

- Astronomy Minor (<http://catalog.unc.edu/undergraduate/programs-study/astronomy-minor/>)
- Physics Minor (<http://catalog.unc.edu/undergraduate/programs-study/physics-minor/>)

Graduate Programs

- M.S. in Physics (<http://catalog.unc.edu/graduate/schools-departments/physics-astronomy/>)
- Ph.D. in Physics (<http://catalog.unc.edu/graduate/schools-departments/physics-astronomy/>)

Student Learning Outcomes

Upon completion of the physics program, students should be able to:

- Demonstrate knowledge of major concepts, theoretical reasoning, and empirical findings in physics and/or astronomy – Knowledge Base in Physics
- Apply knowledge of physics and mathematics to solve problems – Critical Thinking and Problem Solving
- Effectively conduct research under guidance of faculty member – Research and the Advancement of Physics and Astronomy
- Gain entry to top graduate programs, employment as physicists in industry, teaching positions in high school physics and astronomy, or apply their skills in other rewarding careers – Preparation for Future Career

Requirements

In addition to the program requirements, students must

- attain a final cumulative GPA of at least 2.0
- complete a minimum of 45 academic credit hours earned from UNC–Chapel Hill courses
- take at least half of their major course requirements (courses and credit hours) at UNC–Chapel Hill
- earn a minimum of 18 hours of C or better in the major core requirements (some majors require 21 hours).

For more information, please consult the degree requirements section of the catalog (<http://catalog.unc.edu/undergraduate/general-education-curriculum-degree-requirements/#degreerequirementstext>).

Physics Major, B.A. – Standard Option

Code	Title	Hours
Core Requirements		
PHYS 118	Introductory Calculus-based Mechanics and Relativity	4
PHYS 119	Introductory Calculus-based Electromagnetism and Quanta	4
PHYS 201 or PHYS 401	Basic Mechanics ¹ Mechanics I	3
PHYS 211 or PHYS 311	Intermediate Electromagnetism ² Electromagnetism I	3
PHYS 281L	Experimental Techniques in Physics	2
PHYS 331	Numerical Techniques for the Sciences I	4
Nine additional credits chosen from ASTR (numbered above 300) and PHYS (numbered above 200)		9
Additional Requirements		
CHEM 101 & 101L	General Descriptive Chemistry I and Quantitative Chemistry Laboratory I	4
CHEM 102 & 102L	General Descriptive Chemistry II and Quantitative Chemistry Laboratory II ^H	4
MATH 231	Calculus of Functions of One Variable I ^H	4
MATH 232	Calculus of Functions of One Variable II ^H	4
MATH 233	Calculus of Functions of Several Variables ^H	4
MATH 383	First Course in Differential Equations ^H	3
Total Hours		52

H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

¹ Spring course.

² Fall course.

Astronomy (ASTR) and Physics (PHYS) course descriptions (<http://catalog.unc.edu/undergraduate/departments/physics-astronomy/#coursestext>).

Physics Major, B.A. – Astronomy Option

Code	Title	Hours
Core Requirements		
PHYS 118	Introductory Calculus-based Mechanics and Relativity	4
PHYS 119	Introductory Calculus-based Electromagnetism and Quanta	4
PHYS 201 or PHYS 401	Basic Mechanics ¹ Mechanics I	3
PHYS 211 or PHYS 311	Intermediate Electromagnetism ² Electromagnetism I	3
PHYS 281L	Experimental Techniques in Physics	2
PHYS 331	Numerical Techniques for the Sciences I	4
Six additional credits chosen from ASTR (numbered above 300)		6
Three additional credits chosen from:		3
ASTR (numbered above 300)		
PHYS 231	Physical Computing ¹	
PHYS 295	Research with Faculty Mentor I	
PHYS 395	Research with Faculty Mentor II	
PHYS 585	Imaging Science: From Cells to Stars	
PHYS 691H	Senior Honor Thesis Research I	
PHYS 692H	Senior Honor Thesis Research II	
Additional Requirements		
ASTR 101	Introduction to Astronomy: The Solar System ^H	3
ASTR 101L	Introduction to Astronomy Laboratory: Our Place in Space	1
or ASTR 111L	Educational Research in Radio Astronomy	
ASTR 202	Introduction to Astrophysics ²	3
MATH 231	Calculus of Functions of One Variable I ^H	4
MATH 232	Calculus of Functions of One Variable II ^H	4
MATH 233	Calculus of Functions of Several Variables ^H	4
MATH 383	First Course in Differential Equations ^H	3
Total Hours		51

H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

¹ Spring course.

² Fall course.

Astronomy (ASTR) and Physics (PHYS) course descriptions (<http://catalog.unc.edu/undergraduate/departments/physics-astronomy/#coursestext>).

Physics Major, B.A. – Biological Physics Option

Code	Title	Hours
Core Requirements		
PHYS 118	Introductory Calculus-based Mechanics and Relativity	4
PHYS 119	Introductory Calculus-based Electromagnetism and Quanta	4
PHYS 201 or PHYS 401	Basic Mechanics ¹ Mechanics I	3
PHYS 211 or PHYS 311	Intermediate Electromagnetism ² Electromagnetism I	3
PHYS 281L	Experimental Techniques in Physics	2
PHYS 331	Numerical Techniques for the Sciences I	4
PHYS 405	Biological Physics ²	3
PHYS/BMME 441 or CHEM 481	Thermal Physics ² Physical Chemistry I	3
PHYS 585	Imaging Science: From Cells to Stars (capstone)	3
Additional Requirements		
BIOL 101	Principles of Biology ^H	3
CHEM 101 & 101L	General Descriptive Chemistry I and Quantitative Chemistry Laboratory I	4
CHEM 102 & 102L	General Descriptive Chemistry II and Quantitative Chemistry Laboratory II ^H	4
MATH 231	Calculus of Functions of One Variable I ^H	4
MATH 232	Calculus of Functions of One Variable II ^H	4
MATH 233	Calculus of Functions of Several Variables ^H	4
MATH 383	First Course in Differential Equations ^H	3
Six additional credits chosen from:		6
BIOL (numbered above 200)		
CHEM 261	Introduction to Organic Chemistry I ^H	
CHEM 262	Introduction to Organic Chemistry II ^H	
CHEM 430	Introduction to Biological Chemistry ^H	
PHYS (numbered above 200)		
Total Hours		61

H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

¹ Spring course.

² Fall course.

Biology (BIOL) course descriptions (<http://catalog.unc.edu/undergraduate/departments/biology/#coursestext>).

Physics (PHYS) course descriptions (<http://catalog.unc.edu/undergraduate/departments/physics-astronomy/#coursestext>).

Physics Major, B.A. – Energy Option

Code	Title	Hours
Core Requirements		
PHYS 118	Introductory Calculus-based Mechanics and Relativity	4
PHYS 119	Introductory Calculus-based Electromagnetism and Quanta	4

PHYS 131	Energy: Physical Principles and the Quest for Alternatives to Dwindling Oil and Gas ¹	3
PHYS 131L	Energy: Physical Principles and the Quest for Alternatives to Dwindling Oil and Gas	1
or PHYS 281L	Experimental Techniques in Physics	
PHYS 201	Basic Mechanics ¹	3
or PHYS 401	Mechanics I	
PHYS 211	Intermediate Electromagnetism ²	3
or PHYS 311	Electromagnetism I	
PHYS 331	Numerical Techniques for the Sciences I	4
PHYS 351	Electronics I ²	4
PHYS 581	Renewable Electric Power Systems	3
or PHYS 582	Decarbonizing Fuels	
Additional Requirements		
BIOL 101 & 101L	Principles of Biology and Introductory Biology Laboratory ^H	4
BIOL 202	Molecular Biology and Genetics ^H	4
or BIOL 271	Plant Biology	
CHEM 101 & 101L	General Descriptive Chemistry I and Quantitative Chemistry Laboratory I	4
CHEM 102	General Descriptive Chemistry II ^H	3
CHEM 261	Introduction to Organic Chemistry I ^H	3
CHEM 481	Physical Chemistry I	3
MATH 231	Calculus of Functions of One Variable I ^H	4
MATH 232	Calculus of Functions of One Variable II ^H	4
MATH 233	Calculus of Functions of Several Variables ^H	4
MATH 383	First Course in Differential Equations ^H	3
Total Hours		65

H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

¹ Spring course.

² Fall course.

Physics (PHYS) course descriptions (<http://catalog.unc.edu/undergraduate/departments/physics-astronomy/#coursestext>).

Physics Major, B.A. – Quantitative Finance Option

Code	Title	Hours
Core Requirements		
PHYS 118	Introductory Calculus-based Mechanics and Relativity	4
PHYS 119	Introductory Calculus-based Electromagnetism and Quanta	4
PHYS 201	Basic Mechanics ¹	3
or PHYS 401	Mechanics I	
PHYS 211	Intermediate Electromagnetism ²	3
or PHYS 311	Electromagnetism I	
PHYS 281L	Experimental Techniques in Physics	2
PHYS 331	Numerical Techniques for the Sciences I	4
PHYS/BMME 441	Thermal Physics ²	3
or CHEM 481	Physical Chemistry I	
Six additional credits chosen from the following options ³		6

BUSI 407	Financial Accounting ³	
BUSI 410	Business Analytics	
BUSI 584	Financial Modeling	
MATH courses numbered above 200		
PHYS courses numbered above 200		
Additional Requirements		
BUSI 408	Corporate Finance ⁴	3
BUSI 580	Investments ^H	3
BUSI 588	Introduction to Derivative Securities and Risk Management ^{5, H}	1.5
BUSI 589	Fixed Income ^{5, H}	1.5
BUSI 600	Risk Management ⁵	1.5
BUSI 688	Applied Trading Strategies ^{5, H}	1.5
CHEM 101	General Descriptive Chemistry I	3
CHEM 102	General Descriptive Chemistry II ^H	3
MATH 231	Calculus of Functions of One Variable I ^H	4
MATH 232	Calculus of Functions of One Variable II ^H	4
MATH 233	Calculus of Functions of Several Variables ^H	4
MATH 383	First Course in Differential Equations ^H	3
Total Hours		62

H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

¹ Spring course.

² Fall course.

³ Students are strongly encouraged to take BUSI 407.

⁴ ECON 101 and one of BUSI 101, BUSI 102, or BUSI 107 are prerequisites for BUSI 408, but these prerequisites may be waived for students in the Quantitative Finance program.

⁵ Half-semester course. Students are advised to take BUSI 588 and BUSI 688 in the same semester.

Students must maintain a minimum cumulative GPA of at least 2.85. Students majoring in the quantitative finance option cannot pursue the minor in business.

Business Administration (BUSI) course descriptions (<http://catalog.unc.edu/undergraduate/schools-college/kenan-flagler-business-school/#coursestext>).

Mathematics (MATH) course descriptions (<http://catalog.unc.edu/undergraduate/departments/mathematics/#coursestext>).

Physics (PHYS) course descriptions (<http://catalog.unc.edu/undergraduate/departments/physics-astronomy/#coursestext>).

Sample Plan of Study

Sample plans can be used as a guide to identify the courses required to complete the major and other requirements needed for degree completion within the expected eight semesters. The actual degree plan may differ depending on the course of study selected (second major, minor, etc.). Students should meet with their academic advisor to create a degree plan that is specific and unique to their interests. The sample plans represented in this catalog are intended for first-year students

entering UNC–Chapel Hill in the fall term. Some courses may not be offered every term.

Standard Option

First Year

Fall Semester		Hours
MATH 231	Calculus of Functions of One Variable I ^H	4
CHEM 101 & 101L	General Descriptive Chemistry I and Quantitative Chemistry Laboratory I	4
Hours		8

Spring Semester

MATH 232	Calculus of Functions of One Variable II ^H	4
CHEM 102 & 102L	General Descriptive Chemistry II and Quantitative Chemistry Laboratory II ^H	4
Hours		8

Sophomore Year

Fall Semester		Hours
PHYS 118	Introductory Calculus-based Mechanics and Relativity	4
MATH 233	Calculus of Functions of Several Variables ^H	4
Hours		8

Spring Semester

PHYS 119	Introductory Calculus-based Electromagnetism and Quanta	4
MATH 383	First Course in Differential Equations ^H	3
Hours		7

Junior Year

Fall Semester		Hours
PHYS 281L	Experimental Techniques in Physics	2
PHYS 211 or PHYS 311	Intermediate Electromagnetism or Electromagnetism I	3
Hours		5

Spring Semester

PHYS 201 or PHYS 401	Basic Mechanics or Mechanics I	3
PHYS 331	Numerical Techniques for the Sciences I	4
One course (3 hours) chosen from ASTR (numbered above 300) and PHYS (numbered above 200)		3
Hours		10

Senior Year

Fall Semester		Hours
One course (3 hours) chosen from ASTR (numbered above 300) and PHYS (numbered above 200)		3
Hours		3

Spring Semester

One course (3 hours) chosen from ASTR (numbered above 300) and PHYS (numbered above 200)		3
Hours		3
Total Hours		52

^H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

Astronomy Option

First Year

Fall Semester		Hours
MATH 231	Calculus of Functions of One Variable I ^H	4
ASTR 101 & 101L	Introduction to Astronomy: The Solar System and Introduction to Astronomy Laboratory: Our Place in Space ^H	4
Hours		8

Spring Semester

PHYS 118	Introductory Calculus-based Mechanics and Relativity	4
MATH 232	Calculus of Functions of One Variable II ^H	4
Hours		8

Sophomore Year

Fall Semester		Hours
PHYS 119	Introductory Calculus-based Electromagnetism and Quanta	4
MATH 233	Calculus of Functions of Several Variables ^H	4
Hours		8

Spring Semester

PHYS 281L	Experimental Techniques in Physics	2
MATH 383	First Course in Differential Equations ^H	3
Hours		5

Junior Year

Fall Semester		Hours
ASTR 202	Introduction to Astrophysics	3
PHYS 211 or PHYS 311	Intermediate Electromagnetism or Electromagnetism I	3
Hours		6

Spring Semester

PHYS 201 or PHYS 401	Basic Mechanics or Mechanics I	3
PHYS 331	Numerical Techniques for the Sciences I	4
One course chosen from ASTR (numbered above 300)		3
Hours		10

Senior Year

Fall Semester		Hours
One course chosen from ASTR (numbered above 300)		3
One additional elective course ¹		3
Hours		6
Total Hours		51

^H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

¹ Three credits chosen from ASTR (numbered above 300) and PHYS 231, PHYS 295, PHYS 395, PHYS 585, PHYS 691H, PHYS 692H.

Biological Physics Option

First Year

Fall Semester		Hours
MATH 231	Calculus of Functions of One Variable I ^H	4
BIOL 101	Principles of Biology ^H	3

Hours 7

Spring Semester

PHYS 118	Introductory Calculus-based Mechanics and Relativity	4
MATH 232	Calculus of Functions of One Variable II ^H	4
CHEM 101 & 101L	General Descriptive Chemistry I and Quantitative Chemistry Laboratory I	4

Hours 12

Sophomore Year

Fall Semester

PHYS 119	Introductory Calculus-based Electromagnetism and Quanta	4
MATH 233	Calculus of Functions of Several Variables ^H	4
CHEM 102 & 102L	General Descriptive Chemistry II and Quantitative Chemistry Laboratory II ^H	4

Hours 12

Spring Semester

PHYS 281L	Experimental Techniques in Physics	2
MATH 383	First Course in Differential Equations ^H	3

Hours 5

Junior Year

Fall Semester

PHYS 405	Biological Physics	3
Elective course ²		3

Hours 6

Spring Semester

PHYS 201	Basic Mechanics or or Mechanics I PHYS 401	3
PHYS 331	Numerical Techniques for the Sciences I	4
Elective course ²		3

Hours 10

Senior Year

Fall Semester

PHYS 211	Intermediate Electromagnetism or or Electromagnetism I PHYS 311	3
PHYS 441	Thermal Physics or or Physical Chemistry I CHEM 481	3

Hours 6

Spring Semester

PHYS 585	Imaging Science: From Cells to Stars	3
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Hours 3

Total Hours 61

^H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

² Courses may be chosen from BIOL (numbered above 200), CHEM 261, CHEM 262, CHEM 430, PHYS (numbered above 200).

Energy Option

First Year

Fall Semester		Hours
MATH 231	Calculus of Functions of One Variable I ^H	4
CHEM 101 & 101L	General Descriptive Chemistry I and Quantitative Chemistry Laboratory I	4

Hours 8

Spring Semester

PHYS 118	Introductory Calculus-based Mechanics and Relativity	4
MATH 232	Calculus of Functions of One Variable II ^H	4
CHEM 102	General Descriptive Chemistry II ^H	3

Hours 11

Sophomore Year

Fall Semester

PHYS 119	Introductory Calculus-based Electromagnetism and Quanta	4
MATH 233	Calculus of Functions of Several Variables ^H	4
BIOL 101 & 101L	Principles of Biology and Introductory Biology Laboratory ^H	4

Hours 12

Spring Semester

PHYS 131	Energy: Physical Principles and the Quest for Alternatives to Dwindling Oil and Gas	3
PHYS 131L	Energy: Physical Principles and the Quest for Alternatives to Dwindling Oil and Gas or PHYS 281L or Experimental Techniques in Physics	1
MATH 383	First Course in Differential Equations ^H	3
CHEM 261	Introduction to Organic Chemistry I ^H	3

Hours 10

Junior Year

Fall Semester

PHYS 211	Intermediate Electromagnetism or or Electromagnetism I PHYS 311	3
BIOL 202	Molecular Biology and Genetics ^H or or Plant Biology BIOL 271	4

Hours 7

Spring Semester

PHYS 201	Basic Mechanics or or Mechanics I PHYS 401	3
PHYS 331	Numerical Techniques for the Sciences I	4
CHEM 481	Physical Chemistry I	3

Hours 10

Senior Year**Fall Semester**

PHYS 351	Electronics I	4
Hours		4

Spring Semester

PHYS 581	Renewable Electric Power Systems or or Decarbonizing Fuels	3
PHYS 582		
Hours		3

Total Hours		65
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^H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

Quantitative Finance Option**First Year****Fall Semester**

MATH 231	Calculus of Functions of One Variable I ^H	4
CHEM 101	General Descriptive Chemistry I	3
Hours		7

Spring Semester

PHYS 118	Introductory Calculus-based Mechanics and Relativity	4
MATH 232	Calculus of Functions of One Variable II ^H	4
CHEM 102	General Descriptive Chemistry II ^H	3
Hours		11

Sophomore Year**Fall Semester**

PHYS 119	Introductory Calculus-based Electromagnetism and Quanta	4
MATH 233	Calculus of Functions of Several Variables ^H	4
Hours		8

Spring Semester

PHYS 281L	Experimental Techniques in Physics	2
PHYS 331	Numerical Techniques for the Sciences I	4
MATH 383	First Course in Differential Equations ^H	3
Hours		9

Junior Year**Fall Semester**

PHYS 211	Intermediate Electromagnetism or or Electromagnetism I	3
PHYS 311		
PHYS 441	Thermal Physics or or Physical Chemistry I	3
CHEM 481		

BUSI 408	Corporate Finance	3
Hours		9

Spring Semester

PHYS 201	Basic Mechanics or or Mechanics I	3
PHYS 401		

BUSI 580	Investments ^H	3
Hours		6

Senior Year**Fall Semester**

BUSI 588	Introduction to Derivative Securities and Risk Management ^H	1.5
BUSI 589	Fixed Income ^H	1.5
BUSI 688	Applied Trading Strategies ^H	1.5
Elective course ³		3
Hours		7.5

Spring Semester

BUSI 600	Risk Management	1.5
Elective course ³		3
Hours		4.5

Total Hours		62
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^H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

³ Courses may be chosen from BUSI 407, BUSI 410, BUSI 584, MATH (numbered above 200), and PHYS (numbered above 200).

Special Opportunities in Physics and Astronomy**Honors in Physics and Astronomy**

The honors program offers exceptionally well-qualified students an opportunity to perform original research with a faculty member and graduate with honors or highest honors. It requires an overall grade point average of at least 3.3 and a grade point average of at least 3.4 for physics courses at the end of the junior year.

Students who wish to enter the honors program should consult with the departmental coordinator (<http://physics.unc.edu/undergraduate-program/undergraduate-research/>) for the program no later than the preregistration period in the spring semester of their junior year.

Departmental Involvement

The Society of Physics Students, open to anyone interested in physics, builds connections between undergraduates, graduate students, faculty, and alumni. The society invites visitors to give talks and sponsors a number of events for students each year. Women in Physics at UNC–Chapel Hill, an organization that aims to provide resources, advice, and an encouraging social atmosphere for women in the field of physics, welcomes physics majors and all women interested in physics.

UNC–BEST

The UNC Baccalaureate Education in Science and Teaching (UNC–BEST) Program is a collaboration between the School of Education and the College of Arts and Sciences and is designed to allow undergraduate science majors interested in teaching high school science the opportunity to earn their science degree and obtain licensure as a North Carolina high school science teacher in four years. UNC–BEST students meet all the degree requirements for their degree using PHYS 410 as one of their upper-level physics courses.

Code	Title	Hours
PHYS 410	Teaching and Learning Physics	4
EDUC 689	Foundations of Special Education (may substitute EDUC 516)	3

EDUC 532	Human Development and Learning (may substitute EDUC 403)	3
EDUC 615	Schools and Community Collaboration (may substitute EDUC 533)	3
EDUC 593	Internship/Student Teaching	12
EDUC 601	Education Workshops	1

For more details on admission requirements, application deadlines, and submitting an online application, visit the School of Education Web site (<http://www.unc.edu/uncbest/options.html>).

Undergraduate Awards

The department gives awards each year to the senior (Shearin Award) and junior (Johnson Award) who demonstrate the greatest achievement. In addition, the department awards the major with the most research achievement the Robert Sheldon Award for Undergraduate Research.

Undergraduate Research

All majors conduct at least one semester of research under the supervision of a faculty member. Many enjoy the experience so much that they continue for several semesters. An approved learning contract is required prior to registering for PHYS 295 and PHYS 395, and students must be registered within the first week of classes.