

# NANOSCIENCE

Nanoscience is the study of extremely small things – only 10 to 100 atoms wide. It is an interdisciplinary field involving physics, chemistry, and many engineering disciplines. This specialization prepares students for careers in industry and graduate school in engineering as well as Physics.

## About this Program

- **College:** Liberal Arts and Sciences (<http://catalog.ufl.edu/UGRD/colleges-schools/UGLAS/>)
- **Degrees:** Bachelor of Arts ([http://catalog.ufl.edu/UGRD/colleges-schools/UGLAS/PS\\_BA\\_BS/PS\\_BA/](http://catalog.ufl.edu/UGRD/colleges-schools/UGLAS/PS_BA_BS/PS_BA/)) | Bachelor of Science ([http://catalog.ufl.edu/UGRD/colleges-schools/UGLAS/PS\\_BA\\_BS/PS\\_BS/](http://catalog.ufl.edu/UGRD/colleges-schools/UGLAS/PS_BA_BS/PS_BS/))
- **Specializations:** Medical Physics (BS) ([http://catalog.ufl.edu/UGRD/colleges-schools/UGLAS/PS\\_BA\\_BS/PS\\_BS03/](http://catalog.ufl.edu/UGRD/colleges-schools/UGLAS/PS_BA_BS/PS_BS03/)) | Nanoscience (BS) (p. 1) | Optics (BS) ([http://catalog.ufl.edu/UGRD/colleges-schools/UGLAS/PS\\_BA\\_BS/PS\\_BS01/](http://catalog.ufl.edu/UGRD/colleges-schools/UGLAS/PS_BA_BS/PS_BS01/))
- **Credits for Degree:** 120
- **Contact:** Email ([advising@phys.ufl.edu?Subject=Physics%20Major](mailto:advising@phys.ufl.edu?Subject=Physics%20Major))
- **More Info**

*To graduate with this major, students must complete all university, college, and major requirements.*

## Department Information

The Department of Physics is making strides toward becoming one of the premier physics departments in the United States. With active groups in astrophysics, biological physics, condensed matter/materials physics, and elementary particle physics, undergraduate and graduate students participate in cutting-edge research that prepares them for successful careers in a wide variety of fields.

**Website** (<https://www.phys.ufl.edu/wp/>)

## CONTACT

Email ([advising@phys.ufl.edu](mailto:advising@phys.ufl.edu)) 352.392.0521 (tel) | 352.392.0524 (fax)

P.O. Box 118440  
2001 Museum Road  
Gainesville FL 32611-8545

## Curriculum

- Combination Degrees
- Physics
- Physics Minor

A physics major provides a wide range of career options. Many students pursue further studies in physics, other scientific disciplines, and various branches of engineering and medicine. Professional physicists work in universities and government laboratories seeking answers to fundamental questions about nature, in industry leading the development of new technologies, and in the medical sector performing clinical service and research. The analytical, problem-solving, and communications skills acquired by physics majors also lead to career opportunities in business and finance.

The Department of Physics offers two undergraduate degree programs: The Bachelor of Science (BS) is intended for students who wish to pursue graduate study in physics as well as for other students with a deep interest in the subject. The Bachelor of Arts (BA) is intended for students who seek the benefits of a Physics degree but desire greater flexibility to follow interests in other fields.

## Nanoscience

The Physics BS specialization in Nanoscience requires a minimum of 41 credits in Physics including a specific Physics elective, 3 specific courses outside of Physics (9-11 credits), and 28 other credits of related coursework. Minimum grades of C are required for coursework counted toward the major. The coursework is listed below in three different categories: Physics Required Coursework, Required Electives for the Nanoscience specialization, and Related Coursework required for all Physics BS degrees.

## Required Coursework

Code	Title	Credits
PHY 2048 or PHY 2060	Physics with Calculus 1 Enriched Physics with Calculus 1	3
PHY 2048L	Laboratory for Physics with Calculus 1	1
PHY 2049 or PHY 2061	Physics with Calculus 2 Enriched Physics with Calculus 2	3
PHY 2049L	Laboratory for Physics with Calculus 2	1
PHY 3101	Introduction to Modern Physics	3

or PHY 3063	Enriched Modern Physics	
PHY 3221	Mechanics 1	3
or PHZ 3113	Introduction to Theoretical Physics	
PHY 3323	Electromagnetism 1	3
PHY 3513	Thermal Physics 1	3
PHY 4222	Mechanics 2	3
PHY 4324	Electromagnetism 2	3
PHY 4523	Statistical Physics	3
PHY 4604	Introductory Quantum Mechanics 1	3
PHY 4802L	Laboratory Physics 1	3
PHY 4803L	Laboratory Physics 2	3
PHZ 4404	Introduction to Solid State Physics	3
<b>Total Credits</b>		<b>41</b>

### Required Course Outside of Physics | Nanoscience

Code	Title	Credits
EEE 3396	Solid-State Electronic Devices	3
EEE 4331	Microelectronic Fabrication Technologies	3
or EMA 4614	Production of Electronic Materials	
Select one:		3-4
EEE 4222	Resonant MEMS	
EEL 4930	Special Topics in Electrical Engineering	
EGN 3353C	Fluid Mechanics	
EMA 4615	Compound Semiconductor Materials	
<b>Total Credits</b>		<b>9-10</b>

### Related Coursework

- Three semesters of Calculus (MAC 2311, MAC 2312, MAC 2313; 12 credits)
- One year of college-level general chemistry, including one chemistry laboratory course (CHM 2045 and CHM 2046, CHM 2045L; 7 credits)
- Differential Equations MAP 2302 (3 credits)
- Six credits minimum in approved math courses beyond MAP 2302 Differential Equations.
- Certain computer science courses may substitute for one of the math electives.
- Minimum grades of C for coursework counted toward the major

### Critical Tracking

Critical Tracking records each student's progress in courses that are required for progress toward each major. Please note the critical-tracking requirements below on a per-semester basis.

For degree requirements outside of the major, refer to CLAS Degree Requirements: Structure of a CLAS Degree (<http://catalog.ufl.edu/UGRD/colleges-schools/UGLAS/#degreerequirementstext>).

Equivalent critical-tracking courses as determined by the State of Florida Common Course Prerequisites (<https://cpm.flvc.org/advance-search/>) may be used for transfer students.

### Semester 1

- Complete CHM 1025 or CHM 2045; or PHY 2048 or PHY 2060; and a MAC course with minimum grades of C
- 2.0 UF GPA required

### Semester 2

- Complete CHM 2045/CHM 2045L and MAC 2311 with minimum grades of C
- 2.0 UF GPA required

### Semester 3

- Complete CHM 2046, MAC 2312, and PHY 2048 or PHY 2060 with minimum grades of C
- 2.0 UF GPA required

## Semester 4

- Complete MAC 2313; and PHY 2049 or PHY 2061 with minimum grades of C
- 2.5 critical-tracking GPA required
- 2.0 UF GPA required

## Semester 5

- Complete MAP 2302 with a minimum grade of C
- Complete 2 required 3000-level physics courses with minimum grades of C (upper-division tracking)
- 2.5 critical-tracking GPA
- 2.0 UF GPA required

## Semester 6

- Complete the remaining required 3000-level physics courses with minimum grades of C
- Complete 1 of 4 courses required for the Nanoscience specialization
- 2.0 UF GPA required

## Semester 7

- Complete PHY 4802L or PHY 4803L
- Complete 2 required 4000-level physics courses with minimum grades of C in addition to PHY 4802L
- Complete 2 of 4 courses required for the Nanoscience specialization
- 2.0 UF GPA required

## Semester 8

- Complete the remaining required 4000-level physics courses with minimum grades of C
- Complete 1 4000-level or higher physics elective with a minimum grade of C
- Complete all 4 courses required for the Nanoscience specialization
- 2.0 UF GPA required

### Model Semester Plan

This plan is structured for students taking Calculus 1 the first semester. Students can have different schedules when they enter UF because of their backgrounds. In particular, students are encouraged to take Physics with Calculus 1 (PHY 2048 or PHY 2060) as soon as they have completed Calculus 1, even if this means delaying chemistry. For all physics courses, adequate mathematical preparation is essential and is built into the suggested plans. Physics majors should meet with a department advisor before planning their schedules.

Additional sample schedules are available on the department's website.

More Info (<http://www.phys.ufl.edu/academics/undergraduate/degrees.shtml/>)

Students are expected to complete the Writing Requirement while in the process of taking the courses below. Students are also expected to complete the General Education International (GE-N) and Diversity (GE-D) requirements concurrently with another General Education requirement (typically, GE-C, H, or S).

MAC 2312, MAC 2313, MAP 2302, and math electives count towards 3000 level or above electives outside of the major.

To remain on track, students must complete the appropriate critical-tracking courses, which appear in bold. These courses must be completed by the terms as listed above in the Critical Tracking criteria.

*This semester plan represents an example progression through the major. Actual courses and course order may be different depending on the student's academic record and scheduling availability of courses. Prerequisites still apply.*

Course	Title	Credits
<b>Semester One</b>		
CHM 2045 & 2045L	General Chemistry 1 and General Chemistry 1 Laboratory ( <b>Critical Tracking</b> ; State Core Gen Ed Physical Sciences)	4
MAC 2311	Analytic Geometry and Calculus 1 ( <b>Critical Tracking</b> ; State Core Gen Ed Mathematics) <sup>1</sup>	4
State Core Gen Ed Composition ( <a href="http://catalog.ufl.edu/UGRD/academic-programs/general-education/#genedcoursestext">http://catalog.ufl.edu/UGRD/academic-programs/general-education/#genedcoursestext</a> ); Writing Requirement		3

State Core Gen Ed Social and Behavioral Sciences ( <a href="http://catalog.ufl.edu/UGRD/academic-programs/general-education/#genedcoursestext">http://catalog.ufl.edu/UGRD/academic-programs/general-education/#genedcoursestext</a> )		3
Elective		1
	<b>Credits</b>	<b>15</b>
<b>Semester Two</b>		
Quest 1 (Gen Ed Humanities)		3
CHM 2046	General Chemistry 2 ( <b>Critical Tracking</b> ; Gen Ed Physical Sciences) <sup>1</sup>	3
MAC 2312	Analytic Geometry and Calculus 2 ( <b>Critical Tracking</b> ; Gen Ed Mathematics) <sup>1</sup>	4
Select one:		4
PHY 2048 & 2048L	Physics with Calculus 1 and Laboratory for Physics with Calculus 1 ( <b>Critical Tracking</b> ) <sup>1</sup>	
PHY 2060 & PHY 2048L	Enriched Physics with Calculus 1 and Laboratory for Physics with Calculus 1 ( <b>Critical Tracking</b> ; Gen Ed Physical Sciences) <sup>1</sup>	
Elective		1
	<b>Credits</b>	<b>15</b>
<b>Semester Three</b>		
Quest 2 (Gen Ed Biological Sciences OR Gen Ed Social and Behavioral Sciences)		3
MAC 2313	Analytic Geometry and Calculus 3 ( <b>Critical Tracking</b> ; Gen Ed Mathematics) <sup>1</sup>	4
Select one:		4
PHY 2049 & 2049L	Physics with Calculus 2 and Laboratory for Physics with Calculus 2 ( <b>Critical Tracking</b> ) <sup>1</sup>	
PHY 2061 & PHY 2049L	Enriched Physics with Calculus 2 and Laboratory for Physics with Calculus 2 ( <b>Critical Tracking</b> ; Gen Ed Physical Sciences) <sup>1</sup>	
Foreign language		4-5
	<b>Credits</b>	<b>15-16</b>
<b>Semester Four</b>		
MAP 2302	Elementary Differential Equations ( <b>Critical Tracking</b> ; Gen Ed Mathematics) <sup>1</sup>	3
PHY 3101	Introduction to Modern Physics ( <b>Critical Tracking</b> ; Gen Ed Physical Sciences) <sup>1</sup>	3
PHY 3221	Mechanics 1 ( <b>Critical Tracking</b> ; Gen Ed Physical Sciences) <sup>1</sup>	3
Gen Ed Biological Sciences		3
Foreign language		3-5
	<b>Credits</b>	<b>15-17</b>
<b>Semester Five</b>		
PHY 3323	Electromagnetism 1 ( <b>Critical Tracking</b> ; Gen Ed Physical Sciences) <sup>1</sup>	3
PHY 3513	Thermal Physics 1 ( <b>Critical Tracking</b> ; Gen Ed Physical Sciences) <sup>1</sup>	3
PHY 4222	Mechanics 2 ( <b>Critical Tracking</b> ) <sup>1</sup>	3
Gen Ed Biological OR Gen Ed Social and Behavioral Sciences (area NOT taken in semester 3)		3
Elective, or foreign language if 4-3-3 option		3
	<b>Credits</b>	<b>15</b>
<b>Semester Six</b>		
EEE 3396	Solid-State Electronic Devices ( <b>Critical Tracking</b> )	3
ENC 3254	Professional Writing in the Discipline (Recommended; Gen Ed Composition; Writing Requirement)	3
PHY 4324	Electromagnetism 2 ( <b>Critical Tracking</b> ; Gen Ed Physical Science) <sup>1</sup>	3
State Core Gen Ed Humanities ( <a href="http://catalog.ufl.edu/UGRD/academic-programs/general-education/#genedcoursestext">http://catalog.ufl.edu/UGRD/academic-programs/general-education/#genedcoursestext</a> )		3
Mathematics elective		3
	<b>Credits</b>	<b>15</b>
<b>Semester Seven</b>		
EEE 4331 or EMA 4614	Microelectronic Fabrication Technologies ( <b>Critical Tracking</b> ) or Production of Electronic Materials	3
PHY 4604	Introductory Quantum Mechanics 1 ( <b>Critical Tracking</b> ; Gen Ed Physical Sciences) <sup>1</sup>	3
PHY 4802L	Laboratory Physics 1 ( <b>Critical Tracking</b> ) <sup>1</sup>	3
Gen Ed Social and Behavioral Sciences		3
Mathematic elective		3
	<b>Credits</b>	<b>15</b>
<b>Semester Eight</b>		
PHY 4523	Statistical Physics ( <b>Critical Tracking</b> ) <sup>1</sup>	3
PHY 4803L	Laboratory Physics 2 ( <b>Critical Tracking</b> ) <sup>1</sup>	3
PHZ 4404	Introduction to Solid State Physics ( <b>Critical Tracking</b> )	3
Select one:		3-4
EEE 4222	Resonant MEMS ( <b>Critical Tracking</b> )	

EEL 4930	Special Topics in Electrical Engineering ( <b>Critical Tracking</b> )	
EGN 3353C	Fluid Mechanics ( <b>Critical Tracking</b> )	
EMA 4615	Compound Semiconductor Materials ( <b>Critical Tracking</b> )	
Gen Ed Humanities		3
	<b>Credits</b>	<b>15-16</b>
	<b>Total Credits</b>	<b>120</b>

<sup>1</sup> Minimum grade of C required.

## Academic Learning Compact

The laws of Physics are the starting point for most scientific research and engineering applications. Students majoring in Physics obtain broad-based knowledge and experience applying these laws as well as hands-on experience building electronic equipment and performing experiments. Many students go on to graduate study in physics, and a considerable number pursue advanced degrees in other science disciplines, all branches of engineering and medical school. Physics majors are employed in industry doing applied work and in academia seeking the answers to fundamental questions.

## Before Graduating Students Must

- Pass the UF physics field test, which consists of five parts. One part is given in each of these required courses:

Code	Title	Credits
PHY 2060 or PHY 3221	Enriched Physics with Calculus 1 Mechanics 1	3
PHY 3323	Electromagnetism 1	3
PHY 3513	Thermal Physics 1	3
PHY 4604	Introductory Quantum Mechanics 1	3
PHY 4802L	Laboratory Physics 1	3

- Complete requirements for the baccalaureate degree, as determined by faculty.

## Students in the Major Will Learn to

### Student Learning Outcomes | SLOs

#### Content

1. Identify, define, and describe the core fields of physics: classical mechanics, electricity and magnetism, thermal physics, and quantum mechanics.
2. Identify, define, and explain experimental physics and data analysis.

#### Critical Thinking

3. Formulate, solve problems, and draw conclusions from data.

#### Communication

4. Effectively and clearly communicate ideas in speech and in writing in an accepted style.

## Curriculum Map

*I = Introduced; R = Reinforced; A = Assessed*

Courses	SLO 1	SLO 2	SLO 3	SLO 4
PHY 2048 or PHY 2060	I		I	
PHY 2048L	I	I	I	I
PHY 2049 or PHY 2061	I		I	
PHY 2049L	I	I	I	I
PHY 3101 or PHY 3063	I, R		I, R	R
PHY 3221 or PHZ 3113	R, A		R, A	R
PHY 3323	R, A		R, A	R
PHY 3513	R, A		R, A	R
PHY 4604	R, A		R, A	R
PHY 4802L	R, A	R, A	R, A	R, A

## Assessment Types

- Field test
  - Report
  - Presentation
-