

PHYSICS, BACHELOR OF SCIENCE (B.S.) WITH A CONCENTRATION IN PRE-MEDICAL

The Bachelor of Science in Physics with a concentration in pre-medical requires a minimum of 120 credits. The curriculum prepares students for a health sciences career using physics-based technologies. Students from this program who apply to medical school will have a distinctively rigorous preparation. The curriculum also prepares students for graduate medical physics, biomedical engineering and M.D.-Ph.D. programs.

Student learning outcomes

Upon completing this program, students will know how to do the following:

Physics core outcomes

- Perform scientific reasoning and complex problem-solving
Physics majors will receive a fundamental understanding of the main areas of physics so that they are prepared for jobs that use physics-based technologies. They are expected to have mastered the analytical approach to solving technical problems by identifying simple subsystems that obey known physical laws and using these laws to approximate the behavior of the whole system.
- Demonstrate a fundamental understanding of the main areas of physics
- Demonstrate communication skills, both written and oral, needed to explain the analysis of technical problems
- Demonstrate scientific literacy skills including searching, reading and critically reviewing scientific publications
- Demonstrate proficiency in information processing by generating and interpreting data presented in tables, graphs, drawings and models

Pre-medical concentration-specific outcome

- Demonstrate a fundamental understanding of the application of physics concepts, theories and methods to medicine or health care

Double major in engineering and physics

A detailed description of this program (<https://bulletin.vcu.edu/undergraduate/engineering/double-major-physics/>) can be found in the "College of Engineering" section of this bulletin.

Students must complete 37 credits in physics and physics-related electives and 48-56 credits in ancillary requirements.

Degree requirements for Physics, Bachelor of Science (B.S.) with a concentration in premedical

Course	Title	Hours
General education (https://bulletin.vcu.edu/undergraduate/undergraduate-study/general-education-curriculum/)		
Select 30 credits of general education courses in consultation with an adviser.		30
Major requirements		

• Major core requirements		
PHYS 208	University Physics II	5
PHYS 301	Classical Mechanics I	3
PHYS 320 & PHYZ 320	Modern Physics and Modern Physics Laboratory	4
PHYS 340	Statistical Mechanics and Thermodynamics	3
PHYS 376	Electromagnetism I	3
PHYS 380	Quantum Physics I	3
PHYS 450	Senior Physics Laboratory	3
PHYS 490	Seminar in Conceptual Physics	1
• Concentration requirements		
PHYS 317	Preparing for the MCAT and Medical Sciences	3
PHYS 335	Experimental Skills for Physicists	3
PHYS 417	Topics in Biophysics	3
PHYS 425	Computational Physics and Data Analysis	3
Ancillary requirements		
BIOL 151	Introduction to Biological Sciences I	3
BIOZ 151	Introduction to Biological Science Laboratory I	1
BIOL 152 & BIOZ 152	Introduction to Biological Sciences II and Introduction to Biological Science Laboratory II	4
CHEM 101 & CHEZ 101	General Chemistry I and General Chemistry Laboratory I (CHEM 101 satisfies general education BOK for natural sciences and AOI for scientific and logical reasoning)	4
CHEM 102 & CHEZ 102	General Chemistry II and General Chemistry Laboratory II	4
CHEM 301 & CHEZ 301	Organic Chemistry and Organic Chemistry Laboratory I	5
CHEM 302 & CHEZ 302	Organic Chemistry and Organic Chemistry Laboratory II	5
HUMS 202	Choices in a Consumer Society	1
MATH 200	Calculus with Analytic Geometry I (satisfies general education quantitative foundations)	4
MATH 201	Calculus with Analytic Geometry II	4
MATH 301	Differential Equations	3
MATH 307	Multivariate Calculus	4
PHYS 207	University Physics I (satisfies general education BOK for natural sciences and AOI for scientific and logical reasoning)	5
Experiential fine arts ¹		1-3
Foreign language through the 102 level (by course or placement)		0-6
Open electives		
Select any course.		9-17
Total Hours		120

Course offered by the School of the Arts

The minimum number of credit hours required for this degree is 120.

Courses not applicable toward the major

Course	Title	Hours
The following courses are not applicable toward the physics major requirements but may be used as general electives toward the bachelor's degree:		
PHYS 101	Foundations of Physics	3
PHYS 103	Elementary Astronomy	3
PHYS 107	Wonders of Technology	4
PHYS 201	General Physics I	4
PHYS 202	General Physics II	4
PHYS 215	Science, Technology and Society	3
PHYS 291	Topics in Physical Science	1-3
PHYS/MHIS 307	The Physics of Sound and Music	3
PHYS/ENVS 315	Energy and the Environment	3
PHYS 391	Topics in Physics	1-3
PHYZ 101	Foundations of Physics Laboratory	1
PHYZ 103	Elementary Astronomy Laboratory	1

What follows is a sample plan that meets the prescribed requirements within a four-year course of study at VCU. Please contact your adviser before beginning course work toward a degree.

Freshman year

Fall semester		Hours
BIOL 151	Introduction to Biological Sciences I	3
BIOZ 151	Introduction to Biological Science Laboratory I	1
CHEM 101	General Chemistry I (satisfies general education AOI for scientific and logical reasoning)	3
CHEZ 101	General Chemistry Laboratory I	1
MATH 200	Calculus with Analytic Geometry I (satisfies general education quantitative foundations)	4
UNIV 111	Introduction to Focused Inquiry: Investigation and Communication (satisfies general education UNIV foundations)	3
Play course video for Introduction to Focused Inquiry: Investigation and Communication		
Experiential fine arts		1-3
Term Hours:		16-18

Spring semester

BIOL 152 & BIOZ 152	Introduction to Biological Sciences II and Introduction to Biological Science Laboratory II	4
HUMS 202	Choices in a Consumer Society	1
MATH 201	Calculus with Analytic Geometry II	4

PHYS 207	University Physics I (satisfies general education BOK for natural sciences and AOI for scientific and logical reasoning)	5
UNIV 112	Focused Inquiry II (satisfies general education UNIV foundations)	3
Play course video for Focused Inquiry II		

Term Hours: 17

Sophomore year

Fall semester

CHEM 102 & CHEZ 102	General Chemistry II and General Chemistry Laboratory II	4
MATH 307	Multivariate Calculus	4
PHYS 208	University Physics II	5
UNIV 200	Advanced Focused Inquiry: Literacies, Research and Communication (satisfies general education UNIV foundations)	3

Term Hours: 16

Spring semester

CHEM 301 & CHEZ 301	Organic Chemistry and Organic Chemistry Laboratory I	5
MATH 301	Differential Equations	3
PHYS 301	Classical Mechanics I	3
PHYS 320 & PHYZ 320	Modern Physics and Modern Physics Laboratory	4

Term Hours: 15

Junior year

Fall semester

CHEM 302 & CHEZ 302	Organic Chemistry and Organic Chemistry Laboratory II	5
PHYS 317	Preparing for the MCAT and Medical Sciences	3
PHYS 376	Electromagnetism I	3
PHYS 380	Quantum Physics I	3
Foreign language 101		3

Term Hours: 17

Spring semester

PHYS 335	Experimental Skills for Physicists	3
PHYS 340	Statistical Mechanics and Thermodynamics	3
Foreign language 102		3
General education course		3

Term Hours: 12

Senior year

Fall semester

PHYS 417	Topics in Biophysics	3
PHYS 450	Senior Physics Laboratory	3
Open elective		3
General education course (select BOK to complete breadth of knowledge requirement and AOI for diversities in the human experience)		3

Term Hours: 12

Spring semester

PHYS 490	Seminar in Conceptual Physics	1
PHYS 425	Computational Physics and Data Analysis	3
General education course (select BOK to complete breadth of knowledge requirement and AOI for global perspectives)		3
Open electives		8-9
Term Hours:		15-16
Total Hours:		120-123

The minimum number of credit hours required for this degree is 120.

Accelerated B.S. and M.S.

The accelerated B.S. and M.S. program allows academically talented students to earn both the B.S. in Physics and M.S. in Physics and Applied Physics in a minimum of five years by completing approved graduate courses during the senior year of their undergraduate program. Students in the program may count up to 12 hours of graduate courses toward both the B.S. and M.S. degrees. Thus, the two degrees may be earned with a minimum of 138 credits rather than the 150 credits necessary if the two degrees are pursued separately.

Students holding these degrees will be more competitive when seeking research and development positions in industry and admission to physics Ph.D. programs. In addition, an M.S. degree is required for most undergraduate teaching positions. The master's program enables students to deepen their understanding of physics while gaining actual experience in research at the frontiers of physics.

Entrance to the accelerated program

Interested undergraduate students should consult with their adviser as early as possible to receive specific information about the accelerated program, determine academic eligibility and submit (no later than two semesters prior to graduating with a baccalaureate degree, that is, before the end of the spring semester of their junior year) an Accelerated Program Declaration Form to be approved by the graduate program director. Limited spaces may be available in the accelerated program. Academically qualified students may not receive approval if capacity has been reached.

Minimum qualifications for entrance to this accelerated program include completion of 85 undergraduate credit hours, including PHYS 376 and PHYS 380; an overall GPA of 3.25; and a GPA of 3.25 in physics course work.

Once enrolled in the accelerated program, students must meet the standards of performance applicable to graduate students as described in the “**Satisfactory academic progress**” section of Bulletin, including maintaining a 3.0 GPA. Guidance to students in an accelerated program is provided by both the undergraduate physics adviser and the graduate adviser specified in the student's agreed-upon plan of study.

Admission to the graduate program

Entrance to the accelerated program enables the student to take the approved shared courses that will apply to the undergraduate and graduate degrees. However, entry into an accelerated program via an approved Accelerated Program Declaration Form does not constitute application or admission into the graduate program. Admission to the graduate program requires a separate step that occurs through a formal application. In order to continue pursuing the master's degree after the

baccalaureate degree is conferred, accelerated students must follow the admission to graduate study requirements outlined in the VCU Bulletin.

Degree requirements

The Bachelor of Science in Physics degree will be awarded upon completion of a minimum of 120 credits and the satisfactory completion of all undergraduate degree requirements as stated in the Undergraduate Bulletin.

A maximum of 12 graduate credits may be taken prior to completion of the baccalaureate degree. These graduate credits substitute for required major electives or open elective credits for the undergraduate degree. These courses are shared credits with the graduate program, meaning that they will be applied to both undergraduate and graduate degree requirements.

The graduate physics courses that may be taken as an undergraduate, once a student is admitted to the program, are:

Course	Title	Hours
NANO 530	Nanomaterials Characterization Techniques	3
NANO 570	Nanoscale Physics	3
NANO 571	Nanoscale Chemistry	3
PHYS 522	Optics and Laser Physics	3
PHYS 560	Fundamentals of Semiconductor Nanostructures	3

Recommended course sequence/plan of study

What follows is the recommended plan of study for students interested in the accelerated program beginning in the fall of the junior year prior to admission to the accelerated program in the senior year. The thesis option for the M.S. is shown.

Course	Title	Hours
Junior year		
Fall semester		
General education course (select BOK to complete breadth of knowledge requirement)		3
Major electives		6
Open electives		6
Term Hours:		15
Spring semester		
PHYS 340	Statistical Mechanics and Thermodynamics	3
PHYS 376	Electromagnetism I	3
PHYS 380	Quantum Physics I	3
Open electives		6
Term Hours:		15
Senior year		
Fall semester		
NANO 570	Nanoscale Physics	3
PHYS 450	Senior Physics Laboratory	3
Electives		6
PHYS 560	Fundamentals of Semiconductor Nanostructures	3
Term Hours:		15

Spring semester		
NANO 530	Nanomaterials Characterization Techniques	3
PHYS 490	Seminar in Conceptual Physics	1
PHYS 492	Independent Study (begin research)	3
PHYS 522	Optics and Laser Physics	3
Open electives		6
Term Hours:		16
Fifth year		
Fall semester		
PHYS 697	Directed Research	5
600-level PHYS elective ¹		4
Term Hours:		9
Spring semester		
NANO 571	Nanoscale Chemistry	3
PHYS 697	Directed Research	5
600-level PHYS elective ¹		1
Term Hours:		9

¹

It is recommended, but not required, that one hour of PHYS 690 be taken as part of the elective credits.