ENGINEERING PHYSICS - BACHELOR OF SCIENCE (BSEP)

During the freshman and sophomore years, students receive a broad introduction to physics, chemistry, applied mathematics and mathematical methods in physics. Starting in the sophomore year, students take electrodynamics, quantum mechanics, classical mechanics, mathematical methods, thermodynamics and statistical mechanics, and advanced mathematics. In addition, there is a core of four laboratory courses that students take. Laboratory courses emphasize student-developed and student-designed independent projects in which students use the knowledge acquired to build apparatus of their own choosing. One of the capstone lab courses, PHYS 4430, provides students with hands-on experience with optical spectroscopy, nuclear magnetic resonance, scanning tunneling microscopy, and laser cooling and trapping of atoms, among other experiments. The other capstone course, PHYS 4700, provides students an opportunity to gain professional and technical quantum science skills and experience through participation in real-world projects in collaboration with industry leaders and academic investigators.

The program encourages the formation of student research collaborations with faculty in the pursuit of senior thesis projects. Recent projects include research in pulsed laser deposition of high-temperature superconductors, electron diffraction studies of protein structure, and lattice distortion theory of colossal magnetoresistance materials.

Students who plan to become registered professional engineers should check the requirements for registration in their state before choosing their engineering major.

Note: Students may not earn a bachelor's degree in physics from the College of Arts & Sciences as well as a bachelor's degree in engineering physics from the College of Engineering & Applied Science. Furthermore, the physics minor may not be earned with either of these two baccalaureate programs.

Requirements

Program Requirements

In order to earn a bachelor's degree in engineering physics, students must complete the curriculum in the undergraduate major program, as outlined below. For up-to-date program requirements, visit the Bachelor of Science in Engineering Physics (https://www.colorado.edu/physics/ academics/undergraduate-students/bachelor-science-engineeringphysics/) webpage.

Students may not earn a BS in Engineering Physics + BA in Physics or a minor in physics.

Note: Some variations may be possible; students are advised to see their engineering physics academic advisor.

In addition, students must meet the general undergraduate degree requirements of the College of Engineering and Applied Science (https:// www.colorado.edu/engineering-advising/get-your-degree/graduationrequirements/).

Required	Courses and Credits	
Code	Title	

Code	Title	Credit Hours
Required Courses		
PHYS 1115	General Physics 1 for Majors	4
or PHYS 1110	General Physics 1	
PHYS 1125	General Physics 2 for Majors	4
or PHYS 1120	General Physics 2	
PHYS 1140	Experimental Physics 1	1
PHYS 2150	Experimental Physics 2	1
PHYS 2170	Foundations of Modern Physics	3
or PHYS 2130	Introduction to Quantum Mechanics and Its Applications	
PHYS 2210	Classical Mechanics and Mathematical Methods 1	3
PHYS 3210	Classical Mechanics and Mathematical Methods 2	3
PHYS 3220	Quantum Mechanics 1	3
PHYS 3310	Principles of Electricity and Magnetism 1	3
PHYS 3320	Principles of Electricity and Magnetism 2	3
PHYS 3330	Electronics for the Physical Sciences	2
PHYS 4230	Thermodynamics and Statistical Mechanics	3
PHYS 4410	Quantum Mechanics 2	3
Upper-Division Physic	cs Electives	
Complete one of the t	hree options listed in the next table.	9
Required Chemistry 8	Natural Science Courses	
CHEM 1113	General Chemistry 1	4
or CHEN 1201	General Chemistry for Engineers 1	
or CHEN 1211	Accelerated Chemistry for Engineers	
CHEM 1114	Laboratory in General Chemistry 1	1
or CHEM 1221	Engineering General Chemistry Lab	
Natural Science Elect	ives	5
Required Mathematic	s Courses	
APPM 1350	Calculus 1 for Engineers	4
or MATH 1300	Calculus 1	
or APPM 1345	Calculus 1 with Algebra, Part B	
APPM 1360	Calculus 2 for Engineers	4
or MATH 2300	Calculus 2	
APPM 2350	Calculus 3 for Engineers	4
or MATH 2400	Calculus 3	
APPM 2360	Introduction to Differential Equations with Linear Algebra	4
or MATH 2130 & MATH 3430	Introduction to Linear Algebra for Non- Mathematics Majors and Ordinary Differential Equations	
Upper-division APPM,	, MATH, or STAT course. ²	3
Required Engineering	and Computing Courses	25
Choose two of the following computing options		
PHYS 2600	Introduction to Programming and Scientific Computing	
or APPM 1650	Python for Math and Data Science Applicatio	ons

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Total Credit Hours		128
Choose at least 11 credit hours of free electives to meet the minimum 128 credit hours required for the BS degree.		11
Free Electives		
Complete the College's Humanities, Social Sciences and Writing requirements. ⁴		18
Humanities, Social So	ciences and Writing	
Choose engineering courses to reach a minimum of 25 credits in addition to computing and other degree requirements. Must be offered by CEAS departments. ³		
CSCI 3+ credit cou	rse at the 2000 level or above.	
or MCEN 1025	Computer-Aided Design and Fabrication	
AREN 1027	Engineering Drawing	
ECEN 1310	Introduction to C Programming	
CSCI 1300	Computer Science 1: Starting Computing	

- 1 Students may choose courses from the list of Engineering Physics approved natural science electives.
- 2 Excludes MATH 3430 and courses that are approved to count for the CEAS Humanities and Social Science requirement.
- 3 Choose from the following subject codes: APPM, AREN, ASEN, ATLS, BIEN, BMEN, CHEN, COEN, CSCI, CVEN, ECEN, EMEN, ENEN, EVEN, GEEN, IDEN, MCEN or STAT. Excluded: ASEN 3036, ASEN 3046, CHEN 1201, CHEN 1211 and any other courses otherwise approved for the CEAS Humanities and Social Sciences requirement.
- 4 Students may choose courses from the list of college-approved humanities and social sciences (HSS) electives.

Upper-Division Physics Electives

The selection of course offerings changes each semester. See the Engineering Physics Advising Guide (https://www.colorado.edu/physics/ academics/undergraduate-students/bachelor-science-engineeringphysics/) for an up-to-date selection.

Code	Title	Credit Hours
Research/Lab Electiv	es ^{1,2}	3-6
PHYS 4430	Advanced Laboratory	
or PHYS 5430	Advanced Laboratory	
PHYS 4610	Physics Honors ²	
PHYS 4620	Physics Honors ²	
PHYS 4630	Physics Honors ²	
PHYS 4700	Quantum Forge I	
PHYS 4710	Quantum Forge II	
PHYS 4840	Independent Study ²	
Other Upper-Division	Physics Electives	3-6
PHYS 3070	Energy and the Environment	
PHYS 3090	Introduction to Quantum Computing	
PHYS 4150	Plasma Physics	
PHYS 4340	Introduction to Solid State Physics	
PHYS 4420	Nuclear and Particle Physics	
PHYS 4450	History and Philosophy of Physics	
PHYS 4460	Teaching and Learning Physics	
PHYS 4510	Optics	
PHYS 4550	Cells, Molecules and Tissues: A Biophysical Approach	

Fotal Credit Hours			9
	permission of inst	tructor.	
Any PHYS graduate-level courses (5000 level or above), with			
	PHYS 4810	Special Topics in Physics	
	PHYS 4560	Introduction to Biophysics	

Total Credit Hours

1 Students may satisfy the research/lab electives with documentation of accomplishments as an intern with a research group in the Physics Department or suitable cognate department. Approval by an Engineering Physics faculty mentor is required and should be obtained in advance. Students pursuing this option must take 9 credit hours of upper-division physics electives.

2 Students may count a maximum of 6 credit hours from a combination of PHYS 4610/PHYS 4620/PHYS 4630 and PHYS 4840 as physics electives.

Sample Four-Year Plan of Study

Below is a suggested schedule only. For a complete description of the engineering physics course requirements, visit the Department of Physics (http://www.colorado.edu/physics/) website.

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Year One

Fall Semester		Hours
APPM 1350	Calculus 1 for Engineers	4
First Computing Cou	rse ¹	4
PHYS 1115 or PHYS 1110	General Physics 1 for Majors or General Physics 1	4
COEN 1500	CEAS First Year Seminar	1
Humanities or Social	Science Elective ²	2
	Credit Hours	15
Spring Semester		
APPM 1360	Calculus 2 for Engineers	4
Second Computing C	ourse ¹	3
PHYS 1125 or PHYS 1120	General Physics 2 for Majors or General Physics 2	4
PHYS 1140	Experimental Physics 1	1
Humanities or Social	Science Elective ²	3
	Credit Hours	15
Year Two		
Fall Semester		
APPM 2350	Calculus 3 for Engineers	4
CHEM 1113	General Chemistry 1	4
CHEM 1114	Laboratory in General Chemistry 1	1
PHYS 2150	Experimental Physics 2	1
PHYS 2170 or PHYS 2130	Foundations of Modern Physics or Introduction to Quantum Mechanics and Its Applications	3
Engineering Electives	3 ¹	4
	Credit Hours	17
Spring Semester		
APPM 2360	Introduction to Differential Equations with Linear Algebra	4
PHYS 2210	Classical Mechanics and Mathematical Methods 1	3

	Total Credit Hours	128
	Credit Hours	16
Free Electives		6
Humanities or Socia	al Science Elective ²	3
Physics Electives ¹	-	3
Engineering Elective	es ¹	4
Spring Semester		
	Credit Hours	15
Free Electives		3
College-Approved W	/riting Course ⁴	3
Physics Electives ¹		3
Engineering Elective	es ¹	3
PHYS 4410	Quantum Mechanics 2	3
Fall Semester		
Year Four		
	Credit Hours	18
Humanities or Socia	al Science Elective ²	3
Physics Electives ¹		3
Upper Division Math or Applied Math elective		
11113 4230	Mechanics	5
PHVS 1220	Thermodynamics and Statistical	3 2
PHIS 3220	Quantum Mechanics T	3
	Quantum Mechanics 1	С
Spring Somostor	Great Hours	10
FIEE EIECUVES	Cradit Hours	16
Free Fleetivee		3
Engineering Elective		3
PHYS 3330	Electronics for the Physical Sciences	2
PHYS 3310	Principles of Electricity and Magnetism 1	3
	Methods 2	0
PHVS 3210	Classical Mechanics and Mathematical	3
Fall Somestor		
Voor Throp	Creat Hours	10
		16
CHEM 1133	General Chemistry 2	4
	25	4
Engineering Elective		1

¹ For additional information, course options, and planning advice, consult the Engineering Physics Advising Guide on the Engineering Physics Major Website (https://www.colorado.edu/physics/ academics/undergraduate-students/bachelor-science-engineeringphysics/).

- ² Students may choose courses from the list of college-approved humanities and social sciences (HSS) electives (http:// www.colorado.edu/engineering/academics/policies/hss/).
- ³ Students may choose courses from the list of Engineering Physics approved natural science electives.
- ⁴ Students may choose a course from the list of college-approved writing courses.

Learning Outcomes

By the completion of the program, students will be able to:

- Have the knowledge of the basic subfields of physics (classical mechanics, electricity and magnetism, quantum mechanics, statistical mechanics and thermodynamics), as well as at least one specialty area of application (e.g., condensed matter physics or optics).
- Apply major principles of physics towards solving problems in various subfields of physics, including the use of mathematical and computational tools as appropriate.
- Use skills in assembling and using experimental apparatus to conduct and analyze measurements of physical phenomena.
- Have the knowledge of the role of systematic and random experimental errors, along with methods used to analyze experimental uncertainty and compare experiment with theory.
- Use skills in collaborating effectively and communicating results of scientific inquiries verbally and in writing.

Bachelor's-Accelerated Master's Degree Program(s)

The bachelor's-accelerated master's (BAM) degree program options offer currently enrolled CU Boulder undergraduate students the opportunity to receive a bachelor's and master's degree in a shorter period of time. Students receive the bachelor's degree first but begin taking graduate coursework as undergraduates (typically in their senior year).

Because some courses are allowed to double count for both the bachelor's and the master's degrees, students receive a master's degree in less time and at a lower cost than if they were to enroll in a stand-alone master's degree program after completion of their baccalaureate degree. In addition, staying at CU Boulder to pursue a bachelor's-accelerated master's program enables students to continue working with their established faculty mentors.

BS in Engineering Physics, MS in Physics

The BAM program in engineering physics aims to provide new opportunities for undergraduate engineering physics majors. The program is specifically addressed to engineering physics majors in the Department of Physics. The engineering physics major gives students a thorough grounding in theoretical physics, applied mathematics and broad exposure to engineering topics, so that they are well prepared either to proceed with graduate work or with professional employment in either basic science or in applied fields.

For students interested in graduate studies, the BAM program in engineering physics allows for participation in graduate coursework and research in a broad range of areas. For students interested in immediate professional employment, this program would serve as a terminal degree program that qualifies students for a higher level of employment.

Admissions Requirements

In order to gain admission to the BAM program named above, a student must meet the following criteria:

- Have a cumulative GPA of 3.30 or higher and a physics major GPA of 3.30 or higher.
- · Have completed a minimum of 80 credit hours of coursework.

- Completion of all MAPS requirements and no deficiencies remaining (students admitted to CU Boulder prior to Summer 2023 only).
- Transfer students must have completed a minimum of 24 credit hours at CU Boulder.
- Have a letter of support from a faculty advisor to complete master's level research.

Program Requirements

Students may take up to and including 12 hours while in the undergraduate program which can later be used toward the master's degree. However, only six hours may be double counted toward the bachelor's degree and the master's degree. Students must apply to graduate with the bachelor's degree, and apply to continue with the master's degree, early in the semester in which the undergraduate requirements will be completed.

If you are interested in the BAM degree program, please contact the Engineering Physics Faculty Director for more information.