ENGINEERING SCIENCE, B.S.

Begin Campus: Any Penn State Campus

End Campus: University Park

Program Description

Engineering Science is a multidisciplinary honors program that emphasizes enhanced understanding and integrated application of engineering, scientific, and mathematical principles. The program is unique because it provides a broad foundation in the sciences and associated mathematics that underlie engineering and provides students the opportunity to obtain a depth of knowledge in an area of their choosing through technical electives and a research and design honors thesis. The curriculum is designed for students who seek to link the engineering disciplines with science. In addition to taking core courses in mathematics, physics and chemistry - (and biology for students in premedicine), students study thermodynamics, heat transfer, electromagnetics, solid and fluid mechanics, electrical devices, materials science, and topics selected as foundational and technical electives. During the junior year, students investigate a variety of research fields and identify a topic for their honor thesis research and design project. During the senior year, all students complete a capstone project on their chosen topic by writing a thesis that applies the scientific principles of research, design and analysis to engineering. Focus areas of study include, but are not limited to: electrical, mechanical, civil, biomedical, and materials engineering and are expected to be interdisciplinary. Hence, Engineering Science students achieve both depth and breadth in engineering and science, are able to function across disciplines, and graduate well prepared for advanced studies as well as professional employment.

The specific program objectives are tied to the mission of the program as described above. They target the major outcomes expected of Engineering Science students and are flexible and readily adaptable to meet changing constituent needs.

Enrollment is limited to students who have demonstrated that they can benefit from the advanced courses of the curriculum; therefore a minimum grade-point average of 3.0 is required. Qualified students can participate in the integrated undergraduate graduate (IUG) program to streamline the process of earning B.S. and M.S. degrees. Interested students should contact their academic adviser.

What is Engineering Science?

Engineering science is a broad discipline that encompasses many different scientific principles and associated mathematics that underlie engineering. It integrates engineering, biological, chemical, mathematical, and physical sciences with the arts, humanities, social sciences, and the professions to tackle the most demanding challenges and advance the well-being of global society. The unique knowledge and interdisciplinary skill set of engineering scientists allows them to merge multidisciplinary resources to propose and develop innovative, enduring solutions and transform the latest scientific discoveries into enabling new technologies. Engineering scientists research, develop, and design new materials, devices, sensors, and processes for a diverse range of applications.

You Might Like This Program If...

- You are interested in, and excel at, science and math, and want to use your skills in these areas to research, develop, and design new products and processes in a wide variety of fields.
- You are interested in merging multidisciplinary resources to propose and develop innovative, enduring solutions and transforming the latest scientific discoveries into enabling new technologies.
- You're seeking to link science with the engineering disciplines such as electrical, mechanical, chemical, civil, and biomedical.
- You want an engineering curriculum and degree that you can tailor to your interests including research at the undergraduate level.
- You are in the Schreyer Honors College and want a curriculum that will automatically satisfy all requirements of the Honors College.

Entrance to Major

In order to be eligible for entrance to this major, students must satisfy the following requirements:

- 29-55 cumulative credits (excludes transfer and AP credits)
- completed with a grade of C or better: EDSGN 100, CHEM 110, MATH 140, MATH 141, PHYS 211
- earned a minimum cumulative grade-point average (GPA) of 3.00

* In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

* Since Engineering Science is an honors program, admission is limited to students who attain a cumulative GPA of at least 3.0 by the end of the entrance to major semester. In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

Degree Requirements

For the Bachelor of Science degree in Engineering Science, a minimum of 131 credits is required:

Requirement	Credits
General Education	45
Requirements for the Major	113

27 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 9 credits of GN courses; 6 credits of GQ courses; 3 credits of GS courses; 9 credits of GWS courses.

For the non-Honors B.S. degree in Engineering Science, 131 credits and a 2.50 grade-point average are required. The Honors degree requires the same number of total credits but a minimum of 16 honors Jr./Sr. year credits and a higher grade-point average as determined by the faculty.

Requirements for the Major

To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44).

Code	Title	Credits
Prescribed Courses		
CHEM 111	Experimental Chemistry I	1
EE 210	Circuits and Devices	4
EMCH 302H	Thermodynamics, Heat Conduction, and Principles of Modeling, Honors	4
ESC 312	Engineering Applications of Wave, Particle, and Ensemble Concepts	3
ESC 409	Senior Research and Design Project Preparation, Honors	1
ESC 410		3
ESC 411	Senior Research and Design Project II, Honors	2
ESC 433	Engineering Science Research Laboratory Experience	1
MATH 220	Matrices	2
MATH 230	Calculus and Vector Analysis	4
PHYS 214	General Physics: Wave Motion and Quantum Physics	2
Prescribed Courses: Require a grade of C or better		
CHEM 110	Chemical Principles I	3
EDSGN 100	Cornerstone Engineering Design	3
ENGL 202C	Effective Writing: Technical Writing	3
ESC 404	Analysis in Engineering Science	3
ESC 407	Computer Methods in Engineering Science, Honors	3
ESC 414M	Elements of Material Engineering	3
MATH 140	Calculus With Analytic Geometry I	4
MATH 141	Calculus with Analytic Geometry II	4
MATH 251	Ordinary and Partial Differential Equations	4
PHYS 211	General Physics: Mechanics	4
PHYS 212	General Physics: Electricity and Magnetism	4
Additional Courses		
Select 1 credit of First-Year Seminar		1
CMPSC 201	Programming for Engineers with C++	3
or ESC 261M	Computational Methods in Engineering	
Select one of the following:		3
ECON 14	Principles of Economics	
ECON 102	Introductory Microeconomic Analysis and Policy	
ECON 104	Introductory Macroeconomic Analysis and Policy	
Additional Courses: Require a grade of C or better		
CAS 100A	Effective Speech	3
or CAS 100B	Effective Speech	
EMCH 210H	Statics and Strength of Materials, Honors	5
or EMCH 210	Statics and Strength of Materials	
EMCH 212H	Dynamics	3
or EMCH 212	Dynamics	
ENGL 15	Rhetoric and Composition	3
or ENGL 30H	Honors Rhetoric and Composition	
Supporting Courses and Related Areas		
Select 15 credits from the department Foundational Elective List		15
Select 12 credits from the department Technical Elective List [1]		12

[1] Students may apply 3 credits of ROTC or 3 credits of co-op experience.

General Education

Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (https://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program/) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

Foundations (grade of C or better is required.)

- **Quantification (GQ):** 6 credits
- **Writing and Speaking (GWS):** 9 credits

Knowledge Domains

- **Arts (GA):** 6 credits
- **Health and Wellness (GHW):** 3 credits
- **Humanities (GH):** 6 credits
- **Social and Behavioral Sciences (GS):** 6 credits
- **Natural Sciences (GN):** 9 credits

Integrative Studies (may also complete a Knowledge Domain requirement)

- **Inter-Domain or Approved Linked Courses:** 6 credits

University Degree Requirements

First Year Engagement

All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

Cultures Requirement

6 credits are required and may satisfy other requirements

- United States Cultures: 3 credits
- International Cultures: 3 credits

Writing Across the Curriculum

3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits

A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work

Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition

The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80)). For more information, check the Suggested Academic Plan for your intended program.

Integrated B.S. in Engineering Science and M.S. in Engineering Science and Mechanics

Requirements for the Integrated B.S. in Engineering Science and M.S. in Engineering Science and Mechanics can be found in the Graduate Bulletin (https://bulletins.psu.edu/graduate/programs/majors/engineering-science-mechanics/#integratedundergradgradprogramstext).

Program Educational Objectives

The expected accomplishments of Engineering Science graduates in the first several years following graduation are:

1. acquire and apply new knowledge through lifelong learning activities including, but not limited to, masters, doctorate, medical, and law degrees, continuing education, leadership development, management training, innovation/entrepreneurship, and global involvement/awareness;
2. engage in practice in a wide variety of fields including, but not limited to, electrical systems, electronics, mechanical systems, materials development, forensics, biomaterials, medicine, law, and business in industry, academia and government;
3. research, develop, design and/or utilize new products, processes, materials, devices, systems, and/or tools;
4. communicate findings and best practices, at conferences and meetings, and to the general public through presentations, technical publications (journals, reports, memoranda), patents, and other media;
5. apply ethically and professionally the principles and latest tools of engineering, science, and mathematics for the benefit of society;
6. participate in and promote the values of diversity and sustainability in society; and
7. encourage and foster future generations of engineers through mentoring, service, and outreach.

Student Outcomes

Student outcomes describe what students are expected to know and be able to do by the time of graduation. The Engineering Science program is designed to enable students to:

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. Communicate effectively with a range of audiences
4. Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. Acquire and apply new knowledge as needed, using appropriate learning strategies.

Academic Advising

The objectives of the university's academic advising program are to help advisees identify and achieve their academic goals, to promote their intellectual discovery, and to encourage students to take advantage of both in-and out-of class educational opportunities in order that they become self-directed learners and decision makers.

Both advisers and advisees share responsibility for making the advising relationship succeed. By encouraging their advisees to become engaged in their education, to meet their educational goals, and to develop the habit of learning, advisers assume a significant educational role. The advisee's unit of enrollment will provide each advisee with a primary academic adviser, the information needed to plan the chosen program of study, and referrals to other specialized resources.

READ SENATE POLICY 32-00: ADVISING POLICY (https://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy/)

University Park

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Suggested Academic Plan

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2022-23 academic year. To access previous years' suggested academic plans, please visit the archive (https://bulletins.psu.edu/undergraduate/archive/) to view the appropriate Undergraduate Bulletin edition (*Note: the archive only contains suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin*).

Engineering Science, B.S. at University Park Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

If you are starting at a campus other than the one this plan is ending at, please refer to: http://advising.engr.psu.edu/degree-requirements/academic-plans-by-major.aspx

First Year

Fall	Credits	Spring	Credits
CHEM 110 (GN)*#†	3	CHEM 111	1
ECON 102 or 104 (GS)†	3	ENGL 15, 30H, or ESL 15 (GWS)‡†	3
EDSGN 100*#	3	ESC 261M or CMPSC 201	3
MATH 140 or 140E (GQ)*‡#†	4	MATH 141 or 141E (GQ)*‡#†	4
General Education Course†	3	PHYS 211 (PHYS 211L & PHYS 211R (GN))*#†	4
		First Year Seminar†	1
	16		**16**

Second Year

Fall	Credits	Spring	Credits
EMCH 210H*	5	CAS 100A or 100B (GWS)‡†	3
MATH 220	2-3	EMCH 212H*	3
MATH 251*	4	ME 302	4
PHYS 212 (PHYS 212L & PHYS 212R (GN))*†	4	MATH 230	4
General Education Course†	3	PHYS 214	2
	18-19		**16**

Third Year

Fall	Credits	Spring	Credits
EE 210	4	ESC 409	1
ESC 312	3	Foundational Elective	3
ESC 407*	3	Foundational Elective	3
ESC 414M*	3	Foundational Elective	3
ESC 433	1	Foundational Elective	3
General Education Course†	3	Foundational Elective	3
	17		**16**

Fourth Year

Fall	Credits	Spring	Credits
ENGL 202C (GWS)‡†	3	ESC 411	2
ESC 404*	3	Technical Elective	3
ESC 410	3	Technical Elective	3
Technical Elective	3	General Education Course†	3
Technical Elective	3	General Education Course†	3
General Education Course (GHW)†	1.5	General Education Course (GHW)†	1.5
	16.5		**15.5**

Total Credits 131-132

* Course requires a grade of C or better for the major
‡ Course requires a grade of C or better for General Education
# Course is an Entrance to Major requirement
† Course satisfies General Education and degree requirement

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures). W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL 137H/CAS 137H in the fall semester and ENGL 138T/CAS 138T in the spring semester. These courses carry the GWS designation and replace both ENGL 30H and CAS 100. Each course is 3 credits.

College Notes:

- **CMPSC 201:** Students are expected to complete the version of CMPSC that is required for their intended major. The requirement varies across College of Engineering majors. Students should plan the CMPSC course requirement carefully with the assistance of an academic adviser.
- **Foundational Elective:** Select from department list.
- **Health and Physical Activity:** Students who complete the ROTC Program may substitute 3 ROTC credits for the GHW requirement.
- **Technical Elective:** Select from department list. A student may use **only one** of the following as a substitute for a Technical Elective: 3 co-op credits, provided the student completes three Cooperative Education Program rotations; 3 ROTC credits, provided the student completes the ROTC Program; or one 3-credit course required for a minor but not otherwise included in degree requirements, provided the student completes all the requirements of the minor.
- ***These courses offered at University Park in fall semester only:***
  - EE 210
  - EMCH 210H
  - ESC 312
  - ESC 404
  - ESC 407
  - ESC 414M
  - ESC 433
- ***These courses offered at University Park in spring semester only:***
  - EMCH 212H
  - ESC 261M
  - ME 302

Career Paths

Career opportunities for engineering science graduates are limited only by their imagination. Because of the breadth of their training, engineering scientists are well prepared to lead national and international interdisciplinary teams in a diverse array of science and engineering endeavors, in addition to careers in law, medicine, business, politics, and government service. Engineering science graduates are extremely well prepared for graduate study in most engineering disciplines, including

mechanical, electrical, aerospace, industrial, and materials, as well as graduate study in physics and mathematics.

Careers

Penn State engineering science and mechanics alumni are successful entrepreneurs, business executives, captains of industry, leaders in national laboratories, startup founders, physicians, professors, and academic officials. Starting salaries for engineering science graduates in past years have been among the highest for all graduates in the College of Engineering.

MORE INFORMATION ABOUT POTENTIAL CAREER OPTIONS FOR GRADUATES OF THE ENGINEERING SCIENCE PROGRAM (http://www.esm.psu.edu/academics/resources/career-resources.aspx)

Opportunities for Graduate Studies

The ESM department offers the following graduate degree options:

- Master of Engineering (M.Eng.) in Engineering Mechanics
- Master of Engineering (M.Eng.) in Additive Manufacturing
- Master of Science (M.S.) in Engineering at the Nano-scale
- Master of Science (M.S.) in Engineering Science and Mechanics
- Master of Science (M.S.) in Additive Manufacturing
- Doctor of Philosophy (Ph.D.) in Engineering Science and Mechanics
- Doctor of Medicine and Doctor of Philosophy in Engineering Science and Mechanics (M.D./Ph.D.)
- Graduate Certificate in Laser-Materials Processing and Laser-Based Manufacturing

MORE INFORMATION ABOUT OPPORTUNITIES FOR GRADUATE STUDIES (http://www.esm.psu.edu/academics/graduate/prospective-students.aspx)

Accreditation

The baccalaureate program in Engineering Science is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org/.

MORE INFORMATION ABOUT ABET ACCREDITATION (https://www.abet.org/)

Professional Licensure/Certification

Many U.S. states and territories require professional licensure/certification to be employed. If you plan to pursue employment in a licensed profession after completing this program, please visit the Professional Licensure/Certification Disclosures by State (https://psu.edu/state-licensure-disclosures/) interactive map.

Contact

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