MECHANICAL ENGINEERING, BACHELOR OF SCIENCE (B.S.)

Mechanical engineering is one of the oldest and broadest engineering disciplines. Mechanical engineers design and analyze machines of all types, including automobiles, airplanes, rockets, submarines, power generation systems, biomedical instrumentation, robots, manufacturing systems, household appliances and many, many more.

In addition, mechanical engineers design and analyze the energy sources that provide power to machines, fluids that interact with machines and the materials from which machines are constructed. Mechanical engineers also work in cutting-edge fields such as nanotechnology, alternative energy sources and environmentally friendly "green" manufacturing processes. Another important application of mechanical engineering is in medicine, where artificial organs, surgical tools and drug-delivery systems are vital to human well-being.

Mechanical engineers are in continuous demand by virtually all industries and are also employed by state and federal governments and enjoy one of the highest starting salaries of all college majors. Mechanical engineering graduates can, if they wish, continue their studies and obtain advanced degrees in fields such as business, law, medicine and engineering.

The VCU Department of Mechanical and Nuclear Engineering offers an accredited B.S. degree in mechanical engineering, including the option of obtaining a major concentration nuclear engineering.

As part of the B.S. degree in mechanical engineering, all students complete an approved internship or cooperative education experience.

Student learning outcomes

Upon completing this program, students will demonstrate:

1. An ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. An ability to 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. An ability to communicate effectively with a range of audiences
4. An ability to 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. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Special requirements

Students must earn a minimum grade of C in all required engineering courses; in all courses used to satisfy engineering and professional elective requirements; and in the following:

Course	Title	Hours
MATH 200	Calculus with Analytic Geometry I	4
MATH 201	Calculus with Analytic Geometry II	4
MATH 301	Differential Equations	3
MATH 307	Multivariate Calculus	4
PHYS 207	University Physics I	5

Students must maintain a minimum major GPA of 2.0.

Degree requirements for Mechanical Engineering, Bachelor of Science (B.S.)

Course	Title	Hours
General education (http://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		
EGMN 102	Engineering Statics	3
EGMN 110	Engineering Visualization	2
EGMN 190	Introduction to Mechanical and Nuclear Engineering	1
EGMN 201	Dynamics and Kinematics	3
EGMN 202	Mechanics of Deformables	3
EGMN 203	Mechanical and Nuclear Engineering Practicum	1
EGMN 204	Thermodynamics	3
EGMN 210	Computational Methods	2
EGMN 300	Mechanical Systems Design	3
EGMN 301	Fluid Mechanics	3
EGMN 302	Heat Transfer	3
EGMN 303	Thermal Systems Design	3
EGMN 309	Material Science for Engineers	3
EGMN 311	Solid Mechanics Lab	1.5
EGMN 312	Thermal Sciences Lab	1.5
EGMN 315	Process and Systems Dynamics	3
EGMN 321	Numerical Methods	3
EGMN 402	Senior Design Studio (Laboratory/Project Time)	2
EGMN 403	Senior Design Studio (Laboratory/Project Time)	2
EGMN 420	CAE Design	3
EGRE 206	Electric Circuits	4
ENGR 395	Professional Development	1
ENGR 402	Senior Design Studio (Seminar)	1
ENGR 403	Senior Design Studio (Seminar)	1
• Additional major requirements		
EGMN 416	Mechatronics	3
EGMN 421	CAE Analysis	3
Approved internship or cooperative education experience		0
ENGR 296	Part-time Internship Experience	
or ENGR 396	Internship Experience	
or ENGR 398	Cooperative Education Experience	

Review of internship or cooperative education experience		0
ENGR 496	Internship Review	
or ENGR 498	Review of Cooperative Education Experience	
• Major electives		
Select engineering electives as described below.		6
Select additional engineering or professional electives as described below.		6
Ancillary requirements		
CHEM 101	General Chemistry I (satisfies general education BOK for natural sciences and AOI for scientific and logical reasoning)	3
CHEZ 101	General Chemistry Laboratory I	1
ECON 205	The Economics of Product Development and Markets (satisfies general education BOK for social/behavorial sciences and AOI for global perspectives)	3
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
MGMT 310	Managing People in Organizations	3
or SCMA 350	Introduction to Project Management	
PHYS 207	University Physics I (satisfies general education BOK for natural sciences and AOI for scientific and logical reasoning)	5
PHYS 208	University Physics II	5
STAT 441	Applied Statistics for Engineers and Scientists	3
Open electives		
Select any course.		3
Total Hours		**130**

The minimum number of credit hours required for this degree is 130.

Engineering and professional electives

Students must complete a combined total of 12 credits of engineering electives and professional electives. No more than six credits of professional electives may apply toward this total.

Engineering electives

Engineering electives are satisfied by completing courses that meet all four of the following criteria:

1. College of Engineering course (CLSE, CMSC, EGMN, EGRB, EGRE, ENGR)
2. Not otherwise required for the major by the effective bulletin
3. 300-level or greater
4. Three or more credit hours, except for ENGR 497

Note: A minimum of four credits of ENGR 497 must be completed to use this course to meet engineering elective requirements.

A minimum of three credits of engineering electives must come from courses other than CMSC 492, EGMN 492, EGRE 492, ENGR 399, ENGR 492 and ENGR 497. A maximum total of six credits of these same courses may be used as engineering electives as long as they are not being used to satisfy another major requirement.

Professional electives

Professional electives are satisfied by completing courses that meet all four of the following criteria:

1. One of the following course rubrics: ACCT, ANAT, BIOC, BIOL, BIOS, BNFO, BUSN, CHEM, ECON, ENVS, FIRE, HSEP, INFO, INNO, INSC, LFSC, MATH, MGMT, MILS, MKTG, NANO, OPER, PHIS, PHYS, STAT, SCMA, VNTR
2. Not otherwise required for the major by the effective bulletin
3. 300-level or greater
4. Three or more credit hours

In addition, CMSC 255, CMSC 256, EGRB 209 and EGRE 245 may be used as professional electives.

Note that some courses that meet the criteria for engineering electives or professional electives have prerequisites that must be satisfied, and some courses have major or minor restrictions that may prevent mechanical engineering students from completing those courses.

Other courses may be used to satisfy engineering or professional elective requirements with prior written approval from the department chair.

All courses used to satisfy engineering or professional elective requirements must be completed with a minimum grade of C.

Courses taken at other institutions

Students enrolled in degree programs at VCU must receive prior approval to take courses at other institutions to ensure credits earned concurrently at another institution are accepted for transfer at VCU. After enrolling in the VCU undergraduate mechanical engineering program, a student must receive prior approval to complete any course at another institution, and the following policies apply.

1. A student will not be approved to take an EGMN-equivalent course at another institution in a semester when the VCU course is offered. The department chair may approve an exception to this policy in extraordinary circumstances.
2. A total of no more than two EGMN-equivalent courses can be taken at another institution after enrolling in the VCU mechanical engineering program. The department chair may approve additional courses in exceptional circumstances.
3. A student may not transfer an EGMN-equivalent course from another institution for an EGMN course in which the student has a VCU honor code violation. The department chair may approve an exception to this policy in extraordinary circumstances.
4. Courses other than EGMN-equivalent courses (EGRE, MATH, PHYS, etc.) may be approved to be taken outside of VCU if the student receives prior approval for each course using the appropriate VCU form.

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**
CHEM 101	General Chemistry I (satisfies general education BOK for natural sciences and AOI for scientific and logical reasoning)	3
CHEZ 101	General Chemistry Laboratory I	1
EGMN 110	Engineering Visualization	2
EGMN 190	Introduction to Mechanical and Nuclear Engineering	1
MATH 200	Calculus with Analytic Geometry I (satisfies general education quantitative foundations)	4
UNIV 111 Play course video for Focused Inquiry I	Focused Inquiry I (satisfies general education UNIV foundations)	3
General education course		3
	Term Hours:	**17**
Spring semester		
EGMN 102	Engineering Statics	3
EGMN 203	Mechanical and Nuclear Engineering Practicum	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 Play course video for Focused Inquiry II	Focused Inquiry II (satisfies general education UNIV foundations)	3
	Term Hours:	**16**
Sophomore year		
Fall semester		
EGMN 202	Mechanics of Deformables	3
EGMN 309	Material Science for Engineers	3
ENGR 395	Professional Development	1
MATH 301	Differential Equations	3
PHYS 208	University Physics II	5
UNIV 200	Advanced Focused Inquiry: Literacies, Research and Communication (satisfies general education UNIV foundations)	3
	Term Hours:	**18**
Spring semester		
EGMN 201	Dynamics and Kinematics	3
EGMN 204	Thermodynamics	3
EGMN 210	Computational Methods	2
EGRE 206	Electric Circuits	4
MATH 307	Multivariate Calculus	4
	Term Hours:	**16**
Junior year		
Fall semester		
EGMN 300	Mechanical Systems Design	3
EGMN 301	Fluid Mechanics	3
EGMN 311	Solid Mechanics Lab	1.5
EGMN 321	Numerical Methods	3
EGMN 421	CAE Analysis	3
STAT 441	Applied Statistics for Engineers and Scientists	3
	Term Hours:	**16.5**
Spring semester		
ECON 205	The Economics of Product Development and Markets (satisfies general education BOK for social/behavorial sciences and AOI for global perspectives)	3
EGMN 303	Thermal Systems Design	3
EGMN 312	Thermal Sciences Lab	1.5
EGMN 302	Heat Transfer	3
EGMN 315	Process and Systems Dynamics	3
EGMN 420	CAE Design	3
	Term Hours:	**16.5**
Summer semester		
ENGR 396	Internship Experience	0
	Term Hours:	**0**
Senior year		
Fall semester		
EGMN 402	Senior Design Studio (Laboratory/Project Time)	2
EGMN 416	Mechatronics	3
ENGR 402	Senior Design Studio (Seminar)	1
ENGR 496	Internship Review	0
General education course (select AOI for diversities in the human experience or AOI for creativity, innovation and aesthetic inquiry; recommended to select a course that also satisfies BOK for humanities/fine arts if not already satisfied)		3
Engineering elective		3
Engineering or professional elective		3
	Term Hours:	**15**
Spring semester		
EGMN 403	Senior Design Studio (Laboratory/Project Time)	2
ENGR 403	Senior Design Studio (Seminar)	1
MGMT 310 or SCMA 350	Managing People in Organizations or Introduction to Project Management	3
Engineering elective		3
Engineering or professional elective		3
General education course or open elective (select general education BOK for humanities/fine arts; if all general education requirements are already satisfied, select a open elective)		3
	Term Hours:	**15**
	Total Hours:	**130**

The minimum number of credit hours required for this degree is 130.

Accelerated B.S. and M.S.

The accelerated B.S. and M.S. program allows qualified students to earn both the B.S. in Mechanical Engineering and M.S. in Mechanical and Nuclear Engineering (either thesis or non-thesis option) in a minimum of five years by completing approved graduate courses during the senior year of their undergraduate program. Students 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 148 credits rather than the 160 credits necessary if the two degrees are pursued separately.

Students holding these degrees can qualify for more advanced professional positions in industry and enhance knowledge of specific areas.

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 90 or more credits including EGMN 300, EGMN 301, EGMN 302, EGMN 303, EGMN 315, EGMN 321,EGMN 420 and EGMN 421; an overall GPA of 3.0; and a GPA of 3.0 in mechanical engineering course work.

Once admitted into the accelerated program, students must meet the standards of performance applicable to graduate students as described in the "**Satisfactory academic progress (http://bulletin.vcu.edu/academic-regs/grad/satisfactory-academic-progress/)**" section of the Graduate Bulletin, including maintaining a 3.0 GPA. Guidance to students admitted to the accelerated program is provided by both the undergraduate mechanical engineering adviser and the graduate program director for the master's degree.

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 a Mechanical Engineering degree will be awarded upon completion of a minimum of 130 credits and the satisfactory completion of all undergraduate degree requirements as stated in the Undergraduate Bulletin.

A maximum of 12 graduate credits of 500-level graduate courses may be taken prior to completion of the baccalaureate degree. These graduate credits will be utilized to fulfill engineering electives course requirements 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.

Once a student is admitted to the program, with the approval of their adviser, they may choose any 500-level course from the following subject areas: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC and OVPR,

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.

For students pursuing the non-thesis option

Course	Title	Hours
Junior year		
Fall semester		
EGMN 300	Mechanical Systems Design	3
EGMN 301	Fluid Mechanics	3
EGMN 311	Solid Mechanics Lab	1.5
EGMN 321	Numerical Methods	3
EGMN 420	CAE Design	3
STAT 441	Applied Statistics for Engineers and Scientists	3
Term Hours:		16.5
Spring semester		
ECON 205	The Economics of Product Development and Markets	3
EGMN 302	Heat Transfer	3
EGMN 303	Thermal Systems Design	3
EGMN 312	Thermal Sciences Lab	1.5
EGMN 315	Process and Systems Dynamics	3
EGMN 421	CAE Analysis	3
Term Hours:		16.5
Summer semester		
ENGR 396	Internship Experience	0
Term Hours:		0
Senior year		
Fall semester		
EGMN 402	Senior Design Studio (Laboratory/Project Time)	2
EGMN 416	Mechatronics	3
ENGR 402	Senior Design Studio (Seminar)	1
ENGR 496	Internship Review	0
Engineering elective (Shared; select 500-level courses from: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC and OVPR.)		3
Engineering or professional elective (Shared; select 500-level courses from: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC and OVPR.)		3
General education course (select AOI for diversities in the human experience; recommended to select a course that also satisfies BOK for humanities/fine arts if not already satisfied)		3
Term Hours:		15
Spring semester		

EGMN 403	Senior Design Studio (Laboratory/ Project Time)	2
ENGR 403	Senior Design Studio (Seminar)	1
MGMT 310	Managing People in Organizations	3
Engineering elective (Shared; select 500-level courses from: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC and OVPR.)		3
Engineering or professional elective (Shared; select 500-level courses from: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC and OVPR.)		3
General education course or open elective (select general education BOK for humanities/fine arts; if all general education requirements are already satisfied, select an open elective)		3
Term Hours:		15
Fifth year		
Fall semester		
EGMN 605	Mechanical and Nuclear Engineering Analysis	3
EGMN 606	Mechanical and Nuclear Engineering Continuum Mechanics	3
EGMN 610	Topics in Nuclear Engineering	3
Term Hours:		9
Spring semester		
Technical electives (Select 600-level courses from: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC and OVPR.)		6
Technical elective (Select 500- or 600-level course from: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC and OVPR.)		3
Term Hours:		9

For students pursuing the thesis option

Course	Title	Hours
Junior year		
Fall semester		
EGMN 300	Mechanical Systems Design	3
EGMN 301	Fluid Mechanics	3
EGMN 311	Solid Mechanics Lab	1.5
EGMN 321	Numerical Methods	3
EGMN 420	CAE Design	3
STAT 441	Applied Statistics for Engineers and Scientists	3
Term Hours:		16.5
Spring semester		
ECON 205	The Economics of Product Development and Markets	3
EGMN 302	Heat Transfer	3
EGMN 303	Thermal Systems Design	3
EGMN 312	Thermal Sciences Lab	1.5
EGMN 315	Process and Systems Dynamics	3
EGMN 421	CAE Analysis	3
Term Hours:		16.5
Summer semester		
ENGR 396	Internship Experience	0
Term Hours:		0
Senior year		
Fall semester		
EGMN 402	Senior Design Studio (Laboratory/ Project Time)	2
EGMN 416	Mechatronics	3
ENGR 402	Senior Design Studio (Seminar)	1
ENGR 496	Internship Review	0
Engineering elective (Shared; select 500-level courses from: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC and OVPR.)		3
Engineering or professional elective (Shared; select 500-level courses from: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC and OVPR.)		3
General education course (select AOI for diversities in the human experience; recommended to select a course that also satisfies BOK for humanities/fine arts if not already satisfied)		3
Term Hours:		15
Spring semester		
EGMN 403	Senior Design Studio (Laboratory/ Project Time)	2
ENGR 403	Senior Design Studio (Seminar)	1
MGMT 310	Managing People in Organizations	3
Engineering elective (Shared; select 500-level courses from: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC and OVPR.)		3
Engineering or professional elective (Shared; select 500-level courses from: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC and OVPR.)		3
General education course or open elective (select general education BOK for humanities/fine arts; if all general education requirements are already satisfied, select an open elective)		3
Term Hours:		15
Fifth year		
Fall semester		
EGMN 605	Mechanical and Nuclear Engineering Analysis	3
EGMN 606	Mechanical and Nuclear Engineering Continuum Mechanics	3
EGMN 610	Topics in Nuclear Engineering	3
Term Hours:		9
Spring semester		
EGMN 697	Directed Research in Mechanical and Nuclear Engineering	6
Technical elective (Select 600-level courses from: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC and OVPR.)		3
Term Hours:		9