MECHANICAL ENGINEERING, BACHELOR OF SCIENCE (B.S.) WITH A CONCENTRATION IN NUCLEAR ENGINEERING

Mechanical engineering is one of the oldest and broadest engineering disciplines. Mechanical engineers design and analyze machines of all types, including automobiles, airplanes, rocks, 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 is the largest in the College of Engineering and offers an accredited B.S. degree in mechanical engineering, including the option of obtaining a major concentration nuclear engineering. The curriculum for the freshman year is the same with or without the nuclear concentration.

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 nuclear engineering elective requirements; and in the following:

Degree requirements for Mechanical Engineering, Bachelor of Science (B.S.) with a concentration in nuclear engineering

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>MATH 200</td>
<td>Calculus with Analytic Geometry I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 201</td>
<td>Calculus with Analytic Geometry II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 301</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 307</td>
<td>Multivariate Calculus</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 207</td>
<td>University Physics I</td>
<td>5</td>
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</tbody>
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Students must maintain a minimum major GPA of 2.0.

General education (http://bulletin.vcu.edu/undergraduate/undergraduate-study/general-education-curriculum/)

Select 30 credits of general education courses in consultation with an adviser.

Major requirements

- Major core requirements
  - 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

[Course Title]
ENGR 402 Senior Design Studio (Seminar)  1
ENGR 403 Senior Design Studio (Seminar)  1

* Concentration requirements
EGMN 351 Nuclear Engineering Fundamentals  3
EGMN 352 Nuclear Reactor Theory  3
EGMN 355 Radiation Safety and Shielding  3
EGMN 359 Nuclear Power Plants  3
EGMN 456 Reactor Design and Systems  3
EGMN 530 System Analysis of the Nuclear Fuel Cycle  3

* Additional major requirements
Approved internship or cooperative education experience  0
  ENGR 296 Part-time Internship Experience  0
  or ENGR 396 Internship Experience  0
  or ENGR 398 Cooperative Education Experience  0
Review of internship or cooperative education experience  0
  ENGR 496 Internship Review  0
  or ENGR 498 Review of Cooperative Education Experience  0

* Major electives
Select nuclear engineering electives as described below.  6
Ancillary requirements
CHEM 101 General Chemistry I (satisfies general education BOK for natural sciences and A01 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
ECON 205 The Economics of Product Development and Markets (satisfies general education BOK for social/behavioral sciences and A01 for global perspectives)  3
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  3
PHYS 207 University Physics I (satisfies general education BOK for natural sciences and A01 for scientific and logical reasoning)  5
PHYS 208 University Physics II  5
Total Hours  130

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

Nuclear engineering electives
Mechanical engineering students completing the nuclear engineering concentration will choose two nuclear engineering elective courses from the following list. A special topic, independent study or other course may be used as a nuclear engineering elective with prior written approval of the department chair.

<table>
<thead>
<tr>
<th>Course</th>
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<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGMN 510</td>
<td>Probabilistic Risk Assessment</td>
<td>3</td>
</tr>
<tr>
<td>EGMN 545</td>
<td>Energy Conversion Systems</td>
<td>3</td>
</tr>
<tr>
<td>EGMN 550</td>
<td>Energy and Sustainability</td>
<td>3</td>
</tr>
<tr>
<td>EGMN 560</td>
<td>Monte Carlo Simulations</td>
<td>3</td>
</tr>
<tr>
<td>EGMN 574</td>
<td>Nuclear Safeguards, Security and Nonproliferation</td>
<td>3</td>
</tr>
<tr>
<td>EGMN 575</td>
<td>Fast Breeder Reactors</td>
<td>3</td>
</tr>
</tbody>
</table>

All courses used to satisfy nuclear engineering 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 A01 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 Focused Inquiry I (satisfies general education UNIV foundations)  3
Focused Inquiry I  3
Total Hours:  17

Spring semester
EGMN 102 Engineering Statics  3
### Sophomore year
#### Fall semester
- EGMN 201 Dynamics and Kinematics 3
- EGMN 202 Mechanics of Deformables 3
- EGMN 351 Nuclear Engineering Fundamentals 3
- ENGR 395 Professional Development 1
- MATH 301 Differential Equations 3
- PHYS 208 University Physics II 5

**Term Hours:** 18

#### Spring semester
- EGMN 204 Thermodynamics 3
- EGMN 210 Computational Methods 2
- EGMN 359 Nuclear Power Plants 3
- 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 355 Radiation Safety and Shielding 3
- UNIV 200 Advanced Focused Inquiry Literacies, Research and Communication (satisfies general education UNIV foundations) 3

**Term Hours:** 16.5

#### Spring semester
- EGMN 302 Heat Transfer 3
- EGMN 303 Thermal Systems Design 3
- EGMN 312 Thermal Sciences Lab 1.5
- EGMN 352 Nuclear Reactor Theory 3
- EGMN 420 CAE Design 3
- Nuclear engineering elective 3

**Term Hours:** 16.5

#### Summer semester
- ENGR 396 Internship Experience 0

**Term Hours:** 0

### Senior year
#### Fall semester

**Total Hours:** 130

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