School of Engineering

Dean: George N. Facas; Assistant Dean: Martha H. Stella

The School of Engineering is composed of three departments, electrical and computer engineering, mechanical engineering, and technological studies; and two interdisciplinary programs, engineering science, and biomedical engineering. Graduates of the engineering programs are prepared for employment at the professional level or to pursue graduate studies. The program in technological studies prepares students for positions in business, industry, and government or to be teachers of technology education.

Engineering Degree Programs

The School of Engineering offers the following engineering academic programs leading to a bachelor’s degree:

- Bachelor of Science in Computer Engineering
- Bachelor of Science in Electrical Engineering
- Bachelor of Science in Engineering Science (Specializations in Civil Engineering, Biomedical Engineering and Engineering Management)
- Bachelor of Science in Mechanical Engineering
- Bachelor of Arts in Biomedical Engineering
- Seven Year Medical / Bachelor of Science in Engineering Science (Preferences in Electrical Engineering and Mechanical Engineering)
- Seven Year Medical / Bachelor of Arts in Biomedical Engineering (Preferences in Electrical Engineering and Mechanical Engineering)

The School of Engineering offers the following engineering minors:

- Minor in Computer Engineering
- Minor in Electrical Engineering
- Minor in Engineering Science
- Minor in Mechanical Engineering

The engineering programs prepare students for careers in research and development, design, and engineering practice. The engineering programs equip graduates for entry-level positions as engineers in industry and place them on track for professional registration. The course of study in engineering will provide the opportunity to pursue an engineering specialty in one of the following engineering disciplines: biomedical, civil, computer, electrical, or mechanical engineering, or engineering management. The programs also prepare students for admission to graduate school to continue their education toward the MS or PhD degrees in a recognized engineering or other technical specialty, and other related advanced degrees.
The engineering curricula provide each student with a thorough understanding of why and how things work. They develop the ability to predict the effect on a proposed or existing design of different choices in the use of materials, form, and procedures. The curricula are built on a core of general studies taken from many disciplines and taught by experts in those specific fields of study. They are also firmly based on a study of fundamental concepts in mathematics and physical sciences and taught at a high level of intellectual challenge. The curricula provide exposure to the theory of engineering and design that underlies all engineering specialties, while offering the student the opportunity to explore a particular engineering specialty in depth.

The TCNJ engineering programs provide students with considerable exposure to laboratory experiences and are supported by excellent laboratory resources. Laboratory activities help develop skills in original design and develop a student’s confidence in his or her ability to critique and improve a design. The engineering programs at TCNJ are limited to undergraduate studies. Laboratories, therefore, are designed specifically for teaching, are relevant to the course material, and are kept accessible for students.

**Mission Statement**

The mission of the engineering programs is to provide the student with a foundation in engineering and the underlying mathematics and sciences. The graduate of the engineering programs will have a mastery of engineering science and design which will enable him/her to pursue a successful career or continue graduate studies. This mission is achieved within the context of a comprehensive liberal arts college that emphasizes small classes and attention to individual needs.

**Educational Objectives**

The School of Engineering has established the following educational objectives for engineering programs. These objectives outline what TCNJ engineers should be able to accomplish during the first few years after graduation.

The School of Engineering at The College of New Jersey seeks to prepare its graduates:

- To contribute to the economic development of New Jersey and the nation through the ethical practice of engineering;
- To become successful in their chosen career path, whether it is in the practice of engineering, in advanced studies in engineering or science, or in other complementary disciplines;
- To assume leadership roles in industry or public service through engineering ability, communication skills, teamwork, understanding of contemporary global and socio-economic issues, and use of modern engineering tools;
- To maintain career skills through life-long learning and be on the way towards achieving professional licensure.

**Academic Policies and Standards**

A student may repeat any course without seeking approval. If a student wishes to repeat a course more than once, permission must be obtained from the chair of the department or coordinator of the program of study and, if appropriate, the chair of the department offering the course. Permission to repeat a major course more than once will be granted only in cases of extreme extenuating circumstances, i.e., illness, financial, etc. When an engineering course is repeated, only the most recent earned grade is counted in the grade point average, although all grades earned will appear on the student's transcript.
Seniors pursuing bachelor of science degrees in an engineering major are required to take the Fundamentals of Engineering Examination for the Professional Engineer’s License.

Given the nature of the engineering curricula, it is extremely important to follow the recommended course sequence. Violations of this guideline may result in dismissal from the engineering majors.

**Program Entrance, Retention, and Exit Standards**

Every major program at the College has set standards for allowing students to remain in that program, to transfer within the College from one program to another, and to graduate from a program. The following are the standards for engineering majors. Minimum grades are noted in parentheses.

- Retention in the engineering programs is based on the following performance standards in these “critical content courses”: PHY 201 (C–); PHY 202 (C–).
- Transfer into the engineering programs from another program within the College is based upon the following performance standards in these “foundation courses”: FSP (First Seminar) (C+).
- Graduation requires a GPA of 2.0 in courses for the engineering programs. A student who has received two or more Ds or Fs in major courses will be subject to review by the departmental retention committee.

**Electrical and Computer Engineering**

*Faculty: Czeto, Hernandez, Katz, Kurland, Limberis, Riederer*

The Department of Electrical and Computer Engineering offers academic programs leading to a Bachelor of Science in Electrical Engineering and a Bachelor of Science in Computer Engineering.

Electrical engineers are concerned with electrical devices and systems and with the use of electrical energy. Virtually every industry uses electrical engineers, and electrical engineering is the largest of all engineering disciplines. Examples of the products designed by electrical engineers range from the computers used in business to instruments used in the medical profession, military radar systems, cellular telephones, and video conferencing equipment.

The electrical engineering curriculum allows students to focus on communications, electronic devices, instrumentation, digital signal processing, and automatic control systems.

Computer engineering is a discipline that addresses a variety of technological problems associated with the design and application of computers. Computer engineering is concerned with the design and implementation of digital hardware and software.

The curriculum for the computer engineering degree provides breadth and depth across the fields of electrical engineering and computer science. The curriculum structure provides a balanced view of hardware, software, hardware-software trade-offs, and basic modeling techniques used to represent the computing process. The degree requirements include completion of coursework from the computer science as well as the electrical and computer engineering departments.
Electrical and Computer Engineering Program Outcomes

The program outcomes listed below are expected of all graduates of the electrical and computer engineering programs. These outcomes outline what TCNJ electrical and computer engineering graduates are expected to know and be able to do at graduation. These outcomes outline the knowledge, abilities, tools, and skills the programs give the graduates to enable them to accomplish the School of Engineering educational objectives.

Electrical and computer engineering graduates will have:

- An ability to apply knowledge of mathematics, science, and engineering;
- An ability to design and conduct experiments, as well as to analyze and interpret data;
- An ability to design a system, component, or process to meet desired needs;
- An ability to function in multidisciplinary teams;
- An ability to identify, formulate, and solve engineering problems;
- An understanding of professional and ethical responsibility;
- An ability to communicate effectively;
- The broad education necessary to understand the impact of engineering solutions in a global and societal context;
- A recognition of the need for and an ability to engage in life-long learning;
- A knowledge of contemporary issues;
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;
- An ability to analyze and design complex electrical and electronic devices; and
- An ability to analyze and design software and systems containing hardware and software components.

Bachelor of Science in Computer Engineering

Freshman Year

**Fall**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE</td>
<td>201/General Chemistry I</td>
<td>1 course unit</td>
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<tr>
<td>ENG</td>
<td>142/Fundamentals of Engineering Design</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td>CSC</td>
<td>215/Computer Science I</td>
</tr>
<tr>
<td>ENG</td>
<td>095/Introduction to Engineering</td>
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</tr>
<tr>
<td>ENG</td>
<td>091/Engineering Seminar I</td>
<td>0 course unit</td>
</tr>
<tr>
<td>FSP</td>
<td>First Seminar (Social Sciences)*</td>
<td>1 course unit</td>
</tr>
<tr>
<td>MAT</td>
<td>127/Calculus A</td>
<td>1 course unit</td>
</tr>
<tr>
<td>PHY</td>
<td>201/General Physics I</td>
<td>1 course unit</td>
</tr>
</tbody>
</table>

**Spring**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>CSC</td>
<td>215/Computer Science I</td>
<td>1 course unit</td>
</tr>
<tr>
<td>or</td>
<td>ENG</td>
<td>142/Fundamentals of Engineering Design</td>
</tr>
<tr>
<td>ENG</td>
<td>092/Engineering Seminar II</td>
<td>0 course unit</td>
</tr>
<tr>
<td>MAT</td>
<td>128/Calculus B</td>
<td>1 course unit</td>
</tr>
</tbody>
</table>
PHY 202/General Physics II 1 course unit
WRI 102/Academic Writing (if not exempted) (1 course unit)
TST 161/Creative Design 1 course unit

Sophomore Year

Fall
CSC 310/Discrete Structures of Computer Science 1 course unit
CSC 250/Accelerated Computer Science I, II 1 course unit
ENG 212/Circuit Analysis 1 course unit
ENG 214/Circuit Analysis Laboratory .5 course unit
ENG 272/Advanced Engineering Math I 1 course unit
ENG 312/Digital Circuits and Microprocessors 1 course unit

Spring
ENG 222/Statics 1 course unit
ELC 251/Electronics 1 course unit
ELC 321/Signals and Systems 1 course unit
ELC 333/Electrical Engineering Laboratory I .5 course unit
MAT 229/Calculus C 1 course unit
ECO 101/Principles of Microeconomics 1 course unit

Junior Year

Fall
CSC 340/Computer Science III 1 course unit
ELC 343/Microcomputer Systems 1 course unit
ENG 093/Engineering Seminar III 0 course unit
ENG 262/Dynamics 1 course unit
ENG 342/Advanced Engineering Mathematics II 1 course unit
IDS 252/Society, Ethics, and Technology 1 course unit

Spring
ELC 451/Computer Architecture and Organization 1 course unit
ELC 363/Computer Engineering Laboratory I .5 course unit
ENG 094/Engineering Seminar IV 0 course unit
ENG 352/Control Systems 1 course unit
ENG 354/Control Systems Laboratory .5 course unit
ENG 372/Engineering Economy 1 course unit
Liberal Learning Elective* 1 course unit

Senior Year

Fall
CSC 330/Operating Systems 1 course unit
ELC 423/Digital Signal Processing 1 course unit
ELC 433/Electrical Engineering Laboratory III .5 course unit
ELC 411/Embedded Systems 1 course unit
ELC 495/Senior Project I 0 course unit
ENG 099/Senior Professional Seminar 0 course unit
Computer Engineering Elective* 1 course unit
### Spring

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Course Units</th>
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<tbody>
<tr>
<td>ENG 098</td>
<td>Fundamentals of Engineering Review</td>
<td>0 course unit</td>
</tr>
<tr>
<td>ENG 322</td>
<td>Thermodynamics I</td>
<td>1 course unit</td>
</tr>
<tr>
<td>ELC 463</td>
<td>Computer Engineering Laboratory II</td>
<td>.5 course unit</td>
</tr>
<tr>
<td>ELC 496</td>
<td>Senior Project II</td>
<td>1 course unit</td>
</tr>
<tr>
<td></td>
<td>Computer Engineering Elective*</td>
<td>1 course unit</td>
</tr>
<tr>
<td></td>
<td>Liberal Learning Elective*</td>
<td>1 course unit</td>
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</table>

**Total course units** 39 course units

*By advisement only.*

### Minor in Computer Engineering

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Course Units</th>
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<tbody>
<tr>
<td>CSC 250</td>
<td>Computer Science I, II or the equivalent</td>
<td>1 course unit</td>
</tr>
<tr>
<td>ELC 343</td>
<td>Microcomputer Systems</td>
<td>1 course unit</td>
</tr>
<tr>
<td>ELC 451</td>
<td>Computer Architecture and Organization</td>
<td>1 course unit</td>
</tr>
<tr>
<td>ENG 212</td>
<td>Circuit Analysis</td>
<td>1 course unit</td>
</tr>
<tr>
<td>ENG 312</td>
<td>Digital Circuits and Microprocessors</td>
<td>1 course unit</td>
</tr>
</tbody>
</table>

**Total course units** 5* course units

*Only one course unit taken as part of the student’s major may also be counted toward the student’s minor.*

### Bachelor of Science in Electrical Engineering

#### Freshman Year

**Fall**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Course Units</th>
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<tbody>
<tr>
<td>CHE 201</td>
<td>General Chemistry I</td>
<td>1 course unit</td>
</tr>
<tr>
<td>ENG 142</td>
<td>Fundamentals of Engineering Design</td>
<td>1 course unit</td>
</tr>
<tr>
<td>or CSC 215</td>
<td>Computer Science I</td>
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<tr>
<td>ENG 095</td>
<td>Introduction to Engineering</td>
<td>0 course unit</td>
</tr>
<tr>
<td>ENG 091</td>
<td>Engineering Seminar I</td>
<td>0 course unit</td>
</tr>
<tr>
<td>FSP</td>
<td>First Seminar (Social Sciences)*</td>
<td>1 course unit</td>
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<tr>
<td>MAT 127</td>
<td>Calculus A</td>
<td>1 course unit</td>
</tr>
<tr>
<td>PHY 201</td>
<td>General Physics I</td>
<td>1 course unit</td>
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**Spring**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Course Units</th>
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<tbody>
<tr>
<td>CSC 215</td>
<td>Computer Science I</td>
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</tr>
<tr>
<td>or ENG 142</td>
<td>Fundamentals of Engineering Design</td>
<td>1 course unit</td>
</tr>
<tr>
<td>ENG 092</td>
<td>Engineering Seminar II</td>
<td>0 course unit</td>
</tr>
<tr>
<td>MAT 128</td>
<td>Calculus B</td>
<td>1 course unit</td>
</tr>
<tr>
<td>PHY 202</td>
<td>General Physics II</td>
<td>1 course unit</td>
</tr>
<tr>
<td>WRI 102</td>
<td>Academic Writing (if not exempted)</td>
<td>(1 course unit)</td>
</tr>
<tr>
<td>TST 161</td>
<td>Creative Design</td>
<td>1 course unit</td>
</tr>
</tbody>
</table>
### Sophomore Year

#### Fall
- **CSC 310*/Discrete Structures of Computer Science* 1 course unit
- **ENG 212*/Circuit Analysis* 1 course unit
- **ENG 214*/Circuit Analysis Laboratory* .5 course unit
- **ENG 272*/Advanced Engineering Math I* 1 course unit
- **ENG 312*/Digital Circuits and Microprocessors* 1 course unit
- **ECO 101*/Principles of Microeconomics* 1 course unit

#### Spring
- **ENG 222*/Statics* 1 course unit
- **ELC 251*/Electronics* 1 course unit
- **ELC 321*/Signals and Systems* 1 course unit
- **ELC 333*/Electrical Engineering Laboratory I* .5 course unit
- **MAT 229*/Calculus C* 1 course unit
- **IDS 252*/Society, Ethics, and Technology* 1 course unit

### Junior Year

#### Fall
- **ELC 341*/Communication Systems* 1 course unit
- **ELC 343*/Microcomputer Systems* 1 course unit
- **ENG 093*/Engineering Seminar III* 0 course unit
- **ENG 262*/Dynamics* 1 course unit
- **ENG 342*/Advanced Engineering Mathematics II* 1 course unit
- **Liberal Learning Elective* 1 course unit

#### Spring
- **ELC 373*/Electrical Engineering Laboratory II* .5 course unit
- **ELC 361*/Engineering Electromagnetics* 1 course unit
- **ENG 094*/Engineering Seminar IV* 0 course unit
- **ENG 352*/Control Systems* 1 course unit
- **ENG 354*/Control Systems Laboratory* .5 course unit
- **ENG 372*/Engineering Economy* 1 course unit

### Senior Year

#### Fall
- **ELC 423*/Digital Signal Processing* 1 course unit
- **ELC 433*/Electrical Engineering Laboratory III* .5 course unit
- **ELC 411*/Embedded Systems* 1 course unit
- **ELC 495*/Senior Project I* 0 course unit
- **ENG 099*/Senior Professional Seminar* 0 course unit
- **Electrical Engineering Elective* 1 course unit
- **Liberal Learning Elective* 1 course unit

#### Spring
- **ENG 098*/Fundamentals of Engineering Review* 0 course unit
- **ENG 322*/Thermodynamics I* 1 course unit
- **ELC 363*/Computer Engineering Laboratory I* .5 course unit
- **ELC 441*/Digital Systems Engineering* 1 course unit
- **ELC 451*/Computer Architecture and Organization* 1 course unit
ELC 496/Senior Project II 1 course unit
Electrical Engineering Elective* 1 course unit

Total Course Units 39 course units

* By advisement only.

Minor in Electrical Engineering

ELC 251/Electronics 1 course unit
ELC 321/Systems and Signals 1 course unit
ENG 212/Circuit Analysis 1 course unit
ENG 312/Digital Circuits and Microprocessors 1 course unit
Electrical Engineering Elective* 1 course unit

Total course units 5** course units

* Electrical engineering elective must be chosen from the following: ELC 341, ENG 352, ELC 383, ELC 423, ELC 441.
** Only one course unit taken as part of the student’s major may also be counted toward the student’s minor.

Engineering Science

Engineering science is an interdisciplinary program leading to a Bachelor of Science in Engineering Science with specializations in biomedical engineering, civil engineering and engineering management.

Engineering Science/Biomedical Engineering Specialization

Coordinator: Stella

Biomedical Engineering is that interdisciplinary field of study combining engineering with life sciences. The role of the biomedical engineer is to provide answers to problems arising from the study of living systems by employing the methodology and principles of engineering. Biomedical engineers may be called upon in a wide range of capacities: to design instruments, devices, and software; to model the mechanics of the body; to research materials acceptable to the body; or to conduct research needed to solve clinical problems. In this field there is continual change and creation of new areas due to rapid advancement in technology; however, some of the well established specialty areas within the field of biomedical engineering are: biomaterials; biomechanics; cellular, tissue and genetic engineering; medical imaging; and modeling systems physiology. Students who enroll in this program will have the opportunity to follow one of two curricula options: electrical engineering or mechanical engineering.

Engineering Science/Biomedical Engineering Specialization Program Outcomes

The program outcomes listed below are expected of all graduates of the biomedical engineering program. These outcomes outline what TCNJ biomedical engineering graduates are expected to know and be able to do at graduation. These outcomes outline the knowledge, abilities, tools, and skills the program gives the graduates to enable them to accomplish the School of Engineering educational objectives.

Biomedical engineering graduates will have:

- An ability to apply knowledge of mathematics, science, and engineering;
• An ability to design and conduct experiments, as well as to analyze and interpret data;
• An ability to design a system, component, or process to meet desired needs;
• An ability to function in multidisciplinary teams;
• An ability to identify, formulate, and solve engineering problems;
• An understanding of professional and ethical responsibility;
• An ability to communicate effectively;
• The broad education necessary to understand the impact of engineering solutions in a global and societal context;
• A recognition of the need for and an ability to engage in life-long learning;
• A knowledge of contemporary issues;
• An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;
• An understanding of biology and physiology, and the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology; and
• An ability to make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems.

Bachelor of Science in Engineering Science—Biomedical Engineering Specialization, Electrical Engineering Option

Freshman Year

**Fall**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>CHE 201</td>
<td>General Chemistry I</td>
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<td>ENG 142</td>
<td>Fundamentals of Engineering Design</td>
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<tr>
<td>or</td>
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<tr>
<td>CSC 215</td>
<td>Computer Science I</td>
<td></td>
</tr>
<tr>
<td>ENG 095</td>
<td>Introduction to Engineering</td>
<td>0</td>
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<tr>
<td>ENG 091</td>
<td>Engineering Seminar I</td>
<td>0</td>
</tr>
<tr>
<td>FSP</td>
<td>First Seminar (Social Sciences)*</td>
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<tr>
<td>MAT 127</td>
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<tr>
<td>PHY 201</td>
<td>General Physics I</td>
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**Spring**

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<tr>
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<td>Computer Science I</td>
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<td>or</td>
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<td></td>
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<tr>
<td>ENG 142</td>
<td>Fundamentals of Engineering Design</td>
<td>1</td>
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<tr>
<td>ENG 092</td>
<td>Engineering Seminar II</td>
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<tr>
<td>MAT 128</td>
<td>Calculus B</td>
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<tr>
<td>PHY 202</td>
<td>General Physics II</td>
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<tr>
<td>WRI 102</td>
<td>Academic Writing (if not exempted)</td>
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### Sophomore Year

#### Fall
- **BIO** 185/Themes in Biology 1 course unit
- **ENG** 212/Circuit Analysis 1 course unit
- **ENG** 214/Circuit Analysis Laboratory .5 course unit
- **ENG** 272/Advanced Engineering Math I 1 course unit
- **ENG** 312/Digital Circuits and Microprocessors 1 course unit

#### Spring
- **BME** 251/Introduction to Biomedical Engineering 1 course unit
- **ELC** 251/Electronics 1 course unit
- **ELC** 321/Signals and Systems 1 course unit
- **ELC** 333/Electrical Engineering Laboratory I .5 course unit
- **TST** 161/Creative Design 1 course unit
- **ECO** 101/Principles of Microeconomics 1 course unit

### Junior Year

#### Fall
- **BIO** 211/Biology of the Eukaryotic Cell 1 course unit
- **BME** 311/Physiological Systems 1 course unit
- **BME** 333/Physiological Systems Laboratory .5 course unit
- **CHE** 321/Organic Chemistry I 1 course unit
- **ENG** 093/Engineering Seminar III 0 course unit
- **MAT** 229/Calculus C 1 course unit

#### Spring
- **ENG** 094/Engineering Seminar IV 0 course unit
- **ENG** 322/Thermodynamics I 1 course unit
- **ENG** 342/Advanced Engineering Math II 1 course unit
- **ENG** 352/Control Systems 1 course unit
- **BME** 371/Physiological Systems II 1 course unit
- **IDS** 252/Society, Ethics, and Technology 1 course unit

### Senior Year

#### Fall
- **BME** 423/Introduction to Biomaterials 1 course unit
- **ELC** 423/Digital Signal Processing 1 course unit
- **ELC** 433/Electrical Engineering Laboratory III .5 course unit
- **ENG** 099/Senior Professional Seminar 0 course unit
- **BME** 495/Senior Project I 0 course unit
- **ENG** 372/Engineering Economy 1 course unit
- **Biomedical Engineering Elective* 1 course unit

#### Spring
- **BME** 473/Bioinstrumentation 1 course unit
- **BME** 492/Independent Study 1 course unit
- **BME** 496/Senior Project II 1 course unit
- **ENG** 098/Fundamentals of Engineering Review 0 course unit
- **Liberal Learning Elective* 1 course unit
Bachelor of Science in Engineering Science—Biomedical Engineering Specialization, Mechanical Engineering Option

Freshman Year

Fall
CHE 201/General Chemistry I 1 course unit
ENG 142/Fundamentals of Engineering Design 1 course unit
or
CSC 215/Computer Science I 1 course unit
ENG 095/Introduction to Engineering 0 course unit
ENG 091/Engineering Seminar I 0 course unit
FSP First Seminar (Social Sciences)* 1 course unit
MAT 127/Calculus A 1 course unit
PHY 201/General Physics I 1 course unit

Spring
CHE 202/General Chemistry II 1 course unit
CSC 215/Computer Science I 1 course unit
or
ENG 142/Fundamentals of Engineering Design 1 course unit
ENG 092/Engineering Seminar II 0 course unit
MAT 128/Calculus B 1 course unit
PHY 202/General Physics II 1 course unit
WRI 102/Academic Writing (if not exempted) (1 course unit)

Sophomore Year

Fall
BIO 185/Themes in Biology 1 course unit
ENG 212/Circuit Analysis 1 course unit
ENG 214/Circuit Analysis Laboratory .5 course unit
ENG 222/Statics 1 course unit
ENG 272/Advanced Engineering Math I 1 course unit

Spring
BME 251/Introduction to Biomedical Engineering 1 course unit
MAT 229/Calculus C 1 course unit
MEC 251/Strength of Materials 1 course unit
MEC 263/Mechanical Engineering Laboratory I .5 course unit
TST 161/Creative Design 1 course unit
ECO 101/Principles of Microeconomics 1 course unit
### Junior Year

#### Fall

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIO 211</td>
<td>Biology of the Eukaryotic Cell</td>
<td>1</td>
</tr>
<tr>
<td>BME 311</td>
<td>Physiological Systems</td>
<td>1</td>
</tr>
<tr>
<td>BME 333</td>
<td>Physiological Systems Laboratory</td>
<td>0.5</td>
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<tr>
<td>CHE 321</td>
<td>Organic Chemistry I</td>
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<tr>
<td>ENG 093</td>
<td>Engineering Seminar III</td>
<td>0</td>
</tr>
<tr>
<td>ENG 322</td>
<td>Thermodynamics I</td>
<td>1</td>
</tr>
<tr>
<td>IDS 252</td>
<td>Society, Ethics &amp; Technology</td>
<td>1</td>
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</tbody>
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#### Spring

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 343</td>
<td>Biomechanics</td>
<td>1</td>
</tr>
<tr>
<td>ENG 094</td>
<td>Engineering Seminar IV</td>
<td>0</td>
</tr>
<tr>
<td>ENG 342</td>
<td>Advanced Engineering Math II</td>
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</tr>
<tr>
<td>ELC 251</td>
<td>Electronics</td>
<td>1</td>
</tr>
<tr>
<td>ELC 333</td>
<td>Electrical Engineering Laboratory I</td>
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<tr>
<td>BME 371</td>
<td>Physiological Systems II</td>
<td>1</td>
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</table>

### Senior Year

#### Fall

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BME 423</td>
<td>Introduction to Biomaterials</td>
<td>1</td>
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<tr>
<td>ENG 099</td>
<td>Senior Professional Seminar</td>
<td>0</td>
</tr>
<tr>
<td>MEC 311</td>
<td>Mechanical Design I</td>
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</tr>
<tr>
<td>BME 495</td>
<td>Senior Project I</td>
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</tr>
<tr>
<td>MEC 361</td>
<td>Fluid Mechanics</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Liberal Learning Elective*</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Biomedical Engineering Elective*</td>
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#### Spring

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<tr>
<td>BME 473</td>
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<td>BME 496</td>
<td>Senior Project II</td>
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</tr>
<tr>
<td>ENG 372</td>
<td>Engineering Economy</td>
<td>1</td>
</tr>
<tr>
<td>ENG 098</td>
<td>Fundamentals of Engineering Review</td>
<td>1</td>
</tr>
<tr>
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<td>Liberal Learning Elective*</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Biomedical Engineering Elective*</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total course units**: 39 course units

*By advisement only.

### Engineering Science/Civil Engineering Specialization

*Coordinator:* Al-Omaishi

Civil engineers plan, design, and supervise the construction of a wide variety of facilities essential to modern life. Projects include buildings, bridges, highways, mass transit systems, airports, tunnels, dams, flood controls, water and wastewater treatment plants, and offshore structures. The civil engineering specialization within the engineering science program supports the following major areas of civil engineering: structural engineering, transportation engineering, water resources engineering, geotechnical engineering, and construction engineering. The
program offers student laboratory activities in materials testing (structural), fluids measurements (water resources), and soils testing (geotechnical), CAD drafting, and surveying.

**Engineering Science/Civil Engineering Specialization Program Outcomes**

The program outcomes listed below are expected of all graduates of the engineering science/civil engineering specialization program. These outcomes outline what TCNJ civil engineering specialization graduates are expected to know and be able to do at graduation. These outcomes outline the knowledge, abilities, tools, and skills the program gives the graduates to enable them to accomplish the School of Engineering educational objectives.

Engineering science/civil engineering specialization graduates will have:

- An ability to apply knowledge of mathematics, science, and engineering;
- An ability to design and conduct experiments, as well as to analyze and interpret data;
- An ability to design a system, component, or process to meet desired needs;
- An ability to function in multidisciplinary teams;
- An ability to identify, formulate, and solve engineering problems;
- An understanding of professional and ethical responsibility;
- An ability to communicate effectively;
- The broad education necessary to understand the impact of engineering solutions in a global and societal context;
- A recognition of the need for and an ability to engage in life-long learning;
- A knowledge of contemporary issues;
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;
- Proficiency in mathematics through differential equations; probability and statistics; calculus-based physics and chemistry;
- Proficiency in a minimum of four (4) recognized major civil engineering areas;
- An ability to conduct laboratory experiments and to critically analyze and interpret data in more than one of the recognized major civil engineering areas;
- An ability to perform civil engineering design by means of design experiences integrated throughout the professional component of the curriculum; and
- An understanding of professional practice issues such as procurement of work; bidding versus quality based selection processes; how the design professionals and the construction professions interact to construct a project; the importance of professional licensure and continuing education; and/or other professional practice issues.

**Bachelor of Science in Engineering Science—Civil Engineering Specialization**

**Freshman Year**

**Fall**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<td>CHE 201/1</td>
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<tr>
<td>ENG 142/1</td>
<td>Fundamentals of Engineering Design</td>
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</tr>
</tbody>
</table>
or
CSC 215/Computer Science I 1 course unit
ENG 095/Introduction to Engineering 0 course unit
ENG 091/Engineering Seminar I 0 course unit
FSP First Seminar (Social Sciences)* 1 course unit
MAT 127/Calculus A 1 course unit
PHY 201/General Physics I 1 course unit

Spring
CSC 215/Computer Science I
or
ENG 142/Fundamentals of Engineering Design 1 course unit
ENG 092/Engineering Seminar II 0 course unit
MAT 128/Calculus B 1 course unit
PHY 202/General Physics II 1 course unit
WRI 102/Academic Writing (if not exempted) (1 course unit)
TST 161/Creative Design 1 course unit

Sophomore Year

Fall
CIV 211/Surveying .5 course unit
CIV 213/CAD Laboratory .5 course unit
ENG 152/Engineering Materials Science 1 course unit
ENG 222/Statics 1 course unit
ENG 272/Advanced Engineering Math I 1 course unit
GEO 120/Introduction to Geology 1 course unit

Spring
CIV 251/Strength of Materials 1 course unit
CIV 263/Engineering Materials Laboratory .5 course unit
ENG 262/Dynamics 1 course unit
MAT 229/Calculus C 1 course unit
ECO 101/Principles of Microeconomics 1 course unit

Junior Year

Fall
CIV 311/Structural Analysis 1 course unit
CIV 321/Numerical Methods 1 course unit
CIV 331/Soil Mechanics 1 course unit
CIV 333/Soil Mechanics Laboratory .5 course unit
CIV 361/Fluid Mechanics 1 course unit
CIV 363/Fluid Measurement Laboratory .5 course unit
ENG 093/Engineering Seminar III 0 course unit

Spring
CIV 351/Structural Steel Design 1 course unit
CIV 371/Civil Engineering Materials .5 course unit
CIV 381/Environmental Engineering 1 course unit
CIV 385/Hydraulic Engineering and Hydrology 1 course unit
ENG 094/Engineering Seminar IV 0 course unit
ENG 342/Advanced Engineering Math II 1 course unit
ENG 372/Engineering Economy 1 course unit

Senior Year

Fall
CIV 411/Transportation Engineering 1 course unit
CIV 421/Reinforced Concrete Design 1 course unit
CIV 431/Foundation Engineering 1 course unit
CIV 495/Senior Project I 0 course unit
ENG 099/Senior Professional Seminar 0 course unit
Civil Engineering Elective* 1 course unit
IDS 252/Society, Ethics, and Technology 1 course unit

Spring
CIV 451/Construction Management 1 course unit
CIV 496/Senior Project II 1 course unit
ENG 098/Fundamentals of Engineering Review 0 course unit
Civil Engineering Elective* 1 course unit
Liberal Learning Elective* 1 course unit
Liberal Learning Elective* 1 course unit

Total course units 39 course units

*By advisement only.

Engineering Science/Engineering Management Specialization

Coordinator: Kurland

The engineering management specialization integrates engineering and management education to prepare students for engineering management. Graduates of this program are prepared to work as first-line supervisors or plant managers. This course of study provides students with the technical knowledge that first-line supervisors need along with expertise in accounting, finance, production, marketing, and personnel. It includes courses from the engineering programs and departments as well as the School of Business. Engineering management students must select either the electrical engineering or mechanical engineering preference for their studies.

Engineering Science/Engineering Management Specialization Program Outcomes

The program outcomes listed below are expected of all graduates of the engineering science/engineering management specialization program. These outcomes outline what TCNJ engineering science graduates are expected to know and be able to do at graduation. These outcomes outline the knowledge, abilities, tools, and skills the program gives the graduates to enable them to accomplish the School of Engineering educational objectives.

Engineering science/engineering management specialization graduates will have:
- An ability to apply knowledge of mathematics, science, and engineering;
- An ability to design and conduct experiments, as well as to analyze and interpret data;
- An ability to design a system, component, or process to meet desired needs;
An ability to function in multidisciplinary teams;
An ability to identify, formulate, and solve engineering problems;
An understanding of professional and ethical responsibility;
An ability to communicate effectively;
The broad education necessary to understand the impact of engineering solutions in a global and societal context;
A recognition of the need for and an ability to engage in life-long learning;
A knowledge of contemporary issues; and
An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Bachelor of Science in Engineering Science—Engineering Management Specialization, Electrical Preference

Freshman Year

Fall
CHE 201/General Chemistry I 1 course unit
ENG 142/Fundamentals of Engineering Design
or
CSC 215/Computer Science I 1 course unit
ENG 095/Introduction to Engineering 0 course unit
ENG 091/Engineering Seminar I 0 course unit
FSP First Seminar (Social Sciences)* 1 course unit
MAT 127/Calculus A 1 course unit
PHY 201/General Physics I 1 course unit

Spring
CSC 215/Computer Science I 1 course unit
or
ENG 142/Fundamentals of Engineering Design 1 course unit
ENG 092/Engineering Seminar II 0 course unit
MAT 128/Calculus B 1 course unit
PHY 202/General Physics II 1 course unit
WRI 102/Academic Writing (if not exempted) (1 course unit)
TST 161/Creative Design 1 course unit

Sophomore Year

Fall
ECO 101/Principles of Microeconomics 1 course unit
ENG 212/Circuits Analysis 1 course unit
ENG 214/Circuits Analysis Laboratory .5 course unit
ENG 232/Manufacturing Processes 1 course unit
ENG 272/Advanced Engineering Mathematics I 1 course unit
ENG 312/Digital Circuits and Microprocessors 1 course unit

Spring
ACC 201/Accounting Principles I 1 course unit
ECO 102/Principles of Macroeconomics 1 course unit
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELC 251</td>
<td>Electronics</td>
<td>1</td>
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<tr>
<td>ELC 321</td>
<td>Signals and Systems</td>
<td>1</td>
</tr>
<tr>
<td>ELC 333</td>
<td>Electrical Engineering Laboratory I</td>
<td>.5</td>
</tr>
<tr>
<td>MAT 229</td>
<td>Calculus C</td>
<td>1</td>
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**Junior Year**

<table>
<thead>
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<th>Semester</th>
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<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>Fall</td>
<td>BUS 217</td>
<td>Legal Environment of Business</td>
<td>1</td>
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<tr>
<td></td>
<td>ELC 341</td>
<td>Communications Systems</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>ENG 093</td>
<td>Engineering Seminar III</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>ENG 222</td>
<td>Statics</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>ENG 342</td>
<td>Advanced Engineering Mathematics II</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>MEC 321</td>
<td>Numerical Analysis</td>
<td>1</td>
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<tr>
<td></td>
<td>MKT 201</td>
<td>Marketing Principles</td>
<td>.5</td>
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</table>

| Spring     | ENG 094             | Engineering Seminar IV             | 0     |
|            | ENG 152             | Engineering Material Science       | 1     |
|            | ENG 262             | Dynamics                           | 1     |
|            | ENG 372             | Engineering Economy                | 1     |
|            | MGT 201             | Management of Organizational Behavior| .5  |
|            | IDS 252             | Society, Ethics, and Technology    | 1     |
|            | Liberal Learning Elective* |                               | 1     |

**Senior Year**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>ELC 495</td>
<td>Senior Project I</td>
<td>0</td>
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<td></td>
<td>ENG 099</td>
<td>Senior Professional Seminar</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>ENG 322</td>
<td>Thermodynamics I</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>ENG 352</td>
<td>Control Systems</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>ENG 354</td>
<td>Control Systems Laboratory</td>
<td>.5</td>
</tr>
<tr>
<td></td>
<td>FIN 201</td>
<td>Financial Management</td>
<td>.5</td>
</tr>
<tr>
<td></td>
<td>Electrical Engineering Elective*</td>
<td></td>
<td>1</td>
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</table>

| Spring     | ELC 496             | Senior Project II                  | 1     |
|            | ENG 098             | Fundamentals of Engineering Review | 0     |
|            | ENG 452             | Project Management                 | 1     |
|            | Management Elective* |                               | 1     |
|            | Liberal Learning Elective* |                               | 1     |

**Total course units** 39 course units

*By advisement only.*
Bachelor of Science in Engineering Science—Engineering Management Specialization, Mechanical Preference

**Freshman Year**

**Fall**

- **CHE** 201/General Chemistry I 1 course unit
- **ENG** 142/Fundamentals of Engineering Design or
- **CSC** 215/Computer Science I 1 course unit
- **ENG** 095/Introduction to Engineering 0 course unit
- **ENG** 091/Engineering Seminar I 0 course unit
- **FSP** First Seminar (Social Sciences)* 1 course unit
- **MAT** 127/Calculus A 1 course unit
- **PHY** 201/General Physics I 1 course unit

**Spring**

- **CSC** 215/Computer Science I 1 course unit
- **ENG** 142/Fundamentals of Engineering Design or
- **ENG** 092/Engineering Seminar II 0 course unit
- **MAT** 128/Calculus B 1 course unit
- **PHY** 202/General Physics II 1 course unit
- **WRI** 102/Academic Writing (if not exempted) (1 course unit)
- **TST** 161/Creative Design 1 course unit
- **Liberal Learning Elective * 1 course unit**

**Sophomore Year**

**Fall**

- **ECO** 101/Principles of Microeconomics 1 course unit
- **ENG** 212/Circuits Analysis 1 course unit
- **ENG** 214/Circuits Analysis Laboratory .5 course unit
- **ENG** 222/Statics 1 course unit
- **ENG** 232/Manufacturing Processes 1 course unit
- **ENG** 272/Advanced Engineering Mathematics I 1 course unit

**Spring**

- **ACC** 201/Accounting Principles I 1 course unit
- **ECO** 102/Principles of Macroeconomics 1 course unit
- **ENG** 152/Engineering Material Science 1 course unit
- **ENG** 262/Dynamics 1 course unit
- **MAT** 229/Calculus C 1 course unit

**Junior Year**

**Fall**

- **BUS** 217/Legal Environment of Business 1 course unit
- **ENG** 093/Engineering Seminar III 0 course unit
- **ENG** 322/Thermodynamics I 1 course unit
- **ENG** 342/Advanced Engineering Mathematics II 1 course unit
- **MEC** 321/Numerical Analysis 1 course unit
- **MKT** 201/Marketing Principles .5 course unit
IDS 252/Society, Ethics, and Technology 1 course unit

Spring
ENG 094/Engineering Seminar IV 0 course unit
ENG 372/Engineering Economy 1 course unit
MEC 251/Strength of Materials 1 course unit
MEC 263/Mechanical Engineering Laboratory I .5 course unit
MGT 201/Management of Organizational Behavior .5 course unit
Liberal Learning Elective* 1 course unit
Liberal Learning Elective* 1 course unit

Senior Year

Fall
ENG 099/Senior Professional Seminar 0 course unit
ENG 352/Control Systems 1 course unit
ENG 354/Control Systems Laboratory .5 course unit
FIN 201/Financial Management .5 course unit
MEC 311/Mechanical Design Analysis I 1 course unit
MEC 495/Senior Project I 0 course unit
Mechanical Engineering Elective* 1 course unit

Spring
ENG 098/Fundamentals of Engineering Review 0 course unit
ENG 312/Digital Circuits and Microprocessors 1 course unit
ENG 452/Project Management 1 course unit
MEC 361/Fluid Mechanics 1 course unit
MEC 496/Senior Project II 1 course unit
Management Elective* 1 course unit

Total course units 39 course units

* By advisement only.

Minor in Engineering Science
Option A—Mechanical Engineering
ELE 251/Electronics 1 course unit
ENG 212/Circuit Analysis 1 course unit
ENG 222/Statics 1 course unit
ENG 262/Dynamics 1 course unit
Engineering Elective* 1 course unit

Total course units 5** course units

* By advisement.
** Only one course unit taken as part of the student's major may also be counted toward the student's minor.

Minor in Engineering Science
Option B—Civil Engineering
CIV 251/Strength of Materials 1 course unit
CIV 311/Structural Analysis 1 course unit
CIV 351/Structural Steel Design 1 course unit
ENG 222/Statics 1 course unit
Engineering Elective* 1 course unit

Total course units 5** course units

* By advisement.
** Only one course unit taken as part of the student’s major may also be counted toward the student’s minor.

Mechanical Engineering

Faculty: Al-Omaishi, Asper, Chang, Facas, Flynn, Grega, Hess, Kosmopoulos, McGarry, Sepahpour, Shih, Wang

The Department of Mechanical Engineering offers an academic program leading to a Bachelor of Science in Mechanical Engineering.

This program encompasses course work in two areas of study: energy, which includes courses in thermodynamics, fluid mechanics, and heat transfer; and engineering design, with courses in strength of materials and mechanical design. The mechanical engineering degree allows for additional courses in a variety of specialized areas.

Encompassing the broadest of all engineering disciplines, the mechanical engineering program teaches students how to apply the principles of mechanics and energy to design anything from automobile engines to rocket engines and nuclear reactors. Mechanical engineers design and operate power plants and are concerned with the conversion of one form of energy to another. They also design heating, ventilating, and air conditioning systems to provide controlled conditions of temperature and humidity in homes, offices, commercial buildings, and industrial plants. Besides developing equipment and systems for refrigeration of foods and the operation of cold storage facilities, these engineers also are involved with the production of energy from alternative sources such as solar, geothermal, and wind.

Mechanical Engineering Program Outcomes

The program outcomes listed below are expected of all graduates of the mechanical engineering program. These outcomes outline what TCNJ mechanical engineering graduates are expected to know and be able to do at graduation. These outcomes outline the knowledge, abilities, tools, and skills the program gives the graduates to enable them to accomplish the School of Engineering educational objectives.

Mechanical engineering graduates will have:

- An ability to apply knowledge of mathematics, science, and engineering;
- An ability to design and conduct experiments, as well as to analyze and interpret data;
- An ability to design a system, component, or process to meet desired needs;
- An ability to function in multidisciplinary teams;
- An ability to identify, formulate, and solve engineering problems;
- An understanding of professional and ethical responsibility;
- An ability to communicate effectively;
- The broad education necessary to understand the impact of engineering solutions in a global and societal context;
- A recognition of the need for and an ability to engage in life-long learning;
- A knowledge of contemporary issues;
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;
- An ability to apply advanced mathematics through multivariate calculus and differential equations;
- Familiarity with statistics, linear algebra, and numerical methods;
- A knowledge of chemistry and calculus-based physics with depth in at least one of them; and
- An ability to work professionally on both thermal and mechanical systems areas including the design and realization of such systems.

**Bachelor of Science in Mechanical Engineering**

**Freshman Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>ENG 142/Fundamentals of Engineering Design</th>
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</thead>
<tbody>
<tr>
<td>CHE 201/General Chemistry I</td>
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<tr>
<td>ENG 142/Fundamentals of Engineering Design</td>
<td>1 course unit</td>
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<tr>
<td>CSC 215/Computer Science I</td>
<td>1 course unit</td>
</tr>
<tr>
<td>ENG 095/Introduction to Engineering</td>
<td>0 course unit</td>
</tr>
<tr>
<td>ENG 091/Engineering Seminar I</td>
<td>0 course unit</td>
</tr>
<tr>
<td>FSP First Seminar (Social Sciences)*</td>
<td>1 course unit</td>
</tr>
<tr>
<td>MAT 127/Calculus A</td>
<td>1 course unit</td>
</tr>
<tr>
<td>PHY 201/General Physics I</td>
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<table>
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<tbody>
<tr>
<td>CSC 215/Computer Science I</td>
<td>1 course unit</td>
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<tr>
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<tr>
<td>ENG 142/Fundamentals of Engineering Design</td>
<td>1 course unit</td>
</tr>
<tr>
<td>ENG 092/Engineering Seminar II</td>
<td>0 course unit</td>
</tr>
<tr>
<td>MAT 128/Calculus B</td>
<td>1 course unit</td>
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<td>PHY 202/General Physics II</td>
<td>1 course unit</td>
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<tr>
<td>WRI 102/Academic Writing (if not exempted)</td>
<td>(1 course unit)</td>
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<tr>
<td>TST 161/Creative Design</td>
<td>1 course unit</td>
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**Sophomore Year**

<table>
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<tbody>
<tr>
<td>ENG 212/Circuits Analysis</td>
<td>1 course unit</td>
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<tr>
<td>ENG 214/Circuits Analysis Laboratory</td>
<td>.5 course unit</td>
</tr>
<tr>
<td>ENG 222/Statics</td>
<td>1 course unit</td>
</tr>
<tr>
<td>ENG 232/Manufacturing Processes</td>
<td>1 course unit</td>
</tr>
<tr>
<td>ENG 272/Advanced Engineering Mathematics I</td>
<td>1 course unit</td>
</tr>
<tr>
<td>ECO 101/Principles of Microeconomics</td>
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<table>
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<tr>
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<tbody>
<tr>
<td>ENG 152/Engineering Material Science</td>
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</tr>
<tr>
<td>ENG 262/Dynamics</td>
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<td>Course Code</td>
<td>Course Title</td>
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<tr>
<td>-------------</td>
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<tr>
<td>MAT 229</td>
<td>Calculus C</td>
</tr>
<tr>
<td>MEC 251</td>
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<td>MEC 253</td>
<td>Mechanical Engineering Laboratory I</td>
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<tr>
<td>IDS 252</td>
<td>Society, Ethics, and Technology</td>
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<td>MEC 311</td>
<td>Mechanical Design Analysis I</td>
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<td>Engineering Seminar III</td>
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<td>Engineering Seminar IV</td>
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<td>ENG 372</td>
<td>Engineering Economy</td>
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<td>MEC 361</td>
<td>Mechanical Design Analysis I</td>
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<td>Thermodynamics II</td>
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<td>Senior Professional Seminar</td>
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<td>ENG 352</td>
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<td>ENG 354</td>
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<tr>
<td>ENG 098</td>
<td>Fundamentals of Engineering Review</td>
</tr>
<tr>
<td>ENG 312</td>
<td>Digital Circuits and Microprocessors</td>
</tr>
<tr>
<td>MEC 460</td>
<td>Finite Elements in Mechanical Design</td>
</tr>
<tr>
<td>MEC 463</td>
<td>Mechanical Engineering Laboratory IV</td>
</tr>
<tr>
<td>MEC 496</td>
<td>Senior Project II</td>
</tr>
<tr>
<td>MEC 496</td>
<td>Mechanical Engineering Elective*</td>
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</table>

**Junior Year**

**Fall**

- ENG 093/Engineering Seminar III: 0 course unit
- ENG 322-Thermodynamics: 1 course unit
- ENG 342/Advanced Engineering Mathematics II: 1 course unit
- MEC 311/Mechanical Design Analysis I: 1 course unit
- MEC 321/Numerical Analysis: 1 course unit
- Liberal Learning Elective*: 1 course unit

**Spring**

- ENG 094/Engineering Seminar IV: 0 course unit
- ENG 372/Engineering Economy: 1 course unit
- MEC 361/Fluid Mechanics: 1 course unit
- MEC 363/Mechanical Engineering Laboratory II: .5 course unit
- MEC 371-Thermodynamics II: 1 course unit
- Mechanical Engineering Elective*: 1 course unit

**Senior Year**

**Fall**

- ENG 099/Senior Professional Seminar: 0 course unit
- ENG 352/Control Systems: 1 course unit
- ENG 354/Control Systems Laboratory: .5 course unit
- MEC 411-Heat Transfer: 1 course unit
- MEC 433/Mechanical Engineering Laboratory III: .5 course unit
- MEC 495/Senior Project I: 0 course unit
- Mechanical Engineering Elective*: 1 course unit
- Liberal Learning Elective*: 1 course unit

**Spring**

- ENG 098/Fundamentals of Engineering Review: 0 course unit
- ENG 312/Digital Circuits and Microprocessors: 1 course unit
- MEC 460/Finite Elements in Mechanical Design: 1 course unit
- MEC 463/Mechanical Engineering Laboratory IV: .5 course unit
- MEC 496/Senior Project II: 1 course unit
- Mechanical Engineering Elective*: 1 course unit

**Total course units**: 39 course units

* By advisement only.

**Minor in Mechanical Engineering**

**Option A—Mechanical Design**

- ENG 222/Statics: 1 course unit
- ENG 262/Dynamics: 1 course unit
- MEC 251/Strength of Materials: 1 course unit
MEC 311/Mechanical Design I 1 course unit
Mechanical Engineering Elective* 1 course unit

Total course units 5** course units

* Mechanical engineering elective must be chosen from the following: MEC 343, MEC 421, MEC 431, MEC 481.
** Only one course unit taken as part of the student’s major may also be counted toward the student’s minor.

Minor in Mechanical Engineering
Option B—Thermal Systems

ENG 222/Statics 1 course unit
ENG 322/Thermodynamics 1 course unit
MEC 361/Fluid Mechanics 1 course unit
MEC 411/Heat Transfer 1 course unit
Mechanical Engineering Elective* 1 course unit

Total course units 5** course units

* Mechanical engineering elective must be chosen from the following: MEC 371, MEC 451, MEC 461, MEC 471.
** Only one course unit taken as part of the student’s major may also be counted toward the student’s minor.

Bachelor of Arts in Biomedical Engineering

Coordinator: Stella

Biomedical engineering is an interdisciplinary academic program that offers students the opportunity to pursue a Biomedical Engineering specialization under Engineering Science that leads to a Bachelor of Science degree as well as a Bachelor of Arts in Biomedical Engineering. Students who enroll in either the BA or BS program will have the opportunity to follow one of two curricula options: electrical engineering or mechanical engineering. Students who enroll in either the BA or BS program will have the opportunity to follow one of two curricula options: electrical engineering or mechanical engineering.

The biomedical engineering academic programs are designed to provide students the opportunity to pursue a technical education that spans engineering, life sciences and physical sciences. The Biomedical Engineering specialization under Engineering Science (BS) program is designed to provide students the opportunity to pursue a career as design biomedical engineers or graduate study in Biomedical Engineering. The BA program in Biomedical Engineering provides a technical education that also spans the social sciences and humanities. Students who choose the BA program value the analytical skills that the study of engineering provides but do not intend to practice as design engineers.

The BS program will be an excellent choice for students interested in pursuing research or design career opportunities in engineering, medical and pharmaceutical consulting firms and industries. The BA program will be an excellent choice for students interested in research or technical management positions within the pharmaceutical or medical industries, and regulatory government. Students in either program can also continue their education in engineering, biological sciences, medicine, dentistry, and allied health careers.
The BA program in biomedical engineering program is designed to meet medical school admission requirements. Although admission standards vary, most medical schools require one year of college level calculus, one year of general chemistry with lab, one year of general physics with lab, one year of general biology with lab, one year of organic chemistry with lab, and at least six courses of humanities and social sciences. The BA program in biomedical engineering program meets these requirements.

Bachelor of Arts in Biomedical Engineering—Electrical Engineering Option

Freshman Year

Fall

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tr>
<td>or</td>
<td></td>
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<tr>
<td>CSC 215</td>
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<td>ENG 095</td>
<td>Introduction to Engineering</td>
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<td>ENG 091</td>
<td>Engineering Seminar I</td>
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Spring

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Sophomore Year

Fall

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<tr>
<td>ENG 272</td>
<td>Advanced Engineering Math I</td>
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</tr>
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<td>ENG 312</td>
<td>Digital Circuits and Microprocessors</td>
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Spring

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<td>ELC 333</td>
<td>Electrical Engineering Laboratory I</td>
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<td>TST 161</td>
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Junior Year

Fall

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<tr>
<td>BME 311</td>
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<td>Course</td>
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<td>Units</td>
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<tr>
<td>-------------</td>
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<tr>
<td>BME 333</td>
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<td>CHE 321</td>
<td>Organic Chemistry I</td>
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<td>ENG 093</td>
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**Spring**

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<td>ENG 322</td>
<td>Thermodynamics I</td>
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<tr>
<td>ENG 342</td>
<td>Advanced Engineering Math II**</td>
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<tr>
<td>ENG 352</td>
<td>Control Systems</td>
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<td>ECO 101</td>
<td>Principles of Microeconomics</td>
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<tr>
<td>IDS 252</td>
<td>Society, Ethics, and Technology</td>
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**Senior Year**

**Fall**

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<tr>
<th>Course</th>
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<td>BME 423</td>
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<td>ELC 423</td>
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<td>ENG 099</td>
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<td></td>
<td>Social Science/Humanities Elective*</td>
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**Spring**

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<th>Title</th>
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<td>BME 492</td>
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</table>

**Total course units**

36 course units

*By advisement only.

** Students whose goal is admission to medical school are strongly advised to take CHE 322/Organic Chemistry II and a laboratory based biology course instead of ENG 342 and BIO 211 respectively.

**Bachelor of Arts in Biomedical Engineering—Mechanical Engineering Option**

**Freshman Year**

**Fall**

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<thead>
<tr>
<th>Course</th>
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<th>Units</th>
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<tr>
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<td>ENG 142</td>
<td>Fundamentals of Engineering Design</td>
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<td>or</td>
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</tr>
<tr>
<td>CSC 215</td>
<td>Computer Science I</td>
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<tr>
<td>ENG 095</td>
<td>Introduction to Engineering</td>
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<td>Engineering Seminar I</td>
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<td>MAT 127</td>
<td>Calculus A</td>
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<tr>
<td>PHY 201</td>
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**Spring**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>CHE 202</td>
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<td>CSC 215</td>
<td>Computer Science I</td>
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</table>
or
ENG 142/Fundamentals of Engineering Design 1 course unit
ENG 092/Engineering Seminar II 0 course unit
MAT 128/Calculus B 1 course unit
PHY 202/General Physics II 1 course unit
WRI 102/Academic Writing (if not exempted) (1 course unit)

Sophomore Year

Fall
BIO 185/Themes in Biology 1 course unit
ENG 212/Circuit Analysis 1 course unit
ENG 214/Circuit Analysis Laboratory .5 course unit
ENG 222/Statics 1 course unit
ENG 272/Advanced Engineering Math I 1 course unit

Spring
BME 251/Introduction to Biomedical Engineering 1 course unit
MAT 229/Calculus C 1 course unit
MEC 251/Strength of Materials 1 course unit
MEC 263/Mechanical Engineering Laboratory I .5 course unit
TST 161/Creative Design 1 course unit

Junior Year

Fall
BIO 211/Biology of the Eukaryotic Cell** 1 course unit
BME 311/Physiological Systems 1 course unit
BME 333/Physiological Systems Laboratory .5 course unit
CHE 321/Organic Chemistry I 1 course unit
ENG 093/Engineering Seminar III 0 course unit
ENG 322/Thermodynamics I 1 course unit
ECO 101/Principles of Microeconomics 1 course unit

Spring
BME 343/Biomechanics 1 course unit
ENG 094/Engineering Seminar IV 0 course unit
ENG 342/Advanced Engineering Math II** 1 course unit
ELC 251/Electronics 1 course unit
ELC 333/Electrical Engineering Laboratory I .5 course unit
IDS 252/Society, Ethics, and Technology 1 course unit

Senior Year

Fall
BME 423/Introduction to Biomaterials 1 course unit
ENG 099/Senior Professional Seminar 0 course unit
MEC 311/Mechanical Design I 1 course unit
Liberal Learning Elective* 1 course unit
Social Sciences/Humanities Elective* 1 course unit

Spring
BME 473/Bioinstrumentation 1 course unit
MEC 361/Fluid Mechanics 1 course unit
   Liberal Learning Elective* 1 course unit
   Free Elective 1 course unit

Total course units 36 course units

*By advisement only.
** Students whose goal is admission to medical school are strongly advised to take CHE 322/Organic Chemistry II and a laboratory based biology course instead of ENG 342 and BIO 211 respectively.

Seven Year Medical / Engineering
Coordinator: Stella

The School of Engineering offers a combined seven-year medical/engineering program in conjunction with the New Jersey Medical School (NJMS) of the University of Medicine and Dentistry of New Jersey (UMDNJ). Students in the program can pursue undergraduate studies leading to a Bachelor of Science in Engineering Science (preferences in Electrical Engineering and Mechanical Engineering are available) or a Bachelor of Arts in Biomedical Engineering. Students pursuing either degree must select a preference in Electrical or Mechanical Engineering.

Students in this program spend three years at TCNJ completing undergraduate coursework. Upon successful completion of the first year of medical school, the student is granted either a Bachelor of Science in Engineering Science or a Bachelor of Arts in Biomedical Engineering from TCNJ. The M.D. degree is earned at the end of four years at NJMS.

For consideration into the program, the candidates must have earned a minimum SAT score of 1400 or better (from a single test), and hold a class rank within the top 10 percent. Students entering this program must hold advanced placement credit for Calculus A and Calculus B, or General Physics I and II. Retention in the program requires students to carry an overall and semester GPA of 3.4 or higher and earn a B or better in the required science and engineering courses. Two interviews are required as part of the admissions process.

Seven-Year BS (Engineering Science – Electrical Preference)/MD

Freshman Year

Summer

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<th>Course Title</th>
<th>Units</th>
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<td>PHY</td>
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Fall

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<th>Course Title</th>
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<tr>
<td>CHE</td>
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<tr>
<td>ENG</td>
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<tr>
<td>ENG</td>
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<tr>
<td>ENG</td>
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<td>First Seminar (Social Sciences)**</td>
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<tr>
<td>ENG</td>
<td>222/Statics</td>
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<tr>
<td>ENG</td>
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Spring

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<th>Course Code</th>
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<td>CHE</td>
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<td>ENG</td>
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</table>
MAT  229/Calculus C  1 course unit
ENG  212/Circuits Analysis  1 course unit
ENG  214/Circuits Analysis Laboratory  .5 course unit
ENG  262/Dynamics  1 course unit

**Sophomore Year**

**Fall**
ENG  232/Manufacturing Processes  1 course unit
ENG  342/Advanced Engineering Math II  1 course unit
ENG  312/Digital Circuits and Microprocessors  1 course unit
ENG  093/Engineering Seminar III  0 course unit
ECO  101/Principles of Microeconomics  1 course unit
CSC  215/Computer Science I  1 course unit

**Spring**
ELC  251/Electronics  1 course unit
ELC  333/Electrical Engineering Laboratory I  .5 course unit
ELC  321/Signals and Systems  1 course unit
ENG  152/Materials Science  1 course unit
ENG  094/Engineering Seminar IV  0 course unit
ENG  322/Thermodynamics  1 course unit
IDS  252/Society, Ethics & Technology  1 course unit

**Junior Year**

**Summer**
CHE  321/Organic Chemistry I  1 course unit
CHE  322/Organic Chemistry II  1 course unit

**Fall**
ENG  352/Control Systems  1 course unit
ENG  352/Control Systems Laboratory  .5 course unit
ELC  495/Senior Project I  0 course unit
ENG  099/Senior Professional Seminar  0 course unit
BIO  231/Genetics  1 course unit
ELC  341/Communication Systems  1 course unit
Electrical Engineering Elective**  1 course unit

**Spring**
ENG  372/Engineering Economy  1 course unit
TST  161/Creative Design  1 course unit
ELC  496/Senior Project II  1 course unit
ENG  098/Fundamentals of Engineering Review  0 course unit
Liberal Learning Elective**  1 course unit
Electrical Engineering Elective**  1 course unit

**Total course units at TCNJ**
33.5 course units
Senior Year at New Jersey Medical School***

* Students entering the program must hold advanced placement credit in Calculus A and B. Alternatively, students must hold advanced placement credit for General Physics I and II, and complete Calculus A and B during the summer prior to their first semester at TCNJ.

** By advisement only.

*** One Liberal Learning course requirement is met at New Jersey Medical School.

Seven-Year BS (Engineering Science – Mechanical Preference)/MD

Freshman Year

Summer

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Fall

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Spring

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Sophomore Year

Fall

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Spring

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<td>MEC 263</td>
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MEC 361/Fluid Mechanics 1 course unit
ECO 101/Principles of Microeconomics 1 course unit
ENG 094/Engineering Seminar IV 0 course unit

Junior Year

Summer
CHE 321/Organic Chemistry I 1 course unit
CHE 322/Organic Chemistry II 1 course unit

Fall
ENG 352/Control Systems 1 course unit
ENG 352/Control Systems Laboratory .5 course unit
ELC 495/Senior Project I 0 course unit
ENG 099/Senior Professional Seminar 0 course unit
MEC 311/Mechanical Design I 1 course unit
BIO 321/Genetics 1 course unit
Mechanical Engineering Elective** 1 course unit

Spring
ENG 372/Engineering Economy 1 course unit
ELC 496/Senior Project II 1 course unit
ENG 098/Fundamentals of Engineering Review 0 course unit
ENG 312/Digital Circuits and Microprocessors 1 course unit
Mechanical Engineering Elective** 1 course unit
Liberal Learning Elective** 1 course unit

Total course units at TCNJ 33.5 course units

Senior Year at New Jersey Medical School***

* Students entering the program must hold advanced placement credit in Calculus A and B. Alternatively, students
must hold advanced placement credit for General Physics I and II, and complete Calculus A and B during the
summer prior to their first semester at TCNJ.
** By advisement only.
*** One Liberal Learning course requirement is met at New Jersey Medical School.

Seven-Year BA in Biomedical Engineering (Electrical Preference)/MD

Freshman Year

Summer
PHY 201/General Physics I* 1 course unit
PHY 202/General Physics II* 1 course unit

Fall
CHE 201/General Chemistry I 1 course unit
ENG 142/Fundamentals of Engineering Design 1 course unit
ENG 095/Introduction to Engineering 0 course unit
ENG 091/Engineering Seminar I 0 course unit
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<td>ENG</td>
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<td>ENG</td>
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** Total course units at TCNJ **

32 course units
Senior Year at New Jersey Medical School***

* Students entering the program must hold advanced placement credit in Calculus A and B. Alternatively, students must hold advanced placement credit for General Physics I and II, and complete Calculus A and B during the summer prior to their first semester at TCNJ.

** By advisement only.

*** One Liberal Learning course requirement is met at New Jersey Medical School.

Seven-Year BA in Biomedical Engineering (Mechanical Preference)/MD

Freshman Year

**Summer**

**PHY** 201/General Physics I* 1 course unit

**PHY** 202/General Physics II* 1 course unit

**Fall**

**CHE** 201/General Chemistry I 1 course unit

**ENG** 142/Fundamentals of Engineering Design 1 course unit

**ENG** 095/Introduction to Engineering 0 course unit

**ENG** 091/Engineering Seminar I 0 course unit

**FSP** First Seminar (Social Sciences)** 1 course unit

**BIO** 185/Themes in Biology 1 course unit

**ENG** 272/Advanced Engineering Math I 1 course unit

**Spring**

**CHE** 202/General Chemistry II 1 course unit

**ENG** 092/Engineering Seminar II 0 course unit

**MAT** 229/Calculus C 1 course unit

**ENG** 212/Circuits Analysis 1 course unit

**ENG** 214/Circuits Analysis Laboratory .5 course unit

**CSC** 215/Computer Science I 1 course unit

Sophomore Year

**Fall**

**CHE** 321/Organic Chemistry I 1 course unit

**BIO** 211/Biology of the Eukaryotic Cell 1 course unit

**BME** 311/Physiological Systems 1 course unit

**BME** 333/Physiological Systems Laboratory .5 course unit

**ENG** 222/Statics 1 course unit

**ENG** 093/Engineering Seminar III 0 course unit

**IDS** 252/Society, Ethics & Technology 1 course unit

**Spring**

**CHE** 322/Organic Chemistry II 1 course unit

**ENG** 322-Thermodynamics 1 course unit

**BME** 251/Intro. to Biomedical Engineering 1 course unit

**ENG** 094/Engineering Seminar IV 0 course unit

**TST** 161/Creative Design 1 course unit

**MEC** 251/Strength of Materials 1 course unit
MEC 263/Mechanical Engineering Lab I .5 course unit

**Junior Year**

**Fall**
- BME 423/Intro. to Biomaterials 1 course unit
- MEC 311/Mechanical Design I 1 course unit
- ECO 101/Principles of Microeconomics 1 course unit
- BIO 231/Genetics 1 course unit
- ENG 099/Senior Professional Seminar 0 course unit

**Spring**
- BME 473/Bioinstrumentation 1 course unit
- BME 343/Biomechanics 1 course unit
- MEC 361/Fluids 1 course unit
- ELC 251/Electronics 1 course unit
- ELC 333/Electrical Engineering Laboratory I Liberal Learning Elective** .5 course unit
  - 1 course unit

**Total course units at TCNJ**

32 course units

**Senior Year at New Jersey Medical School***

* Students entering the program must hold advanced placement credit in Calculus A and B. Alternatively, students must hold advanced placement credit for General Physics I and II, and complete Calculus A and B during the summer prior to their first semester at TCNJ.
  ** By advisement only.
  *** One Liberal Learning course requirement is met at New Jersey Medical School.

**General Engineering Courses**

**ENG 091, 092/Engineering Seminar I, II**

0 course unit

Students in the freshman year are expected to engage in appropriate professional and service activities over two semesters. Activities such as attendance at technical presentations, professional society functions, service activities, and professional membership are required. (P/U)

**ENG 093, 094/Engineering Seminar III, IV**

0 course unit

The requirement for professional and/or service activities (ENG 091, 092) is repeated for students in the junior year. (P/U)

**ENG 095/Introduction to Engineering**

(fall semester)

0 course unit

The course provides an introduction to the engineering profession. Students are provided with an orientation to the program as well as the engineering specializations offered by the department. Areas of study include academic success strategies, time management, and the development of skills needed for successful group work. (P/U)

**ENG 098/Fundamentals of Engineering Review**

(spring semester)

0 course unit
**Prerequisite:** Senior standing
A review of engineering principles in preparation for the Fundamentals of Engineering (FE) certification examination. (P/U)

**ENG 099/Senior Professional Seminar** 0 course unit
(fall semester)
*Prerequisite:* Senior standing
Orientation course to aid students making the transition from college to graduate school/industry. Topics include career planning, resume preparation, interviewing techniques, professional responsibilities, ethics, graduate, and continuing education. (P/U)

**ENG 142/Fundamentals of Engineering Design** 1 course unit
(with design hour)
(every semester)
An introduction to the study of engineering design as set within the graphical context of computer-aided engineering software and the procedural context of reverse engineering. Activities include the graphical analysis of the engineering design of products for visualization and communication, utilizing parametric solid modeling and also reverse engineering problems requiring the adaptation of an existing design.

**ENG 152/Engineering Materials Science** 1 course unit
(every semester)
*Corequisite:* CHE 201
Fundamentals of metallurgy and properties of engineering materials, including ferrous and nonferrous metals, plastics, wood, and ceramics.

**ENG 212/Circuit Analysis** 1 course unit
(every semester)
*Prerequisite:* PHY 202
*Corequisite:* ENG 272
Electric circuit concepts, Kirchoff’s laws, node and mesh analysis, network theorems, natural and forced response, steady state analysis, phasor notation, balanced 3 phase, Fourier series, and frequency selective networks.

**ENG 214/Circuit Analysis Laboratory** .5 course unit
(every semester)
*Corequisite:* ENG 212
A practical laboratory experience designing, simulating, breadboarding, and testing electric circuits to complement the theory in ENG 212.

**ENG 222/Statics** 1 course unit
(every semester)
*Prerequisite:* PHY 201
Analysis of force systems and applications to structural analysis. Force analysis of plane trusses and frames, friction effects, centroids and moments, and products of inertia of plane areas and curves.

**ENG 232/Manufacturing Processes** 1 course unit
(with laboratory)
(every semester)
An introduction to the basic tools, processes, and materials of manufacturing. The manufacturing enterprise is examined with special attention to key organizational systems including production and inventory control, quality control, marketing, and finance. In addition, fundamental processes of the metals and plastics industries are treated in depth.

**ENG 262/Dynamics**
1 course unit
(every semester)
*Prerequisite:* ENG 222
Displacement, velocity, and acceleration of a particle. Dynamics of particles and rigid bodies. Work-energy and impulse momentum methods for particles and rigid bodies.

**ENG 272/Advanced Engineering Mathematics I**
1 course unit
(every semester)
*Prerequisite:* MAT 128
Integrated introduction to matrix algebra and standard topics in differential equations and basic linear algebra. Topics include: linear systems, basis, vectors, matrices, eigenvalue-eigenvector problems, and experimental design with computer applications for engineering.

**ENG 312/Digital Circuits and Microprocessors**
1 course unit
(with design hour)
(every semester)
*Corequisite:* CSC 215 or permission of the instructor
Analysis and design of digital systems including Boolean algebra, combinational and sequential circuit designs, programmable logic devices, VHDL or verilog, CMOS logic circuits, and computer basics.

**ENG 322/Thermodynamics I**
1 course unit
(every semester)
*Prerequisites:* PHY 202, CHE 201
*Corequisite:* ENG 222
Study of the thermodynamic properties of pure substances, relationship of pressure and temperature to thermodynamic properties, concepts of work and heat. First and second laws of thermodynamics. Process and cycle analysis.

**ENG 342/Advanced Engineering Mathematics II**
1 course unit
(every semester)
*Prerequisite:* ENG 272
Topics include: Probability, continuous and discrete distributions, simple and multiple regression and correlation. Fourier series, periodic functions, functions of arbitrary period, even and odd functions, and half-range expansions. Solutions to second order partial differential equations.

**ENG 352/Control Systems**
1 course unit
(every semester)
*Prerequisite:* ENG 212
A study of theory and applications of electrical analog and digital control systems. Emphasis is on study of specific applications of such control systems to industrial processes and especially their application to electrical, hydraulic, pneumatic, and mechanical systems.

**ENG 354/Control Systems Laboratory**
.5 course unit
(every semester)
*Corequisite:* ENG 352
Designing, modeling, and the simulation of analog and digital controllers.

**ENG 372/Engineering Economy**  
(every semester)  
Prerequisites: MAT 128, ECO 200  
Economic and financial considerations in engineering decisions. Topics include decision criteria. Also, cost concepts, financial calculations, capital sources, accounting data, and depreciation. Comparison of alternatives by annual cost, present worth, and discounted cash flow methods. Minimum cost and maximum profit determination. Replacement and economic life, break-even analysis, effect of taxes, intangible factors, and time value of money. Students will also become familiar with the common cost accounting systems and applications, their strengths and weaknesses.

**ENG 412/Process and Quality Control**  
(occasionally)  
Prerequisites: ENG 232, and ENG 272 or equivalent  
Industrial practices with respect to the control of quality of manufactured products including standards, inspection, organization, sampling, and corrective action. The use of inspection instruments and procedures is included.

**ENG 452/Project Management**  
(spring semester)  
Prerequisite: ENG 372  
Techniques of project management at introductory level. Topics include life cycle of a project, project evaluation, project screening and selection, structuring the project, project management and control, project scheduling, project budget, and resource management.

**ENG 470/Special Topics in Engineering**  
(with design hour)  
(occasionally)  
Prerequisite: Permission of instructor  
Study of advanced topics in engineering chosen by the instructor.

**Biomedical Engineering Courses**

**BME 251/Introduction to Biomedical Engineering**  
(spring semester)  
Introduction to specializations within the field of biomedical engineering. Overview of classical and current trends related to biosensors and instrumentation, physiological models, biomechanics, and biomaterials. Consideration of ethical and biosafety issues.

**BME 311/Physiological Systems**  
(fall semester)  
Prerequisites: BIO 185, CHE 202  
Corequisite: BME 333  
Control and integration of physiological function of the systems of the human body. Study of structure and function of systems, and homeostatic mechanisms in health and disease. Overview of sensory and biological control systems.
BME 333/Physiological Systems Laboratory  .5 course unit
(laboratory)
(fall semester)
Prerequisites: BIO 185, CHE 202
Corequisite: BME 311
Measurement and analysis of human physiological signals, from an engineering point of view. Biological potentials (ECG, EMG, EEG) and cardiopulmonary function. Physiological effects of sleep and exercise.

BME 343/Biomechanics  1 course unit
(same as MEC 343)
(with design hour)
(fall semester)
Prerequisite: MEC 251
Comprehensive study of structure, function, and mechanical properties of biological soft and hard tissues. Topics include joint and tissue mechanics, analysis of tissue remodeling, fatigue and fracture resistance, and mechanical properties of skeletal tissue.

BME 371/Physiological Systems II  1 course unit
(spring semester)
Prerequisite: BME 251
Continuation of BME 251, with an emphasis on integrative function within and between systems.

BME 391/Independent Study  .5-1 course unit
(occasionally)
Prerequisite: Permission of instructor and department
For advanced students wishing to pursue a special area of interest. Topic(s) developed in consultation with a faculty adviser.

BME 423/Introduction to Biomaterials  1 course unit
(same as MEC 423)
(with design hour)
(fall semester)
Prerequisite: CHE 201
Introduction to metal, polymeric, ceramic, and biological materials used as surgical implants in humans. Topics include acute and chronic biological response to implants, degradation of artificial materials, artificial organs, and medical devices. Consideration of ethical issues.

BME 470/Special Topics in Biomedical Engineering  1 course unit
(with design hour)
(occasionally)
Prerequisite: Permission of instructor and department
Study of advanced topics in biomedical engineering chosen by the instructor.

BME 473/Bioinstrumentation  1 course unit
(same as ELC 473, MEC 473)
(with laboratory and design hour)
(spring semester)
Prerequisites: ENG 212, ENG 214
Theory and design of biomedical instruments used for measurements on humans and animals. Detailed coverage of sensors and transducers that quantify force, pressure, flow, sound, temperature, and displacement. Origin of biopotentials (ECG, EMG, EEG) and biological signal processing. Consideration of noise, interference, and electrical safety issues.

**BME 495, 496/Senior Project I, II**

(0, 1 course unit)

*(every semester)*

*Prerequisites:* Senior standing and approved project proposal

Senior project focuses students’ previous experience upon a specific technical project. Library research, preliminary design, evaluation of alternatives, project planning, cost and scheduling analysis, written reports, and oral presentation. Students work closely with a faculty adviser.

**Civil Engineering Courses**

**CIV 211/Surveying**

(.5 course unit)

(laboratory)

(fall semester)

*Prerequisite:* MAT 127

An introduction to the theory and applications of modern surveying processes. Students use optical and digital land surveying instruments to measure distance, direction, elevation and location. Electronic data collection in the field and computers for subsequent survey computation in the laboratory are used. Concepts of higher order survey techniques and global positioning systems are introduced.

**CIV 213/CAD Laboratory**

(.5 course unit)

(laboratory)

(fall semester)

This course focuses on the principles of computerized drafting and design, graphic entities, hatch patterns, layering, part file creation, and information extraction. Two-dimensional drafting and drawings using a CAD system is used. Three-dimensional modeling and surface revolution is introduced.

**CIV 251/Strength of Materials**

(1 course unit)

(same as MEC 251)

(spring semester)

*Prerequisites:* ENG 222, computer programming

Topics include axial, lateral, and torsional loading of shafts and beams; statically indeterminate structures; temperature and prestrain effects; shear force and bending moment in beams; axial, shear, bearing and bending stresses; deflection of beams; and buckling of columns.

**CIV 263/Engineering Materials Laboratory**

(.5 course unit)

(same as MEC 263)

(laboratory)

(spring semester)

*Corequisite:* CIV 251

Experiments related to strength of materials and basic stress analysis and material science. Computer data acquisition and data analysis.

**CIV 311/Structural Analysis**

(1 course unit)

(fall semester)

*Prerequisites:* ENG 262, CIV 251
The nature of loads, restraints, and types of structural elements are introduced, and then statically determinate structures are reviewed. Shear and moment diagrams of beams and frames, along with influence lines are covered. Virtual work principles are viewed and applied to various structures. Analysis of indeterminate structures is introduced. Displacement methods of an analysis including moment distribution are also covered.

**CIV 321/Numerical Methods for Engineers**  
1 course unit  
(same as MEC 321)  
(fall semester)  
*Prerequisites:* ENG 272, computer programming  
Numerical solutions to linear and non-linear systems of equations; root finding methods; numerical integration; numerical methods for finding eigenvalues and eigenvectors; numerical integration of ordinary and partial differential equations.

**CIV 331/Soil Mechanics**  
1 course unit  
(fall semester)  
*Prerequisite:* CIV 251  
*Corequisite:* CIV 333  
The basic principles of soil mechanics are introduced. Topics included are elements of mechanics and hydraulic properties of soils, soil-water systems and fluid flow, stresses in soils, compressibility, consolidation and settlement, shear strength, bearing capacity, lateral earth pressure, and application to foundations, retaining structures and slope stability.

**CIV 333/Soil Mechanics Laboratory**  
.5 course unit  
(laboratory)  
(fall semester)  
*Corequisite:* CIV 331  
In this course, students obtain extensive hands-on experience in the use of laboratory equipment and in the essentials of engineering classifications of soils and rocks, physical properties and shear strength of soils such as moisture content limits, compaction, permeability, unconfined compression, and direct shear tests.

**CIV 351/Structural Steel Design**  
1 course unit  
(with design hour)  
(spring semester)  
*Prerequisite:* CIV 311  
The load and resistance factor design (LRFD) approach is used throughout the course. Types of loading, structural systems, analysis and design of components of structural systems in tension, compression, flexure, and combined axial bending loads are covered. Bolted and welded connections, steel joists and decking and use of computer in analysis, design, and detailing are also discussed.

**CIV 361/Fluid Mechanics**  
1 course unit  
(same as MEC 361)  
(with design hour)  
(fall semester)  
*Prerequisites:* MAT 229, ENG 272  
Topics include hydrostatics; kinematics of fluid motion; conservation equations in integral and differential form; dimensional analysis; laminar and turbulent viscous incompressible flow; boundary layer theory; lift and drag.
CIV 363/Fluid Measurement Laboratory  
(laboratory)  
(fall semester)  
Prerequisite: CIV 263  
Corequisite: CIV 361  
Experiments related to fluid mechanics illustrating principles of flow behavior including computer aided analysis and interpretation.

CIV 371/Civil Engineering Materials  
(with laboratory)  
(spring semester)  
Prerequisites: ENG 152, CIV 333  
This course covers the behavior, testing, and analysis of aggregates, cement and admixtures, asphalt binders, mix design of Portland and bituminous concretes, material selection, production, placing and curing, environmental influences, durability, and field quality control. Common ASTM laboratory testing procedures and specifications, and statistical applications are used.

CIV 381/Environmental Engineering  
(with design hour)  
(spring semester)  
Prerequisites: CIV 361, CIV 363  
This introductory course deals with the principles of environmental engineering such as water quality, atmospheric quality, pollution prevention, solid and hazardous wastes engineering. Design of water, air, and waste management systems is also introduced.

CIV 385/Hydraulic Engineering and Hydrology  
(spring semester)  
Prerequisites: CIV 361, CIV 363  
This course covers basic concepts of viscous flows, conversation laws (mass, momentum, and energy), pipe flows and open-channel flows, water distribution systems, and hydraulic modeling. It also covers the fundamentals of hydrology such as hydraulic cycle, weather and hydrology, precipitation, evaporation and transpiration, stream flow, and subsurface hydrology.

CIV 411/Transportation Engineering  
(with design hour)  
(fall semester)  
Prerequisite: CIV 211  
This course covers the fundamentals of transport facilities and service design, with emphasis on highway geometric design, pavement design, and transit service design. Topics include vehicle performance, horizontal and vertical alignments of highways, earthwork, flexible and rigid pavements, pavement management, transit operations and control, and transit route design.

CIV 421/Reinforced Concrete Design  
(with design hour)  
(fall semester)  
Prerequisites: CIV 311, CIV 371  
An introduction to the design of reinforced concrete structures, concrete technology, properties of concrete and reinforcing steel, construction practice, and general code requirements. Students are introduced to analysis and design of members subjected to axial load, flexure, shear, and restraint forces. Serviceability conditions, fire resistance, durability, distress and failure, and computer applications are also included.
**CIV 431/Foundation Engineering**
1 course unit
(with design hour)
(fall semester)
*Prerequisites:* CIV 331, CIV 333
This course discussed subsoil exploration and interpretation, and introduces the concepts of analysis and design for foundations, retaining systems, and earth works. Topics include bearing capacity, slope stability, lateral earth pressure, retaining structures, shallow and deep foundations, reinforced soil, and soil-structure interaction.

**CIV 441/Structural Steel Design II**
1 course unit
(with design hour)
(occasionally)
*Prerequisite:* CIV 351
This course focuses on the behavior and design of various structural members in steel building and bridge structures. Topics include code design requirements, stability and post-buckling, plate girders, composite steel/concrete girders, second-order frame behavior, high-strength bolted and welded connections, fatigue and brittle fracture, and methods of plastic analysis.

**CIV 443/Geotechnical Engineering**
1 course unit
(with design hour)
(occasionally)
*Prerequisite:* CIV 431
This course considers practical design and construction of various geotechnical structures. Topics discussed for each structure include background theory and current design standards plus a case history. The structures considered are: shallow foundations, deep foundations, excavation support, retaining walls, slope stability, rock tunnel, landfill design, and pavement system. Soil investigation, ground water and dewatering, and soft ground are also discussed.

**CIV 445/Water Resources Engineering**
1 course unit
(with design hour)
(occasionally)
*Prerequisites:* CIV 381, CIV 391
The course includes analysis and design of advanced hydraulic structures. Water supply, meteorological data analysis, urban drainage and runoff control, reservoir analysis, flood control, modeling techniques, and power generation are also discussed.

**CIV 451/Construction Management**
1 course unit
(spring semester)
*Prerequisite:* Senior status
An introduction to the management of construction projects and the project delivery processes. Topics include the nature of the industry, construction planning and scheduling, allocation of resources, critical path networks, and use of computer software, estimating, bidding and cost control, contract administration, and dispute resolutions.

**CIV 461/Reinforced Concrete Design II**
1 course unit
(with design hour)
(occasionally)
*Prerequisite:* CIV 421
Behavior and design of reinforced concrete structures and structural components subjected to axial, flexural, and torsion loading conditions. Topics include detailing of reinforcement, design of two-way floor systems, slender columns, members subjected to torsion, shear walls, strut and tie models, and connections in precast elements. An introduction to prestressed concrete and seismic design of reinforced concrete structures is made.

**CIV 471/Transportation Engineering II**  
(with design hour)  
(occasionally)  
*Prerequisite:* CIV 411  
The fundamentals of transportation engineering with application to various modes, planning, selection, formulation, and administration of modern transportation systems are covered. Impacts of economic, sociological, geographic, environmental, and political factors on transportation systems are also discussed.

**CIV 481/Structural Analysis II**  
(with design hour)  
(occasionally)  
*Prerequisite:* CIV 311  
The course covers the general flexibility and stiffness methods of analysis; multi-span beams, trusses, frames and grids; loadings due to force, support displacement, temperature change and member pre-strain; axial and flexural stability; and basic plasticity. This course represents the basis for the finite element method of analysis.

**CIV 495, 496/Senior Project I, II**  
(every semester)  
*Prerequisites:* Senior standing and approved project proposal  
Senior project focuses students’ previous experience upon a specific technical project. Library research, preliminary design, evaluation of alternatives, project planning, cost and scheduling analysis, written reports, and oral presentation. Students work closely with a faculty adviser.

**Computer and Electrical Engineering Courses**

**ELC 251/Electronics**  
(spring semester)  
*Prerequisite:* ENG 212  
Introduction to electronic devices and related circuits. Topics include diodes, bipolar junction and field-effect transistors, operational amplifiers, and related integrated circuit components.

**ELC 321/Signals and Systems**  
(spring semester)  
*Prerequisite:* ENG 272  

**ELC 333/Electrical Engineering Lab I**  
(laboratory)  
(spring semester)  
*Corequisite:* ELC 251
A practical laboratory experience designing, simulating, breadboarding, and testing electronic circuits to complement the theory in ELC 251.

**ELC 341/Communication Systems**  
1 course unit  
(fall semester)  
*Prerequisites:* ELC 251, ELC 321  
Digital and analog communication systems including baseband, pulse, AM, FM, and digital modulated systems.

**ELC 343/Microcomputer Systems**  
1 course unit  
(fall semester)  
*Prerequisite:* ENG 312  
An introductory course in microcontrollers, microprocessors, embedded control architecture, and assembly language programming. Interfacing of external devices with microcontrollers is emphasized.

**ELC 361/Engineering Electromagnetics**  
1 course unit  
(spring semester)  
*Prerequisites:* ENG 342, PHY 202  
An integration of theory and practical applications in electromagnetics, transmission lines, and electromagnetic fields and waves. Includes impedance matching, Smith Chart, CAD tools, and waveguides.

**ELC 363/Computer Engineering Lab I**  
.5 course unit  
(laboratory hours)  
(spring semester)  
*Corequisite:* ELC 451  
Hands on laboratory experience to reinforce the concepts covered in ELC 451. Students will do at least three projects involving computer data-path design, micro-code and finite state machine control, and memory and I/O subsystem analysis and design.

**ELC 373/Electrical Engineering Lab II**  
.5 course unit  
(with design hour)  
(spring semester)  
*Corequisite:* ELC 361  
Design issues and modeling techniques in communication transmission systems. Experiments include linear, nonlinear, and digital modulation/demodulation and computer-aided design.

**ELC 383/Electronics II**  
1 course unit  
(with design hour)  
(spring semester)  
*Prerequisite:* ELC 251  
The continuation of ELC 251 covering the analysis and design of electronic circuits and systems: biasing, small-signal analysis, frequency response, feedback amplifiers, active filters, non-linear op-amp applications, and oscillators.

**ELC 391/Independent Study**  
.5-1 course unit  
(occasionally)  
*Prerequisites:* Permission of instructor and department, senior status required  
For advanced students wishing to pursue a special area of interest. Topic(s) developed in consultation with a faculty adviser.
ELC 411/Embedded Systems 1 course unit
(with design hour)
(fall semester)
Prerequisites: ELC 251, ELC 343
This course deals with embedded systems and their interactions with their physical environments. It focuses on embedded system design issues such as limited memory, cost, performance guarantees, real-time operations, power, and reliability.

ELC 423/Digital Signal Processing 1 course unit
(fall semester)
Prerequisites: ENG 312, ELC 321
Sampling data systems, z-transform, DFT, FFT, and digital filter design with applications to digital signal processing.

ELC 431/RF/Microwave Engineering 1 course unit
(with design hour)
(occasionally)
Prerequisite: ELC 361
An extension of Engineering Electromagnetics. Topics include RF/microwave active devices, amplifier design using scattering parameters, and modern filter design.

ELC 433/Electrical Engineering Lab III .5 course unit
(laboratory)
(fall semester)
Corequisite: ELC 361
DSP systems will be designed and tested with MATLAB and LabVIEW and implemented with DSP processors.

ELC 441/Digital Engineering Systems 1 course unit
(with design hour)
(spring semester)
Prerequisites: ENG 312, ELC 251
Treatment of digital system engineering problems: power, noise, signaling, and timing.

ELC 451/Computer Architecture and Organization 1 course unit
(spring semester)
Prerequisites: ENG 312, ELC 343
Microprocessor design philosophy, data typing and addressing modes, multi-processors, multi-tasking, process communications, memory management, and virtual memory.

ELC 453/Digital Control Systems 1 course unit
(same as MEC 453)
(occasionally)
Prerequisite: ENG 352
Digital control systems, dynamic response modeling, design, and compensation techniques.

ELC 463/Computer Engineering Lab II .5 course unit
(laboratory hours)
(spring semester)
Prerequisite: ELC 363
A semester long design experience involving the formal design and simulation of a major microprocessor or microcomputer system or subsystem. Students will do a major project consisting of the design and simulation of a small microprocessor or microcomputer, cache controller, etc.

**ELC 471/VLSI Design**  
(1 course unit)  
(with design hour)  
(occasionally)  
Prerequisites: ELC 251 ELC 451
Structured design methodologies for VLSI systems. Topics include switching models, device equations, combinational and sequential systems design, simulation, timing, verification and tools for computer-aided design.

**ELC 473/Bioinstrumentation**  
(1 course unit)  
(same as BME 473, MEC 473)  
(with laboratory and design hour)  
(spring semester)  
Prerequisites: ENG 212, ENG 214
Theory and design of biomedical instruments used for measurements on humans and animals. Detailed coverage of sensors and transducers that quantify force, pressure, flow, sound, temperature and displacement. Origin of biopotentials (ECG, EMG, EEG) and biological signal processing. Consideration of noise, interference, and electrical safety issues.

**ELC 475/Advanced Digital Signal Processing**  
(1 course unit)  
(with design hour)  
(fall semester)  
(occasionally)  
Prerequisite: ELC 423
Digital filter design, discrete random signals, effects of finite word length arithmetic, fast Fourier transform and applications, power spectrum estimation, and implementation using DSP microprocessors.

**ELC 483/Robotics**  
(1 course unit)  
(same as MEC 483)  
(with design hour)  
(occasionally)  
Prerequisite: ENG 272
Introduction to robotics foundations in kinematics, dynamics, control, trajectory generation, actuation, sensing, and design. Laboratory projects involving building mobile robots and operating manipulators are incorporated to reinforce the basic principles introduced in the lecture.

**ELC 495, 496/Senior Project I, II**  
(0, 1 course unit)  
(every semester)  
Prerequisites: Senior standing and approved project proposal
Senior project focuses students’ previous experience upon a specific technical project. Library research, design, cost analysis, construction, testing, and project management. Students work closely with a faculty adviser.
Mechanical Engineering Courses

MEC 251/Strength of Materials 1 course unit
(same as CIV 251)
(spring semester)
Prerequisites: ENG 222, CSC 215, or 250
Topics include axial, lateral, and torsional loading of shafts and beams; statically indeterminate structures; temperature and prestrain effects; shear force and bending moment in beams; axial, shear, bearing and bending stresses; deflection of beams; and buckling of columns.

MEC 263/Mechanical Engineering Laboratory I .5 course unit
(laboratory)
(spring semester)
Corequisite: MEC 251 or CIV 251
Experiments related to strength of materials and basic stress analysis and material science. Computer data acquisition and data analysis.

MEC 311/Mechanical Design Analysis I 1 course unit
(with design hour)
(fall semester)
Prerequisite: MEC 251
Combined stresses, energy methods, Castigiano’s theorem, failure theories for static failure of ductile and brittle materials, low- and high-cycle fatigue, bolted connections with symmetric and eccentric loading.

MEC 321/Numerical Methods for Engineers 1 course unit
(same as CIV 321)
(fall semester)
Prerequisites: ENG 272, CSC 215
Numerical solutions to linear and non-linear systems of equations; root finding methods; numerical integration; numerical methods for finding eigenvalues and eigenvectors; numerical integration of ordinary and partial differential equations.

MEC 343/Biomechanics 1 course unit
(same as BME 343)
(with design hour)
(fall semester)
Prerequisite: MEC 251
Comprehensive study of structure, function and mechanical properties of biological soft and hard tissues. Topics include joint and tissue mechanics, analysis of tissue remodeling, fatigue and fracture resistance, and mechanical properties of skeletal tissue.

MEC 361/Fluid Mechanics 1 course unit
(same as CIV 361)
(with design hour)
(spring semester)
Prerequisites: ENG 222, ENG 272
Topics include hydrostatics; kinematics of fluid motion; conservation equations in integral and differential form; dimensional analysis; laminar and turbulent viscous incompressible flow; boundary layer theory; and lift and drag.
MEC 363/Mechanical Engineering Laboratory II .5 course unit
(laboratory)
(spring semester)
Prerequisite: MEC 263
Corequisites: MEC 361, MEC 371

MEC 371/Thermodynamics II 1 course unit
(spring semester)
Prerequisite: ENG 322
Topics include availability and irreversibility; power and refrigeration cycles; mixtures and solutions; chemical reactions; Maxwell relations and one-dimensional flow through nozzles and diffusers.

MEC 391/Independent Study .5-1 course unit
(occasionally)
Prerequisites: Permission of instructor, senior status required
For students wishing to study an advanced area of interest. Topic(s) developed in consultation with a faculty member.

MEC 411/Heat Transfer 1 course unit
(with design hour)
(fall semester)
Prerequisites: ENG 322, ENG 342, MEC 321, MEC 361

MEC 421/Kinematics and Mechanisms 1 course unit
(with design hour)
(occasionally)
Prerequisites: ENG 262, CSC 215, junior status required
Analysis of displacement, velocity, and acceleration in mechanical linkages, cams, gears, and mechanisms; synthesis of linkages, analytical, graphical, and computer-generated solutions.

MEC 423/Introduction to Biomaterials 1 course unit
(same as BME 423)
(with design hour)
(fall semester)
Prerequisite: CHEM 201
Introduction to metal, polymeric, ceramic, and biological materials used as surgical implants in humans. Topics include acute and chronic biological response to implants, degradation of artificial materials, artificial organs, and medical devices. Consideration of ethical issues.

MEC 431/Mechanical Design Analysis II 1 course unit
(with design hour)
(occasionally)
Prerequisites: MEC 311, senior status
Bolted and welded connections; mechanical springs; rolling and journal bearings; spur, helical, bevel, and worm gears; clutches, brakes, and flexible mechanical elements; safety, economic, reliability, and design considerations.
MEC 433/Mechanical Engineering Laboratory III  .5 course unit
(laboratory)  (fall semester)
Prerequisite: MEC 363
Corequisite: MEC 411
Experiments related to heat transfer in forced and natural convection. Computer data acquisition and data analysis.

MEC 441/Vibration Analysis  1 course unit
(with design hour)  (occasionally)
Prerequisites: ENG 262, MEC 321
Response of one, two, and multi-degree of freedom mechanical systems to periodic inputs. Energy principles to obtain natural frequencies. Response to linear and nonlinear damping effects. Problem formulation using curvilinear and Lagrange’s equations to generate normal modes and decoupled system descriptions. Formulation of the problem of vibration of continuous bodies and techniques for reducing continuous systems to lumped models. Response to non-periodic forcing effects.

MEC 451/Heating, Ventilating, and Air Conditioning  1 course unit
(with design hour)  (occasionally)
Prerequisites: MEC 361, MEC 371
Corequisite: MEC 411
Heating and cooling loads; principles of psychrometrics; air, electric, hydronic, and steam heating systems; absorption; evaporation and vapor compression air conditioning system. Design and analysis of residential, commercial, and industrial HVAC systems.

MEC 453/Digital Control Systems  1 course unit
(same as ELC 453)  (with design hour)  (occasionally)
Prerequisite: ENG 352
Digital control Systems, dynamic response modeling, design, and compensation techniques.

MEC 460/Finite Elements in Mechanical Design  1 course unit
(spring semester)
Prerequisites: MEC 311, MEC 411
Introduction to finite element analysis. Application of modern engineering tools in the design of mechanical and thermal systems.

MEC 461/Thermal Systems Design  1 course unit
(with design hour)  (occasionally)
Prerequisites: MEC 361, MEC 411
Workable and optimum systems, modeling of thermal systems, system simulation, and optimization.

MEC 463/Mechanical Engineering Laboratory IV  .5 course unit
(laboratory)  (spring semester)
Prerequisites: MEC 263, MEC 311, ENG 262
Experiments related to advanced mechanical engineering topics including free and forced vibrations for first- and multi-degree of freedom systems. Measurements on elements experiencing combined stresses.

**MEC 471/Compressible Fluid Mechanics** 1 course unit
(with design hour)
(occasionally)
*Prerequisites:* ENG 322, MEC 361
Study of physical acoustics, one-dimensional compressible flow, normal and oblique shock waves.
Design of ducts and nozzles for compressible flow.

**MEC 473/Bioinstrumentation** 1 course unit
(same as BME 473, ELC 473)
(with laboratory and design hour)
(spring semester)
*Prerequisites:* ENG 212, ENG 214
Theory and design of biomedical instruments used for measurements on humans and animals. Detailed coverage of sensors and transducers that quantify force, pressure, flow, sound, temperature, and displacement. Origin of biopotentials (ECG, EMG, EEG) and biological signal processing. Consideration of noise, interference, and electrical safety issues.

**MEC 481/Advanced Strength of Materials** 1 course unit
(with design hour)
(occasionally)
*Prerequisite:* MEC 311
Beams on elastic foundations, rotating discs, membrane stresses in shells, Castigliano’s principles, torsional bucking of beams, and shafts.

**MEC 483/Robotics** 1 course unit
(same as ELC 483)
(with design hour)
(occasionally)
*Prerequisite:* ENG 272
Introduction to robotics foundations in kinematics, dynamics, control, trajectory generation, actuation, sensing, and design. Laboratory projects involving building mobile robots and operating manipulators are incorporated to reinforce the basic principles introduced in the lecture.

**MEC 495, 496/Senior Project I, II** 0, 1 course unit
(every semester)
*Prerequisites:* Senior standing and approved project proposal
Senior project focuses students’ previous experience upon a specific technical project. Library research, design, cost analysis, construction, testing, and project management. Students work closely with a faculty adviser.