

# 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 Arts in Biomedical Engineering
- Bachelor of Science in Computer Engineering
- Bachelor of Science in Electrical Engineering
- Bachelor of Science in Engineering Science (Specializations in Civil Engineering and Engineering Management)
- Bachelor of Science in 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.

## **Biomedical Engineering**

*Coordinator:* Stella

Biomedical engineering is an interdisciplinary academic program leading to a Bachelor of Arts in Biomedical Engineering. Students who enroll in this program will have the opportunity to follow one of two curricula options: electrical engineering or mechanical engineering.

The biomedical engineering program is designed to provide students the opportunity to pursue a technical yet broad education that spans engineering, life sciences, physical sciences, and social sciences and humanities. Students who will choose this major value the analytical skills that the study of engineering provides but do not intend to practice as design engineers.

The program will be an excellent choice for students interested in pursuing research or technical management career opportunities in engineering, medical and pharmaceutical consulting firms and industries, and regulatory government. Students can also continue their education in engineering, biological sciences, medicine, dentistry, and allied health careers.

The 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 biomedical engineering program meets these requirements.

## **Biomedical Engineering 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.

## **Bachelor of Arts in Biomedical Engineering—Electrical Engineering Option**

### **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**

CHE	202/General Chemistry II	1 course unit
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)

### **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 units
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
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
ECO	101/Microeconomics	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
	Liberal Learning Elective*	1 course unit
	Social Science/Humanities Elective*	1 course unit

### Spring

BME	473/Bioinstrumentation	1 course unit
BME	492/Independent Study	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.*

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

### **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**

CHE	202/General Chemistry II	1 course unit
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)

### **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/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.*

## 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**

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	
	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

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/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

ENG	098/Fundamentals of Engineering Review	1 course unit
ENG	322/Thermodynamics I	1 course unit
ELC	463/Computer Engineering Laboratory II	.5 course unit
ELC	496/Senior Project II	1 course unit
	Computer Engineering Elective*	1 course unit
	Liberal Learning Elective*	1 course unit

**Total course units**

**39 course units**

*\* By advisement only.*

## Minor in Computer Engineering

CSC	250/Computer Science I, II or the equivalent	1 course unit
ELC	343/Microcomputer Systems	1 course unit
ELC	451/Computer Architecture and Organization	1 course unit
ENG	212/Circuit Analysis	1 course unit
ENG	312/Digital Circuits and Microprocessors	1 course unit

**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

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	
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

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/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 1	.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	1 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
<b>Total Course Units</b>		<b>39 course units</b>

\* 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

*Civil Engineering Coordinator:* Al-Omaishi

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

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.

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 Program Outcomes**

The program outcomes listed below are expected of all graduates of the engineering science 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 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—Civil Engineering Specialization**

#### **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	
	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/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	391/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.*

## 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	
	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/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/Macroeconomics	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

## Junior Year

### Fall

BUS	217/Legal Environment of Business	1 course unit
ELC	341/Communications Systems	1 course unit
ENG	093/Engineering Seminar III	0 course unit
ENG	222/Statics	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

### Spring

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

## Senior Year

### Fall

ELC	495/Senior Project I	0 course unit
ENG	099/Senior Professional Seminar	0 course unit
ENG	322/Thermodynamics I	1 course unit
ENG	352/Control Systems	1 course unit
ENG	354/Control Systems Laboratory	.5 course unit
FIN	201/Financial Management	.5 course unit
	Electrical Engineering Elective*	1 course unit



## Spring

ELC	496/Senior Project II	1 course unit
ENG	098/Fundamentals of Engineering Review	0 course unit
ENG	452/Project Management	1 course unit
	Management Elective*	1 course unit
	Liberal Learning Elective*	1 course unit
	<b>Total course units</b>	<b>39 course units</b>

*\*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	
	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)
	Liberal Learning Elective *	1 course unit

### Sophomore Year

#### Fall

ECO	101/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/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
<b>Total course units</b>		<b>5** course units</b>

\* 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
<b>Total course units</b>		<b>5** course units</b>

\* 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, 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

#### 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

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
ECO	101/Microeconomics	1 course unit

### Spring

ENG	152/Engineering Material Science	1 course unit
ENG	262/Dynamics	1 course unit
MAT	229/Calculus C	1 course unit
MEC	251/Strength of Materials	1 course unit
MEC	253/Mechanical Engineering Laboratory I	.5 course unit
IDS	252/Society, Ethics, and Technology	1 course unit

## 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
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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/Computer Aided Mech. Engr. 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
<b>Total course units</b>		<b>39 course units</b>

\* 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
<b>Total course units</b>		<b>5** course units</b>

\* 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
<b>Total course units</b>		<b>5** course units</b>

\* 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.

## 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** **0 course unit**

(fall semester)

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** **0 course unit**

(spring semester)

*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** **0.5 course unit**  
(every semester)

*Corequisite:* ENG 352

Designing, modeling, and the simulation of analog and digital controllers.

**ENG 372/Engineering Economy** **1 course unit**  
(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** **1 course unit**  
(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** **1 course unit**  
(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** **1 course unit**  
(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** **1 course unit**  
(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** **1 course unit**  
(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, with an emphasis on integrative function within and between 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 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.

**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**

**.5 course unit**

(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**

**.5 course unit**

(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**

**1 course unit**

(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 391/Hydraulic Engineering and Hydrology**

**1 course unit**

(spring semester)

*Prerequisites:* CIV 361, CIV 363

This course covers basic concepts of viscous flows, conservation 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**

**1 course unit**

(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**

**1 course unit**

(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** **1 course unit**  
(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** **1 course unit**  
(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** **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.

### **Computer and Electrical Engineering Courses**

**ELC 251/Electronics** **1 course unit**  
(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** **1 course unit**  
(spring semester)

*Prerequisite:* ENG 272

Continuous and discrete signals and systems. Convolution, impulse response, system classifications, differential and difference equations. Fourier series, Fourier transform, Laplace transform, and z-transform. Transfer functions and stability.

**ELC 333/Electrical Engineering Lab I** **.5 course unit**  
(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, Castigliano'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

Experiments related to fluid mechanics and thermodynamics. Calibration and uncertainty. Performance testing of an internal combustion engine.

**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

Multi-dimensional steady state and transient conduction. Internal and external convection, blackbody and graybody thermal radiation, numerical methods for heat transfer. Design and analysis of heat exchangers.

**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/Computer-Aided Mechanical Engineering 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)

*Prerequisite:* MEC 433

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.