

## Biomedical Engineering

*Faculty:* Hall, Chair, BuSha, Lau, Wagner, Wei

Biomedical engineers integrate engineering skills with the understanding of the complexity of physiological systems, from the cellular level to the whole body, in order to improve healthcare. Biomedical engineers design instruments, devices, and develop computational models of physiological systems and signals. Some of the well established specialty areas within the field of biomedical engineering are: bioinstrumentation; biomaterials; biomechanics; cell and tissue engineering; medical imaging; rehabilitation engineering; and quantitative modeling of physiology. Biomedical engineers are employed in universities, in industry, in hospitals, in research facilities of educational and medical institutions, in teaching, and in government regulatory agencies.

### Program Educational Objectives:

The biomedical engineering program has established the following educational objectives. These objectives outline what TCNJ biomedical engineers are expected to attain within the first few years after graduation.

- To contribute to the economic development of New Jersey, the nation and /or the global community 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 their chosen profession;
- To enhance career skills through life-long learning.

### Student Outcomes:

The student 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 by the time of graduation. These outcomes outline the knowledge, abilities, tools, and skills the program gives the graduates to enable them to accomplish the biomedical engineering program 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 within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on 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, economic, environmental, 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.
- the ability to apply principles of mathematics, including differential equations and statistics, to biomedical engineering problems
- The ability to solve biomedical engineering problems addressing the interaction between living and non-living systems

### **Academic Policies and Standards**

A student may repeat any course without seeking approval. However, 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, e.g., 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-); MAT 127 (C-), MAT 128 (C-). A student who does not achieve these minimum performance standards, earns a grade of F, and/or has a cumulative GPA of less than 2.0 will be placed on the Engineering Programs Retention List. Placement on the Retention List for two consecutive semesters or three non-consecutive semesters will result in dismissal from the major. Students dismissed from the major may appeal for re-entry into the major.
- To ensure academic success, first year, sophomore, and first-semester junior students will not be permitted to take more than 4.5 course units unless they have a GPA of 2.75 or greater. Upper class students can register for 5.5 course units if they are in good academic standing.
- Entrance (internal transfer) into the engineering programs from another program within the College is based upon the following performance standards in these "foundation courses": PHY 201 (C); MAT 127 (C). Internal transfer within engineering programs will be considered as long as enrollment limits are not exceeded.
- Graduation requires an in-major cumulative GPA of 2.0.

**Bachelor of Science in Biomedical Engineering****First Year****Fall**

CHE	201/General Chemistry I	1 course unit
ENG	142/Fundamentals of Engineering Design	
	<i>or</i>	
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	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	
	<i>or</i>	
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**

BME	251/Fundamentals of Biomedical Engineering	1 course unit
BME	222/Introduction to Mechanics	1 course unit
ENG	212/Circuit Analysis	1 course unit
ENG	214/Circuit Analysis Laboratory	.5 course unit
ENG	272/Advanced Engineering Mathematics I	1 course unit

**Spring**

BME	323/Introduction to Biomaterials	1 course unit
BIO	201 Foundations of Biological Inquiry	1 course unit
MAT	229/Multivariable Calculus	1 course unit
ELC	321 Signals and Systems	1 course unit
	Liberal Learning Elective	1 course unit

**Junior Year****Fall**

BME	313/Biomedical Instrumentation and Measurements Lab	.5 course unit
BME	311/Physiological Systems I	1 course unit
CHE	331/Organic Chemistry I	1 course unit
BIO	211/Biology of the Eukaryotic Cell	1 course unit
ENG	093/Engineering Seminar III	0 course unit
ENG	342/Advanced Engineering Mathematics II	1 course unit
	3xx/4xx/Engineering Elective	1 course unit

**Spring**

BME	333/Physiological Systems Laboratory	.5 course unit
BME	343/Biomechanics	1 course unit
ENG	094/Engineering Seminar IV	0 course unit
BME	350/Biofluid Mechanics	1 course unit
BME	371/Physiological Systems II	1 course unit
	Biomedical Engineering or Math/Science Elective	1 course unit
TST	161/Creative Design	1 course unit

**Senior Year****Fall**

BME	450/Mass and Heat Biotransport	1 course unit
BME	473/Bioinstrumentation	1 course unit
BME	433/Bioinstrumentation Laboratory	.5 course unit
BME	495/Senior Project I	.5 course unit
	Biomedical Engineering Elective	1 course unit
	Liberal Learning Elective	1 course unit
ENG	099/Senior Professional Seminar	0 course unit

**Spring**

BME	480/Physiological Modeling	1 course unit
BME	496/Senior Project II	.5 course unit
	Biomedical Engineering Elective	1 course unit
ENG	098/Fundamentals of Engineering Review	0 course unit
	Liberal Learning Elective	1 course unit
IDS	252/Society, Ethics and Technology	1 course unit

**Total course units****39 course units\***

*\*39 course units are required for the degree. Transfer courses that are accepted as equivalent to TCNJ courses may yield a fractional course unit, even though the course content is satisfied. In this case, students need to complete additional coursework to meet the 39 course unit requirement.*

**Seven-Year BS in Biomedical Engineering/MD****Freshman Year****Summer**

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

**Fall**

ENG	095/Introduction to Engineering	0 course unit
ENG	091/Engineering Seminar I	0 course unit
FSP	First Seminar Program	1 course unit
BME	251/Fundamentals of Biomedical Engineering	1 course unit
BME	222 Introduction to Mechanics	1 course unit
ENG	272/Advanced Engineering Mathematics I	1 course unit
ENG	212/Circuits Analysis	1 course unit
ENG	214/Circuits Analysis Laboratory	.5 course unit

**Spring**

ELC	321/Signals and Systems	1 course unit
ENG	092/Engineering Seminar II	0 course unit
CSC	215/Computer Science I	1 course unit
BIO	201/Foundations of Biological Inquiry	1 course unit
ENG	142/Fundamentals of Engineering Design	1 course unit
MAT	229/Multivariable Calculus	1 course unit

**Sophomore Year****Summer**

CHE	201/General Chemistry I	1 course unit
CHE	202/General Chemistry II	1 course unit

**Fall**

BME	311/Physiological Systems	1 course unit
BME	313/Biomedical Instrumentations and Measurements Laboratory	.5 course unit
ENG	093/Engineering Seminar III	0 course unit
ENG	342/Advanced Engineering Math II	1 course unit
BIO	211/Biology of the Eukaryotic Cell	1 course unit
	3xx/4xx I Engineering Elective	1 course unit
	Liberal Learning Elective	1 course unit

**Spring**

ENG	094/Engineering Seminar IV	0 course unit
BME	343/Biomechanics	1 course unit
BME	323/Introduction to Biomaterials	1 course unit
BME	371/Physiological Systems II	1 course unit
BME	333/Physiological Systems Laboratory	.5 course unit
BME	350/Biofluid Mechanics	1 course unit
	Liberal Learning Elective	1 course unit

**Junior Year****Summer**

CHE	331/Organic Chemistry I	1 course unit
CHE	332/Organic Chemistry II (BME or Science Elective**)	1 course unit

**Fall**

BME	473/Bioinstrumentation	1 course unit
BME	433/Bioinstrumentation Laboratory	.5 course unit
ENG	099/Senior Professional Seminar	0 course unit
BME	4xx/Biomedical Engineering Elective	1 course unit
BME	495/Senior Project I	.5 course unit
BME	450/Mass and Heat Biotransport Phenomena	1 course unit
TST	161/Creative Design	1 course unit

**Spring**

ENG	098/Fundamentals of Engineering Review	0 course unit
BME	496/Senior Project II	.5 course unit
BME	4xx/Biomedical Engineering Elective	1 course unit
BME	480/Physiological Modeling	1 course unit

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Liberal Learning Elective  
IDS 252/Society, Ethics and Technology

1 course unit  
1 course unit

**Total course units at TCNJ****37\*\*\* course units****Senior Year at New Jersey Medical School**

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

*\*\*One BME elective can be math/science or other technical course. 7 year Medical students must take CHE 332*

*\*\*\*Total course units, including AP credit, are 39. Transfer courses that are accepted as equivalent to TCNJ courses may yield a fractional course unit, even though the course content is satisfied. In this case, students need to complete additional coursework to meet the 39 course unit requirement.*