Department of Biomedical Engineering

Biomedical Engineering (2016)

I. Introduction

SUSTech Biomedical Engineering Department absorbed Columbia University's Department of biomedical engineering undergraduate training courses, established the cultivating way of the enhanced version of the Columbia University Biomedical Engineering. The programs in biomedical engineering at Sustech (B.S.,M.S., Ph.D., Eng.Sc.D., and M.D./Ph.D.) prepare students to apply engineering and apply science to problems in biology, medicine, and the understanding of living systems and their behavior, and to develop biomedical systems and devices. Modern engineering encompasses sophisticated approaches to measurement, data acquisition and analysis, simulation, and systems identification. These approaches are useful in the study of individual cells, organs, entire organisms, and populations of organisms. The increasing value of mathematical models in the analysis of living systems is an important sign of the success of contemporary activity. The programs offered in the Department of Biomedical Engineering seek to emphasize the confluence of basic engineering science and applied engineering with the physical and biological sciences, particularly in the areas of biomechanics, cell and tissue engineering, and biosignals and biomedical imaging.

Programs in biomedical engineering are taught by its own faculty, members of other Engineering departments, and faculty from other University divisions who have strong interests and involvement in biomedical engineering. Several of the faculty holds joint appointments in Biomedical Engineering and other University departments. Educational programs at all levels are based on engineering and biological fundamentals. From this basis, the program branches into concentrations along three tracks: biomechanics, cell and tissue engineering, and biosignals and biomedical imaging. The intrinsic breadth of these tracks, and a substantial elective content, prepare bachelor’s and master’s students to commence professional

activity in any area of biomedical engineering or to go on to graduate school for further studies in related fields.

II. Objectives

The objectives of the undergraduate program in biomedical engineering are as follows:

- Professional employment in areas such as the medical device industry, engineering consulting, and biotechnology;
- Graduate studies in biomedical engineering or related fields;
- Attendance at medical, dental, or other professional schools.

The undergraduate program in biomedical engineering will prepare graduates who will have:

(a) An ability to apply knowledge of mathematics, science, and engineering;

(b) An ability to design and conduct experiments, as well as to analyze and interpret data;

(c) 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;

(d) An ability to function on multidisciplinary teams;

(e) An ability to identify, formulate, and solve engineering problems;

(f) An understanding of professional and ethical responsibility;

(g) An ability to communicate effectively;

(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;

(i) A recognition of the need for, and an ability to engage in life-long learning;

(j) A knowledge of contemporary issues (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;

(l) An understanding of biology and physiology;

(m) The capability to apply advanced mathematics (including differential equations and statistics), science, and engineering, to solve the problems at the interface of engineering and biology;

(n) The ability to make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and nonliving materials and systems.

The first two years provides a strong grounding in the physical and chemical sciences, engineering fundamentals, mathematics, and modern biology. This background is used to provide a unique physical approach to the study of biological systems. The last two years of the undergraduate program provide substantial exposure to fundamentals in biomedical engineering with emphasis on the integration of principles of biomedical engineering, quantitative analysis of physiology, and experimental quantification and measurements of biomedical systems. The common core biomedical engineering curriculum provides a broad yet solid foundation in biomedical engineering. The flexible choice of technical electives in the Department of Biomedical Engineering, other departments in the Engineering School, as well as in other departments in the arts and sciences allows students to broaden their biomedical engineering education to their individualized interests for a personalized curriculum. These qualities allow the faculty to prepare students for activity in all contemporary areas of biomedical engineering. Graduates of the program are equipped for employment in the large industrial sector devoted to health care, which includes pharmaceuticals, medical devices, artificial organs, prosthetics and sensory aids, diagnostics, medical instrumentation, and medical imaging.

Graduates also accept employment in oversight organizations (FDA, NIH, OSHA, and others), medical centers, and research institutes. They are prepared for graduate study in biomedical engineering and several related areas of engineering and the health sciences. Students can meet entrance requirements for graduate training in the various allied health professions. No more than three additional courses are required to satisfy entrance requirements for most U.S. medical schools.

III. Period of Study and Degree Requirement

Time length: 4 years

Degree conferred: Bachelor of Engineering

The minimum credit requirement for graduation: 154.5 credits

IV. Discipline

Biomedical Engineering

V. Main Courses

Major Foundational Courses： The Fundamentals of Electric Circuits、Fundamentals of Materials Science and Technology、 Theoretical Mechanics、 Probability and Mathematical Statistics、Cell Biology、Animal Physiology

Major Core Courses： Quantitative Physiology I、 Quantitative Physiology II、 Biomedical Engineering I、Biomedical Engineering II、Biomedical Engineering Lab I、Biomedical Engineering Lab II

VI. Practice-Based Courses

Research Projects， Internship， Biomedical Engineering Design I， Biomedical Engineering Design II

VII. Course Structure and Credit Requirements

GE Required Courses: 66.5 credits;

GE Elective Courses: 10 credits;

Major Foundational Courses: 21 credits;

Major Core Courses: 18 credits;

Major Elective Courses: 27 credits;

Undergraduate Thesis/Projects, Research Projects, Internship: 12 credits;

The minimum credit requirement for graduation: 154.5 credits.

Note: Biomedical Engineering Design I and II replace the undergraduate thesis for students of biomedical engineering. The courses of Columbia University are used as reference.

VIII. Course Arrangement

Table 1: Major Required Course (Foundational and Core Courses)

Course Code	Course Name	Credits	Lab Credits	Hours/week	Terms	Advised term to take the course	Instruction language	Prerequisite	Dept.
EE104	The Fundamentals of Electric Circuits	2		2	Spr.	1/Spr.		MA101B, MA103A	EEE
MSE201	Fundamentals of Materials Science and Technology	4	1	5	Fall	2/Fall		PHY105B, CH101A	MSE
MAE203	Theoretical Mechanics I	3		3	Fall	2/ Fall		MA102B, PHY105B	MAE
MA212	Probability and Mathematical Statistics	3		3	Spr. /Fall	2/Spr.		MA102a or MA102B	MATH
BIO206-15	Cell Biology	4		4	Fall	2/ Fall		BIO102A	BIO
BIO311-14	Animal Physiology	3		3	Fall	3/ Fall			BIO
BIO104	General Biology Laboratory	2	2	4	Spr.	2/Spr.		BIO102A or BIO102B	BIO
Total		**21**	**3**	**24**					
BMEB311	Quantitative Physiology I	3		3	Fall	3/ Fall			BME
BMEB312	Quantitative Physiology II	3		3	Spr.	3/Spr.		BMEB311	BME
BMEB313	Biomedical Engineering I	3		3	Fall	3/ Fall			BME
BMEB314	Biomedical Engineering II	3		3	Spr.	3/Spr.		BMEB313	BME
BMEB321	Biomedical Engineering Lab I	3	3	6	Fall	3/ Fall			BME
BMEB322	Biomedical Engineering Lab II	3	3	6	Spr.	3/Spr.		BMEB321	BME
Total		**18**	**6**	**24**					
BMEB121	Research Projects	2	2	4					BME
BMEB323	Internship	2	2	4	Smr.	3/ Smr.			BME
BMEB422	Biomedical Engineering Design I	4		4	Fall	4/ Fall			BME

BMEB423	Biomedical Engineering Design II	4		4	Spr.	4/Spr.		BMEB422	BME

Table 2. Major Elective Courses

Course Code	Course Name	Credits	Lab Credits	Hours/week	Terms	Advised term to take the course	Instruction language	Prerequisite	Dept.
BMEB131	Introduction to Biomedical Engineering	2		2	Spr.	1/Spr.			BME
BMEB317	Principles of Medical Imaging Systems	3		3	Fall	3/ Fall		EE104, EE205	BME
BMEB325	Medical Imaging Systems Laboratory	2		2	Fall	3/ Fall		BMEB317, EE205	BME
BMEB221	Biomedical instrumentation	4	2	6	Spr.	2/ Spr.			BME
BMEB318	Biomechanics	3	1	4	Fall	3/ Fall			BME
BIO411-16	Dynamical Systems Simulation in Biology	3		3	Fall	4/ Fall		BIO102A, MA103B, MA101B	BIO
BIO332	Stem Cell and Regenerative Medicine	2		2	Spr.	3/Spr.		BIO206-15	BIO
BIO203	Microbiology	3		3	Fall	2/ Fall			BIO
BIO201	Biochemistry（Macromolecules）	3		3	Fall	2/ Fall		BIO102A, CH101A	BIO
BIO405	Immunology	3		3	Fall	4/ Fall		BIO206-15	BIO
BIO202	Biochemistry（Metabolism）	3		3	Spr.	2/Spr.		BIO201	BIO
BIO222	Biochemistry and Molecular Biology Laboratory	2	2	4	Spr.	2/Spr.		BIO201, BIO104,BIO320	BIO
BIO306	Bioinformatics	4	2	6	Spr.	3/Spr.		BIO309	BIO
BIO304	Systems Biology	3		3	Spr.	3/Spr.		BIO102A , MA212, BMEB311	BIO
BIO313-15	Animal Physiology Laboratory	2	2	4	Fall	3/ Fall		BIO311-14 , BIO104	BIO
BIO320	Molecular Biology	3		3	Spr.	2/Spr.		BIO102A	BIO
BIO310	Neurobiology	3		3	Spr.	3/Spr.		BIO201	BIO
BMEB316	Medical image processing	3	1	4	Fall	3/ Fall			BIO
EE326	Digital image processing	3	1	4	Spr.	3/Spr.		EE205	EEE
BMEB315	Biomedical Optics	2		2	Spr.	3/Spr.	CH/ EN		BME
BMEB324	Biomedical Optics Laboratory	2	2	4	Spr.	3/Spr.	CH/ EN	BMEB315	BIO
MSE316	Biomaterials	4	2	6	Spr.	3/Spr.	EN	MSE201	MSE
MA305	Numerical Analysis	3		3	Fall	3/ Fall	CH	MA203a or MA213	MATH
EE306	Introduction to MEMS	3	1	4	Spr.	3/Spr.	CH/ EN	PHY105B	EEE
EE407	Energy Harvesting Technologies	3		3	Fall	4/ Fall			EEE
EE419	Biosensors	3	1	4	Fall	4/ Fall			EEE
EE208	Engineering electromagnetics	3	1	4	Spr.	2/Spr.	CH/ EN	MA101B, MA103A,EE104	EEE
EE202-17	Digital Circuit	3	0	3	Spr.	2/Spr.	CH	PHY105B	EEE
EE202-17L	Digital Circuit Laboratory	1	1	2	Spr.	2/Spr.	CH	EE202-17	EEE
EE205	Signals and Systems	3	1	4	Fall	2/Fall	CH/ EN		EEE
EE323	Digital Signal Processing	3	1	4	Fall	3/Fall	EN	EE205	EEE
EE303	Fundamental of Optoelectronic Technology	3	1	4	Fall	3/Fall		PHY105B	EEE

CS301	Embedded System	3	1	4	Fall	3/Fall		CS207	CS
CS203	Data structures and algorithm analysis	3	1	4	Fall	2/Fall		CS102A	CS
CS202	Computer organization Principle	3	1	4	Spr.	2/Spr.		CS207	CS
EE201	Analog circuit	3	1	4	Fall	2/Fall		PHY105B, EE104	EEE
BIO208	Cell Biology Laboratory	2	2	4	Fall	Spr		BIO206-15 , BIO104	BIO
EE429	Image and Video Processing	3	1	4	Fall	4/Fall		EE205, MA103A, MA212	EEE
EE431	BioMEMS and Lab-on-a-Chip	3		3	Fall	4/Fall			EEE
Total		**114**	**31**	**142**					
A minimum of 27 credits MUST be taken to fulfill Major Requirements.									

Table 3: Overview of Practice-Based Courses

Course Code	Course Name	Credits	Lab Credits	Hours/week	Terms	Advised term to take the course	Instruction language	Prerequisite	Dept.
BIO313-15	Animal Physiology Laboratory	2	2	4	Fall	3/Fall		BIO311-14 , BIO104	BIO
BIO306	Bioinformatics	4	2	6	Spr.	3/Spr.		BIO309	BIO
BIO222	Biochemistry and Molecular Biology Laboratory	2	2	4	Spr.	2/Spr.	CH/ EN	BIO201, BIO104	BIO
BIO208	Cell Biology Laboratory	2	2	4	Fall	Spr		BIO206-15 ,BIO104	BIO
BMEB316	Medical Image Processing	3	1	4	Fall	3/Fall	CH/ EN		BME
EE207	Data Structure and Algorithm Analysis	3	1	4	Fall	2/Fall		CS102A	EEE
BMEB325	Medical Imaging Systems Laboratory	2		2	Fall	3/Fall	CH	BMEB317, EE205	BME
BMEB221	Biomedical instrumentation	4	2	6	Spr.	2/Spr.	CH		BME
BMEB318	Biomechanics	3	1	4	Fall	3/Fall			BME
BMEB324	Biomedical Optics Laboratory	2	2	4	Spr.	3/Spr.	CH/ EN	BMEB315	BME
EE202-15	Digital Circuit	4	1	5	Spr.	2/Spr.	CH	PHY105B, EE201-17	EEE
EE326	Digital image processing	3	1	4	Spr.	3/Spr.		EE205	EEE
EE208	Engineering electromagnetics	3	1	4	Spr.	2/Spr.	CH/ EN	MA101B, MA103A, EE104	EEE

EE303	Fundamental of Optoelectronic Technology	3	1	4	Fall	3/Fall	CH/ EN	PHY105B	EEE
EE323	Digital Signal Processing	3	1	4	Fall	3/Fall	EN	EE205	EEE
EE319	Embedded System	3	1	4	Fall	3/Fall		CS207	CS
EE205	Signals and Systems	3	1	4	Fall	2/Fall	CH/ EN		EEE
EE306	Introduction to MEMS	3	1	4	Spr.	3/Spr.	CH/ EN	PHY105B	EEE
MSE201	Fundamentals of Materials Science and Technology	4	1	5	Fall	2/Fall	EN	PHY105B, CH101-A	MSE
MSE316	Biomaterials	4	2	6	Spr.	3/Spr.	EN	MSE201	MSE
CS202	Computer organization Principle	3	1	4	Spr.	2/Spr.		CS207	CS
BMEB121	Projects of Science and Technology Innovation	2	2	4					BME
BMEB321	*Professional practice	2	2	4	Smr.	3/ Smr.			BME
BMEB422	Biomedical Engineering Design I	4		4	Fall	4/Fall	EN		BME
BMEB423	Biomedical Engineering Design II	4		4	Spr.	4/Spr.	EN	BMEB422	BME
Total		**75**	**34**	**109**					

Table 4. Overview of Credit Hours and Credits

Course Category	Total Course Hours	Total Credits	The Minimum Credit Requirement
General Education (GE) Required Courses	1168	66.5	66.5
General Education (GE) Elective Courses	3144	182.5	10
Major Foundational Courses	384	21	21
Major Core Courses	384	18	18
Major Elective Courses	1984	114	27
Undergraduate Thesis/Projects, Research Projects, Internship	448	12	12
Total	7512	414	154.5