Department of Biomedical Engineering

Program of Intelligent Medical Engineering for International Students (2024)

I. Introduction

The department of biomedical engineering was established in June 2016. Research areas in the department include MechanoMedicine, wearable devices and wireless health monitoring, de novo regenerative engineering, multiscale and multimodal biomedical imaging, computational medicine for big data and health informatics, biomedical MEMS.

The core knowledge base of Intelligent Medical Engineering is obtained through enormous quantities of medical data by applying intelligent perception, big data analysis, intelligent decision making, precision medicine and medical human-machine interface; as well as the investigation of working principles in intelligent biological systems such as the nervous system. Students in the Intelligent Medical Engineering program would also master the fundamentals of Basic Medicine and Clinical Medicine. Graduates of the program are well-equipped for careers not only in general and clinical medical research at large general hospitals, they are also excellent candidates at universities, research institutes, and industries in the fields of artificial intelligence and intelligent medicine for careers in research, development and project management.

Intelligent Medicine is poised to define the future direction of medicine. It is an emerging interdisciplinary field based on theories of modern medicine and natural sciences, while applying the advancement in neuroscience, big data, cloud computing, artificial intelligence, intelligent perception, and robotics, etc. This field of study aims to discover the principles of human life and diseases, and explore intelligent diagnosis and treatment methods through human-machine collaborations. Research in Intelligent Medicine will be conducted through close integration of health care and emerging industries such as artificial intelligence, robotics, and big data. Clinical needs will be the motivation and end-point of Intelligent Medicine research. By building a bridge between the laboratory and the operating table, this field is positioned for the integration of medicine and intelligent technologies, translation of research findings, and innovations in

engineering. The emphasis of the Intelligent Medical Engineering program is the application of emerging intelligent technologies in medicine, including intelligent perception, analysis, and decision-making based on medical data. The objectives of research in Intelligent Medical Engineering include drug discovery, medical robots, intelligent diagnosis and treatment, intelligent image recognition, intelligent health data management, etc. The Intelligent Medical Engineering program aims to become an interdisciplinary, diversified teaching and research platform that promotes the integration of multiple disciplines, and fosters well-rounded, high-quality talents that are able to adapt to future developments.

Academic subject areas: Intelligent Medical Engineering

Program code: 101011T

II. Objectives and Learning Outcomes

1. Objectives

(1) Intelligent Medical Engineering is a highly interdisciplinary field that integrates medicine, science, and engineering. In direct response to the needs of the major national initiative “Healthy China 2030”, this program aims to train top-notch, innovative talents with solid background in medicine in addition of possessing strong practical engineering capabilities.

(2) Training of professional talents with vision in modern medicine, comprehensive data thinking, strong engineering skills and innovative capabilities.

2. Learning Outcomes

(1) Flexibly apply basic sciences such as mathematics, artificial intelligence and modern engineering technologies.

(2) Master basic medical knowledge.

(3) Design and conduct experiments, analyze and interpret data.

(4) Effectively contribute to a multidisciplinary team.

(5) Full understanding of professional and ethical responsibilities.

(6) Strong self-learning ability and capacity to grasp new technologies.

(7) The ability to utilize technologies, techniques and modern tools that are required for engineering practice.

III. Study Length, Degree, and Graduation Requirements

1. Study length: 4 years.

2. Degree conferred: Students who complete and meet the degree requirements of the undergraduate program will be awarded a bachelor's degree in Engineering.

3. The minimum credit requirement for graduation: 155 credits. The specific requirements are as follows.

<table>
<tr><th colspan="2">Module</th><th>Category</th><th>Minimum Credit Requirement</th></tr>
<tr><td rowspan="15">General Education Courses</td><td>Chinese Language and Culture Module</td><td>Chinese Language and Culture</td><td>16</td></tr>
<tr><td rowspan="2">Arts and Physical Education Module</td><td>Physical Education</td><td>4</td></tr>
<tr><td>Arts</td><td>2</td></tr>
<tr><td rowspan="3">Competence Development Module</td><td>Computer Programming</td><td>3</td></tr>
<tr><td>Writing</td><td>2</td></tr>
<tr><td>Foreign Languages</td><td>14</td></tr>
<tr><td rowspan="3">Humanities and Social Sciences Module</td><td>Humanities</td><td rowspan="2">6</td></tr>
<tr><td>Social Sciences</td></tr>
<tr><td>Chinese Studies</td><td>2</td></tr>
<tr><td rowspan="4">Mathematics and Natural Sciences Module</td><td>Mathematics</td><td>12</td></tr>
<tr><td>Physics</td><td>10</td></tr>
<tr><td>Chemistry</td><td>3</td></tr>
<tr><td>Geoscience + Life Science</td><td>3</td></tr>
<tr><td>GE to Majors Bridging Module</td><td>Introduction to Majors</td><td>2</td></tr>
<tr><td rowspan="4">Major Courses</td><td rowspan="3">Major Required Courses</td><td>Major Foundational Courses</td><td>15</td></tr>
<tr><td>Major Core Courses</td><td>22</td></tr>
<tr><td>Practice-based Learning (Undergraduate Thesis, Internships, Research projects, etc.)</td><td>16</td></tr>
<tr><td>Major Elective Courses</td><td>Major Elective Courses</td><td>23 (including a minimum of 6 lab credits)</td></tr>
<tr><td colspan="3">Total</td><td>155</td></tr>
<tr><td colspan="4">Note: please see the General Education Requirement for more details on Chinese Language and Culture Module, Arts and Physical Education Module, Competence Development Module (Foreign Languages & Writing), Humanities and Social Sciences Module, and GE to Majors Bridging Module.</td></tr>
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IV. Course Requirements for the Mathematics and Natural Sciences Module and Computer Programming

Course Category	Course Code	Course Name	Credits	Terms	Prerequisite	Dept.
Mathematics	MA117/ MA101a	Calculus I/ Mathematical Analysis I	4/5	1 Fall	None	Department of Mathematics
	MA127/ MA102a	Calculus II/ Mathematical Analysis II	4/5	1 Spring	Calculus I/Mathematical Analysis I	
	MA113/ MA107	Linear Algebra/ Advanced Linear Algebra I	4	1 Spring & Fall	None	
Physics	PHY105/ PHY101	College Physics I/ General Physics I	4/5	1 Fall	None	Department of Physics
	PHY106/ PHY102	College Physics II/ General Physics II	4/5	1 Spring	College Physics I/General Physics I	
	PHY104B	Experiments of Fundamental Physics	2	1-2 Spring & Fall	None	
Chemistry	CH105/ CH103	Chemistry: The Central Science/ General Chemistry	3/4	1-2 Spring & Fall	None	Department of Chemistry
Geoscience + Life Science	BIO103	Principles of Biology	3	1-2 Spring & Fall	None	Department of Biology
Computer Programming ①	CS109	Introduction to Computer Programming	3	1-2 Spring & Fall	None	Department of Computer Science and Engineering
	CS110	Introduction to Java Programming	3	1-2 Spring & Fall	None	
	①NOTES: You are required to complete and pass at least 1 course in the part of Computer Programming.					

V. Prerequisites for Major Declaration

Major Declaration Time	Course Code	Course Name	Prerequisite
Declare major at the end of the first academic year	MA117/MA101a	Calculus I/ Mathematical Analysis I	None
	MA127/MA102a	Calculus II/ Mathematical Analysis II	MA117/MA101a
	MA113/MA107	Linear Algebra/ Advanced Linear Algebra I	None
	PHY105/PHY101	College Physics I/ General Physics I	None
	PHY106/PHY102	College Physics II/ General Physics II	PHY105/PHY102
	CH105/CH103	Chemistry: The Central Science/ General Chemistry	None
		Computer Programming①	None
	BIO103	Principles of Biology	None
	PHY104B	Experiments of Fundamental Physics	None
	Notes: There are 9 courses in the list of Pre-requisites courses and you are required to complete and pass at least 4 courses of them at the end of First Year. ① For the Computer Programming, you are required to complete and pass at least 1 course.		
Declare major at the end of the second academic year	MA117/MA101a	Calculus I/ Mathematical Analysis I	None
	MA127/MA102a	Calculus II/ Mathematical Analysis II	MA117/MA101a
	MA113/MA107	Linear Algebra/ Advanced Linear Algebra I	None
	PHY105/PHY101	College Physics I/ General Physics I	None
	PHY106/PHY102	College Physics II/ General Physics II	PHY105/PHY102
	CH105/CH103	Chemistry: The Central Science/ General Chemistry	None
		Computer Programming①	None
	BIO103	Principles of Biology	None
	PHY104B	Experiments of Fundamental Physics	None
	Notes: There are 9 courses in the list of Pre-requisites courses and you are required to complete and pass at least 7 courses of them at the end of Second Year . ① For the Computer Programming, you are required to complete and pass at least 1 course.		

Note:

1. If the number of students entering a major at the end of the first academic year in the department is greater than or equal to the total number of the teaching-research faculty (PI)*2*60%, all majors in the department may implement the prerequisites for major declaration at the end of the second academic year.
2. If the number of students entering a major at the end of the first academic year in the department is less than the total number of the teaching-research faculty (PI)*2*60%, all majors in the department do not implement the prerequisites for major declaration at the end of the second academic year.
3. Suppose the number of students applying for a major at the end of the first academic year exceeds four times the total number of the teaching-research faculty (PI), then the department may select students according to predetermined rules. In principle, the rules set by the department shall examine the students' suitability for the major and not based on weighted GPA (Specific rules shall be set by the department and announced in advance).
4. For departments that do not implement prerequisites for major declaration at end of the second academic year, if the cumulative number of students applying for a major at the end of the second academic year and the number of students who have entered a major at the end of the first academic year exceeds four times the total number of the teaching-research faculty (PI), the department may select students according to predetermined rules. In principle, the rules set by the department shall examine the students' suitability for the major and not based on weighted GPA (Specific rules shall be set by the department and announced in advance).

VI: Major Course Arrangement

Table 1: Major Required Courses

Program of Intelligent Medical Engineering

Course Category	Course Code	Course Name	Credits	Practice-based Learning Credits	Terms	Prerequisite	Dept.
Major Foundational Courses	BMEB111	Principles of Electric Circuits	3		1/Spring		BME
	EE205	Signals and Systems	3	1	2/Fall	MA117	EE
	CS203B	Data Structures and Algorithm Analysis B①	3	1	2/Fall	CS109	CS
	MA212	Probability and Statistics	3		2/Spring & Fall	MA127	MA
	BMEB215	Machine Learning and its Medical Engineering Applications	3		2/Spring	MA113,MA212	BME
	Total		15	2			
Major Core Courses	BMEB316	Medical Image Processing	3	1	3/Fall		BME
	BMEB317	Principles of Medical Imaging Systems	3		3/Fall	BMEB111	BME
	BMEB333	Neural Engineering and Brain-computer Interface	3		3/Fall	MA113	BME
	BMEB330	Medical Robotics	3		3/Spring	MA113	BME
	BMEB331	Medical Big Data	3	1	3/Spring	MA127 MA113 MA212	BME
	BMEB332	Intelligent Sensing Technology	3		3/Spring		BME
	BMEB328	Experiment on Intelligence Medical Engineering I	2	2	3/Fall		BME
	BMEB329	Experiment on Intelligence Medical Engineering II	2	2	3/Spring		BME
	Total		22	6			
Practice-based Courses	BMEB121*	Projects of Science and Technology Innovation	2	2	Start from 1 Spring		BME
	BMEB470	Professional Practice	2	2	Summer		BME
	BMEB491	Undergraduate Thesis②	12	12	4/Spring		BME
	Total		16	16			
Total			53	24			

Note:
①Students who have completed CS207 are not required to take the CS203B.
②Students who have completed Comprehensive Design I&II are not required to take the BMEB491.

Table 2: Major Elective Courses

Program of Intelligent Medical Engineering

Course Code	Course Name	Credits	Practice-based Learning Credits	Terms	Prerequisite	Dept.
BMEB211	Introduction to Nanobiomedicine	3		1/ Spring		BME
BMEB216	Anatomy and Physiology	3		2/ Spring		BME
BMEB315	Biomedical Optics	2		3/ Spring		BME
BMEB324	Biomedical Optics Laboratory	2	2	3/ Spring	BMEB315	BME
BMEB326	Clinical Perception for Biomedical Engineering I	2		2/ Spring		BME
BMEB214	Fundamentals of Biomedical Materials	2		2/Fall		BME
BMEB217	Fundamentals of Engineering Mechanics	3		2/Fall		BME
BMEB218	Molecular Cell Biology	3		2/Fall		BME
BMEB213	Medical Materials and Devices	3		2/ Fall		BME
BMEB327	Clinical Perception for Biomedical Engineering II	2	2	2/ Summer	BMEB326	BME
BMEB318	Biomechanics	3		3/ Fall		BME
BMEB311	Quantitative Physiology I	3		3/ Fall		BME
BMEB312	Quantitative Physiology II	3		3/ Spring	BMEB311	BME
BMEB319	Biomaterials and Tissue Engineering	3		3/ Spring		BME
BMEB325	Medical Imaging Systems Laboratory	2	2	3/ Spring	BMEB317	BME
BMEB334	Biomaterials and Tissue Engineering Laboratory	2	2	3/ Fall		BME
BIO104	General Biology Laboratory	2	2	1/ Spring	BIO103 or BIO102B	BIO
BIO201	Biochemistry (Macromolecules)	3		2/Fall	BIO103, CH103	BIO
BIO306	Bioinformatics	4	2	3/ Spring	BIO309	BIO
BIO304	Systems Biology	3		3/ Spring	BIO103, MA212	BIO
BIO310	Neurobiology	3		3/ Spring	BIO201	BIO
BIO309	Computational Biology	3	1	3/ Fall		BIO
BIO405	Immunology	3		4/ Fall	BIO206-15	BIO
EE202-17	Digital Circuits	3		2/ Spring	PHY105	EE
EE202-17L	Digital Circuits Laboratory	1	1	2/ Spring	EE202-17	EE
EE323	Digital Signal Processing	3	1	3/ Fall	EE205	EE
EE303	Fundamentals of Optoelectronic Technology	3	1	3/ Fall	PHY105	EE
EE332	Digital System Design	3	1	3/ Spring	EE202-17	EE
EE342	Sensors and Applications	3		3/ Spring		EE
CS205	C/C++ Programming Design	3	1	1/ Fall		CS
CS301	Embedded System and Microcomputer Principle	3	1	3/ Fall	EE202-17 EE202-17L CS207	CS

CS207	Digital Logic	3	1	2/Spring		
CS401	Intelligent Robots	3	1	3/ Spring	CS109; CS203; MA212	CS
CS308	Computer Vision	3	1	3/ Spring		CS
CS202	Computer Organization	3	1	2/Spring	EE202-17 EE202-17L CS207	CS
CS306	Data Mining	3	1	3/ Spring	CS203	CS
MA305	Numerical Analysis	3		3/ Fall	MA203a or MA213	MA
MED103	History of Medicine	2		1/ Fall		MED
MED306	Histology and Embryology	3	1	3/ Fall		MED
MED307	Pathology	3	1	3/ Spring	MED204; MED205; MED306	MED
MED404	Medical Genetics	3		3/ Fall	BIO202; MED204; MED205	MED
MED309	Medical Neurobiology	3		3/ Fall		MED
ME112	Introduction to Matlab	2	1	1/Spring		ME
ME232	Prolegomenon to Robotics	3		1/Spring		ME
ME102	CAD and Engineering Drawing	3	1.5	1/Fall		ME
ME331	Robot Modeling and Control	3			MAE203B	ME
Total		127	28.5			

Note:
(1) A minimum of 23 credits are required from Major Elective Courses (including a minimum of 6 lab credits).
(2) If students have completed the part of Introduction to Majors and have more credits, you can use the course of "Introduction to Biomedical Engineering" and "Introduction to Intelligent Medical Engineering" to exchange the major elective credits.

Table 3: Overview of Practice-based Learning

Program of Intelligent Medical Engineering

Course Code	Course Name	Credits	Practice-based Learning Credits	Terms	Prerequisite	Dept.
BMEB121*	Projects of Science and Technology Innovation	2	2	Start from 1 Spring		BME
BMEB470	Professional Practice	2	2	3/Summer		BME
BMEB491	Undergraduate Thesis	12	12	4/Spring		BME
EE205	Signals and Systems	3	1	2/Fall	MA117	EE
CS203B	Data Structures and Algorithm Analysis B	3	1	2/Fall	CS109	CS
BMEB316	Medical image processing	3	1	3/Fall		BME
BMEB328	Experiment on Intelligence Medical Engineering I	2	2	3/Fall		BME
BMEB329	Experiment on Intelligence Medical Engineering II	2	2	3/Spring	BMEB328	BME
BMEB324	Biomedical Optics Laboratory	2	2	3/Spring	BMEB315	BME
BMEB325	Medical Imaging Systems Laboratory	2	2	3/Spring	BMEB317	BME
BMEB327	Clinical Perception for Biomedical Engineering II	2	2	2/Summer	BMEB326	BME
BIO306	Bioinformatics	4	2	3/Spring	BIO309	BIO
BIO104	General Biology Laboratory	2	2	1/Spring	BIO103 or BIO102B	BIO
BIO309	Computational Biology	3	1	3/Fall		BIO
EE202-17L	Digital Circuit Laboratory	1	1	2/Spring	EE202-17	EE
EE323	Digital Signal Processing	3	1	3/Fall	EE205	EE
EE303	Fundamental of Optoelectronic Technology	3	1	3/Fall	PHY105	EE
EE332	Digital System Design	3	1	3/ Spring	EE202-17	EE
CS205	C/C++ Programming Design	3	1	1/Spring		CS
CS301	Embedded System and Microcomputer Principle	3	1	3/Fall	EE202-17 EE202-17L CS207	CS
CS207	Digital Logic	3	1	2/Spring		CS
CS401	Intelligent Robots	3	1	3/Spring	CS109; CS203; MA212	CS
CS308	Computer Vision	3	1	3/Spring		CS
CS306	Data Mining	3	1	3/Spring	CS203	CS
MED307	Pathology	3	1	3/Spring	MED204; MED205; MED306	MED
MED306	Histology and Embryology	3	1	3/Fall		MED
ME112	Introduction to Matlab	2	1	1/Spring		ME
ME102	CAD and Engineering Drawing	3	1.5	1/Fall		ME
Total		83	48.5			

Curriculum Structure of Intelligent Medical Engineering