

**JORDAN UNIVERSITY OF SCIENCE AND
TECHNOLOGY**



**FACULTY OF ENGINEERING
BIOMEDICAL ENGINEERING DEPARTMENT**

**Course Curriculum for BSc. in
Biomedical Engineering**

JORDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY
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Undergraduate Study Plan

In order to obtain the Degree of Bachelor of Science in Biomedical Engineering at the Jordan University of Science and Technology, the student should successfully complete (159) credit hours distributed as shown in the following table and detailed after it.

Requirements		Compulsory credits			Elective credits	Total
		Lecture	Lab	Total		
University Requirements		15	1	16	9	25
Faculty Requirements	From outside the Faculty	27	2	29	0	29
	From inside the Faculty	0	0	0	0	0
Department Requirements		89	8	97	9	105
TOTAL		-	-	141	18	159

A) University Requirements: (25) credit hours distributed as follows:

1. Sixteen (16) credit hours of Compulsory Courses as shown in the following table:

Course Number	Course Title	Credit Hours	Weekly Hours		Pre. Course
			Lecture	lab	
Arab 101	Arabic 1	3	3	0	----
Arab 103	Arabic Language Lab.	1	0	3	Arab 101 or with
Engl 111	English 1	3	3	0	----
Engl 112	English 2	3	3	0	Engl 111
CIS 100	Computer Skills	3	3	0	----
* MS 100	Military Science	3	3	0	----
Total		16			

Note:

Non-Arabic speakers take special courses in Arabic Language; these are:-

- Arab 101 A: Arabic Language for Non-Arabic speakers (3 credit hours instead of Arab 101)
- Arab 103 A: Arabic language laboratory for Non-Arabic speaker. (1 credit hour).

* Must be taken by Jordanian students only. The grade of this course is "Pass" or "Fail". Students who are graduate from military schools or institutes are exempted. For non-Arabic speakers an elective course can be taken as a substitute. In this case the grade of the elective course is counted in collection of their average.

2. Nine (9) credit hours of elective courses selected from the following table.

Course Number	Course Title	Credit Hours	Weekly Hours		Pre. Course
			Lecture	lab	
HSS 112	Hadith Shareef	3	3	0	----
HSS 113	Aqideh	3	3	0	----
HSS 114	Fekeh	3	3	0	----

HSS	115	Islam and Recent Problems	3	3	0	----
HSS	116	Islamic Economy System	3	3	0	----
HSS	121	Principles of Sociology	3	3	0	----
HSS	122	Intr. to Anthropology	3	3	0	----
HSS	123	Intr. to Educational Science	3	3	0	----
HSS	124	Education System in Jordan	3	3	0	----
HSS	125	Intr. to Philosophy	3	3	0	----
HSS	126	Principles of Psychology	3	3	0	----
HSS	127	Educational Technology	3	3	0	----
HSS	131	Islamic Civilization	3	3	0	----
HSS	132	The History of Jerusalem	3	3	0	----
HSS	134	Human Rights	3	3	0	----
HSS	136	Law in our life	3	3	0	----
HSS	141	Principles of Economics	3	3	0	----
HSS	142	Libraries, Information, and Search	3	3	0	----
HSS	151	Principles of Management	3	3	0	----
HSS	161	Contemporary Problems	3	3	0	----
HSS	211	Principles of Psychology in English	3	3	0	----
HSS	221	Principles of Sociology in English	3	3	0	----
HSS	231	History of Science in Islam	3	3	0	----
HSS	429	The Science of Behaving and dealing with children	3	3	0	----
ES	103	Environment Protection	3	3	0	----
NURS	100	Health strengthening	3	3	0	----
PHAR	104	Drugs Uses and Side Effects	3	3	0	----
PH	104	Society Health and Feeding	3	3	0	----
PH	200	First Aid Emergency Procedures	3	3	0	----
VET	211	Animal health (for non Veterinary Medicine and Agriculture students)	3	3	0	----
NR	200	Natural Resources and Humans	3	3	0	----
ME	211	Principle of cars maintenance	3	3	0	----
AGRI	200	The Home Garden	3	3	0	----
AGRI	201	Bee Keeping (for non Agriculture Students)	3	3	0	----

B) College Requirements: (29) credit hours as shown below:

Course Number	Course Title	Credit Hours	Weekly Hours		Pre. Course
			Lecture	lab	
A:- Mathematics Courses.					
MATH 101	Calculus I	3	3	0	
MATH 102	Calculus II	3	3	0	MATH 101
MATH 201	Intermediate Analysis	3	3	0	MATH 102
MATH 203	Ordinary Differential Equations	3	3	0	MATH 102
B:- Physics Courses.					
PHYS 101	General Physics I	3	3	0	
PHYS 102	General Physics II	3	3	0	PHYS 101
PHYS 107	General Physics Lab.	1	0	3	PHYS 102 or with
C:- Chemistry Courses.					
CHEM 101	General Chemistry I	3	3	0	
CHEM 102	General Chemistry II	3	3	0	CHEM 101

CHEM 107	General Chemistry Lab.	1	0	3	CHEM 102 or with
D:- Computer & Information Technology courses Courses.					
CS 115	Programming in C++ Language	3	3	0	CIS 100
Total		29			

C) Department Requirements: (105) credit hours distributed as follows:

1. Compulsory courses which comprise 96 credit hours in the following areas:

◆ **Biomedical Engineering Courses (47 Credit Hours).**

Course Number	Course Title	Credit Hours	Weekly Hours		Pre. Course
			Lecture	lab	
BME 300	Signals and Systems	3	3	0	EE 204, EE 212
BME 310	Biostatistics	3	3	0	---
BME 321	Medical Electronics I	3	3	0	EE 212
BME 322	Medical Electronics II	3	3	0	BME 321
BME 328	Electronic Circuits Lab	1	0	3	EE 322
BME 400	Physiological Fluid Mechanics	3	3	0	Math 203, ME 331
BME 420	Digital Signal Processing & Pattern Recognition	4	4	0	EE 300, BME 310
BME 430	Biomedical System Analysis	3	3	0	Math 203, MED 236A
BME 441	Biomedical Instrumentation I	3	3	0	BME 300 (BME 322 with)
BME 442	Biomedical Instrumentation II	3	3	0	BME 441
BME 443	Biomedical Instrumentation Lab I	1	0	3	BME 441
BME 490	Engineering Training	3	3	0	Completion of 120 C.H
BME 531	Biomedical Transport	3	3	0	BME 400
BME 541	Biomedical Sensors	3	3	0	BME 322
BME 544	Biomedical Instrumentation Lab II	1	0	3	BME 442
BME 550	Diagnostic Techniques	3	3	0	BME 441
BME 560	Biomedical Engineering Seminar	0	1	0	5 th – Year level
BME 591	Biomedical Graduation Project I	1	0	3	BME 441
BME 592	Biomedical Graduation Project II	3	3	0	BME 591
Total		47			

◆ **Electrical Engineering Courses (15 Credit Hours).**

Course Number	Course Title	Credit Hours	Weekly Hours		Pre. Course
			Lecture	lab	
EE 200	Engineering Drawing	1	0	3	CIS 100
EE 204	Linear Algebra	3	3	0	Math 201,CIS 100
EE 212	Electric Circuits	3	3	0	Phys 102 , (Math 203 with)
EE 302	Numerical Analysis	3	3	0	EE 204, CIS 115
EE 316	Electric Circuits Lab	1	0	3	EE 212
EE 412	Control System	3	3	0	BME 300
EE 416	Control System Lab	1	0	3	EE 412
Total		15			

◆ **Mechanical Engineering Courses (13 Credit Hours).**

Course Number	Course Title	Credit Hours	Weekly Hours		Pre. Course
			Lecture	lab	
ME 161	Engineering Workshops	2	2	0	----
ME 161A	Engineering Workshops Lab	0	0	0	----
ME 215	Engineering Mechanics	3	3	0	Phys 101
ME 261	Engineering Economics	2	2	0	----

ME 331	Fluid Mechanics I	3	3	0	Phys 101, Math 203
ME 341	Thermodynamics I	3	3	0	Phys 101, Math 102
Total		13			

◆ **Faculty of Computer & Information Technology (6 Credit Hours).**

Course Number	Course Title	Credit Hours	Weekly Hours		Pre. Course
			Lecture	lab	
CPE 254	Digital Logic Design	3	3	0	CS 115
CPE 353	Microprocessors and computer architecture	3	3	0	CPE 254
Total		6			

◆ **Faculty of Sciences Courses (11 Credit Hours).**

Course Number	Course Title	Credit Hours	Weekly Hours		Pre. Course
			Lecture	lab	
Bio 103	General Biology I	3	3	0	
Bio 107	General Biology Lab	1	0	3	Bio 103 or with
Chem 217	Organic Chemistry	3	3	0	Chem 101 or
Chem 218	Organic Chemistry lab	1	0	3	Chem 217 or with
Chem 362	Biochemistry	3	3	0	Chem 217
Total		11			

◆ **Faculty of Medical Sciences Courses (4 Credit Hours).**

Course Number	Course Title	Credit Hours	Weekly Hours		Pre. Course
			Lecture	lab	
MED 236A	Physiology	3	3	0	Bio 103, Bio 107
MED 236B	Physiology Lab	1	0	3	MED 236A or with
Total		4			

2. Department Elective Courses: (9 Credit Hours)

The student is required to complete an additional 9 credit hours from the Biomedical engineering courses given in the following table.

COURSE #	COURSE TITLE	C.H.	PRE-REQUISITE
BME 410	Materials Science	3	ME 215
BME 510	Introduction to Biomaterials	3	BME 410, MED 236A
BME 520	Image Processing	3	BME 420
BME 532	Control Communication in the Nervous System	3	EE 412, MED 236A
BME 533	Biomedical Engineering Design	3	BME 442
BME 534	Control of Human Limbs and their Artificial Replacements	3	ME 215, MED 236A
BME 535	Biomechanics of Movement	3	ME 215, MED 236A
BME 536	Biomechanics of Aging	3	ME 215, MED 236A
BME 537	Mechanics of Deformable Bodies	3	ME 215
BME 538	Advanced Fluid Mechanics in Engineering and Biology	3	ME 331, MED 236A
BME 543	Cardiovascular Instrumentation	3	BME 442, MED 236A
BME 551	Magnetic Resonance Imaging (MRI)	3	BME 322
BME 552	Therapeutic Techniques	3	5 th –Year Level
BME 580A	Special Topics in Biomedical Engineering	3	5 th – Year Level
BME 580B	Special Topics in Biomedical Engineering	2	5 th – Year Level
BME 580C	Special Topics in Biomedical Engineering	1	5 th – Year Level

Course Numbering

To facilitate course numbering, the second digit in a course number is related to the area as follows :

- 0 : Basic Courses**
- 1 : Materials**
- 2 : Signals and Systems**
- 3 : Biomedical Systems**
- 4 : Biomedical Instrumentation**
- 5 : Biomedical Techniques**
- 6 : Seminars**
- 8 : Special Topics in Biomedical Engineering**
- 9 : Graduation Projects**

The following notation will also be used :

- C : Credit Hours**
- H : Lecture Hours**
- L : Laboratory Hours**

Study Plan
Biomedical Engineering Department

First Year

First Semester

Course #	Course Name	C.H.	Pre.	Co.	Course classification
Math 101	Calculus I	3	----	----	Theoretical
Phys 101	General Physics I	3	----	----	Theoretical
Chem 101	General Chemistry I	3	----	----	Theoretical
Engl 111	English 1	3	----	----	Theoretical
CIS 100	Computer skills	3	----	----	Theoretical
MS 100	Military Science	3	----	----	Theoretical
Total		18			

Second Semester

Course #	Course Name	C.H.	Pre.	Co.	Course classification
Math 102	Calculus II	3	Math 101	----	Theoretical
Phys 102	General Physics II	3	Phys 101	----	Theoretical
Phys 107	General Physics Lab	1	----	Phys 102	Practical
Chem 102	General Chemistry II	3	Chem 101	----	Theoretical
Chem 107	General Chemistry Lab	1	----	Chem 102	Practical
Arab 101	Arabic Language	3	----	----	Theoretical
Arab 103	Arabic Lab	1	----	Arab 101	Practical
Engl 112	English 2	3	Engl 111	----	Theoretical
Total		18			

Second Year

First Semester

Course #	Course Name	C.H.	Pre.	Co.	Course classification
Math 201	Intermediate Analysis	3	Math 102	----	Theoretical
Math 203	Ordinary Differential Equations	3	Math 102	----	Theoretical
ME 161	Engineering Workshops	2	----	----	Theoretical
ME 161A	Engineering Workshops Lab	0	----	----	Practical
Chem 217	Organic Chemistry	3	Chem 102	----	Theoretical
CS 115	Programming in C++ Language (C++ Language Lab)	3 0	CIS 100	----	Theoretical Practical
Bio 103	General Biology I	3	----	----	Theoretical
Bio 107	General Biology Lab	1	----	Bio 103	Practical
Total		18			

Second Semester

Course #	Course Name	C.H.	Pre.	Co.	Course classification
EE 200	Engineering Drawing	1	CIS100	----	Theoretical + Practical
ME 215	Engineering Mechanics	3	Phys 101	----	Theoretical
ME 261	Engineering Economics	3	----	----	Theoretical
EE 204	Linear Algebra	3	Math	----	Theoretical

			, CIS 100		
EE 212	Electric Circuits	3	Phys102	Math 203	Theoretical
Chem 218	Organic Chemistry Lab	1	----	Chem 217	Practical
***	University Elective	3	----	----	Theoretical
Total		16			

Third Year

First Semester

Course #	Course Name	C.H.	Pre.	Co.	Course classification
BME 300	Signals and Systems	3	EE 204, EE 212	----	Theoretical
EE 316	Electric Circuits Lab	1	EE 212	----	Practical
BME 321	Medical Electronics I	3	EE 212	----	Theoretical
ME 331	Fluid Mechanics I	3	Phys 101, Math 203	----	Theoretical
MED 236 A	Physiology	3	Bio 103, Bio 107	----	Theoretical
MED 236 B	Physiology Lab	1	---	MED 236A	Practical
CPE 254	Digital Logic Design	3	CIS 100	----	Theoretical
Total	17				

Second Semester

Course #	Course Name	C.H.	Pre.	Co.	Course classification
BME 310	Biostatistics	3	----	----	Theoretical
BME 322	Medical Electronics II	3	BME 321	----	Theoretical
Chem 362	Biochemistry	3	Chem 217	----	Theoretical
ME 341	Thermodynamics I	3	Phys 101, Math 102	----	Theoretical
BME 441	Biomedical Instrumentation I	3	BME 300	BME 322	Theoretical
Total	15				

Fourth Year

First Semester

Course #	Course Name	C.H.	Pre.	Co.	Course classification
EE 302	Numerical Analysis	3	EE 204, CS 115	----	Theoretical
EE 328	Electronic Circuits Lab	1	BME 321	----	Practical
EE 412	Control Systems	3	BME 300	----	Theoretical
CIE 353	Microprocessors and computer architecture	3	CPE 254	----	Theoretical
BME 442	Biomedical Instrumentation II	3	BME 441	----	Theoretical
***	University Elective	3	----	---	Theoretical
Total	16				

Second Semester

Course #	Course Name	C.H.	Pre.	Co.	Course classification
EE 416	Control Systems Lab	1	EE 412	----	Practical
BME 400	Physiological Fluid Mechanics	3	Math 203, ME 331	----	Theoretical
BME 420	Digital Signal Processing and Pattern Recognition	4	EE 300, BME 310	----	Theoretical
BME 430	Biomedical System Analysis	3	Math 203, MED 236A	----	Theoretical
BME 443	Biomedical Instrumentation Lab I	1	BME 441	----	Practical
***	University Elective	3	----	----	Theoretical
Total	15				

Summer Semester

Course #	Course Name	C.H.	Pre.	Course classification	Remarks
BME 490	Engineering Training	3	Completion of 120 C.H.	Practical	8 weeks to be takes in accredited establishments

Fifth Year

First Semester

Course #	Course Name	C.H.	Pre.	Co.	Course classification
BME 531	Biomedical Transport	3	BME 400	----	Theoretical
BME 541	Biomedical Sensors	3	BME 322	----	Theoretical
BME 544	Biomedical Instrumentation Lab II	1	BME 442	----	Practical
BME 560	Biomedical Engineering Seminar	0	Fifth-year level	----	Theoretical
BME 591	Biomedical Graduation Project I	1	Fifth-year level,	----	Theoretical + Practical
***	Department Elective	3	+	----	Theoretical
***	University Elective	3	----	----	Theoretical
Total		14			

Second Semester

Course #	Course Name	C.H.	Pre.	Co.	Course classification
BME 550	Diagnostic Techniques	3	BME 441	----	Theoretical
BME 592	Biomedical Graduation Project II	3	BME 591	----	Theoretical + Practical
***	Department Elective	3	+	----	Theoretical
***	Department Elective	3	+	----	Theoretical
Total		12			

+ Prerequisite depends on the chosen elective course.

*****Description of Biomedical Technical Courses*****

BME 400 Physiological Fluid Mechanics (3C, 3H)

Basic concepts and problems of fluid and solid mechanics are introduced and applied to the analysis of blood flow in the macro and micro-circulation, and to other physiological flows. Analysis of mathematical models is combined with discussions of physiological mechanisms.

BME 410 Materials Science (3C, 3H)

Metals structure and recrystallization, materials in engineering applications, plastic deformation on micro and macro structure levels, materials failure, heat treatment processes.

BME 420 Digital Signal Processing and Pattern Recognition (4C, 4H)

Discrete signals and systems, discrete and fast Fourier transform, design of non-recursive filters, design of recursive filters, spectral analysis and processing of biomedical signals, introduction to pattern recognition, decision functions, statistical decision theory, cluster analysis and feature selection.

BME 430 Biomedical System Analysis (3C, 3H)

Design of system elements, prosthesis, materials, case studies of biomechanical system examples, computer-aided design methods, design of subsystems, product reliability.

BME 441 Biomedical Instrumentation I (3C, 3H)

Basic concepts of instrumentation, transducer principles, amplifiers, origin of biopotentials, blood flow and pressure measurement, data acquisition, respiratory system measurements, patient safety.

BME 442: Biomedical Instrumentation II (3C, 3H)

Concepts of analogue and digital circuits design, filters, interfacing with minicomputers, measurement of temperature, force, blood flow, and respiratory system, vital signals: ECG, EEG, EMG, Medical imaging lasers and applications.

BME 443: Biomedical Instrumentation Lab I (1C, 3L)

Measurements errors, signal conditioning, amplification, filtration, processing, A/D and D/A converters, interfacing with digital computers, medical measuring devices: flow, pressure, potentials, force, biomedical properties.

BME 490 Engineering Training (3C)

Eight weeks to be taken in accredited establishments.

BME 510 Introduction to Biomaterials (3C, 3H)

Introduction to important materials with engineering application, properties, biocompatibility characteristics, performance requirements of materials for implants, case studies.

BME 520 Image Processing (3C, 3H)

Two-dimensional discrete systems, design of two-dimensional filters, digital image processing, human perception of images, colour models, picture processing, sampling and data compression, picture enhancement, restoration and analysis, hardware and software implementation.

BME 531: Biomedical Transport (3C, 3H)

Principles of momentum, heat, and mass transfer with applications to medical and biological systems and medical device design.

BME 532 Control and Communication in the Nervous System (3C, 3H).

An introduction to the structural and functional elements common to nervous systems with emphasis on cellular dynamics, interneuronal communication, sensory and effector system.

BME 533 Biomedical Engineering Design (3C, 3H)

Design strategy and concepts, including reliability , safety , ethics, economic analysis, and marketing, FDA regulations and patents.

BME 534 Control of Human Limbs and their Artificial Replacements (3C, 3H).

Human movement, biomechanics, skeletal and muscular anatomy, comparative anatomy, muscle physiology, and locomotion. engineering design of artificial limbs.

BME 535 Biomechanics of Movement (3C, 3H).

Engineering mechanics applied to analyze human movement, including models of muscle and tension, kinematics of joints, and dynamics of multijoint movement. Applications in sports, rehabilitation, and orthopaedics.

BME 536 Biomechanics of Aging (3C, 3H).

Techniques to quantify biomechanical /electrical characteristics of hard and soft tissues, kinetics of body segments during daily activities, effect of age on hard and soft tissues, joints, nervous system, hearing , vision , cardiovascular system, spine, surgical procedures to alleviate pain, restore joint function, preventive measures to reduce fracture.

BME 537 Mechanics of Deformable Bodies (3C, 3H).

Elementary theory of deformable bodies, stress, strain, application of equilibrium analysis, strain-displacement relation, constitutive relationships to practical structural system and elementary plane elasticity problems.

BME 538 Fluid Mechanics in Engineering and Biology (3C, 3H).

Derivation of fluid mechanical principles and their applications to engineering and biomedical problems. Techniques of dimensional scaling, approximations, linear and nonlinear analysis and perturbation. Topics include kinematics, momentum balance, mass balance, kinematics and stress boundary conditions, and surface-tension phenomena, vorticity dynamics, potential flow, compressibility effects, waves, viscous flow, boundary layers, fluid-elastic interactions, heat and mass transport.

BME 541 Biomedical Sensors (3C, 3H).

Principles and fundamentals of transducers: dynamic, linearity, hysteresis, and frequency range, blood flow and volume measurement, temperature measurement, muscle contraction transducers, bipotential measurements, radioactive sensors, optical fiber sensors, electrochemical and optical sensors.

BME 543 Cardiovascular Instrumentation (3C, 3H).

Theory, design, and application of instrumentation used for diagnosis, monitoring, treatment, and research investigation of cardiac and cardiovascular diseases. Examples from the current literature.

BME 544: Biomedical Instrumentation Lab II (1C, 3L)**BME 550 Diagnostic Techniques (3C, 3H)**

Fundamental concepts of wave propagation, absorption and dispersion of ultrasound, microwave and radio frequency currents, wave interaction with tissues, sources of ultrasound , receiving and measuring techniques , focusing system , introduction to one and two dimensional diagnostic arrays.

BME 551 Magnetic Resonance Imaging (MRI) (3C, 3H).

Principles of MRI, magnetic field modalities, relaxation time, gradient and RF inductors, RF impulse sequences, image reconstruction, magnetic resonance spectroscopy.

BME 552: Therapeutic Techniques (3C, 3H).

Principles of therapy, principles and techniques of radiotherapy, EM and RF current therapy, ultrasound therapy, principles of physical therapy, ultrasound and EM energy generation, personal safety.

BME 560: Biomedical Engineering Seminar (0C)

Professional aspects of biomedical engineering presented through lectures and discussions by guest speakers, field trips, films, panel discussions; may be repeated

BME 580A Special Topics in Biomedical Engineering (3C, 3H).**BME 580B Special Topics in Biomedical Engineering (2C, 2H).****BME 580C Special Topics in Biomedical Engineering (1C, 1H).****BME 591 Biomedical Graduation Project I (1C, 1H)**

Technical, regulatory, economic, legal, social and ethical aspects of medical device systems, engineering design.

BME 592 Biomedical Graduation Project II (3C , 3H)
Continuation of Design Project I.

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