

**IZMIR INSTITUTE OF TECHNOLOGY  
FACULTY OF ENGINEERING  
DEPARTMENT OF BIOENGINEERING  
UNDERGRADUATE PROGRAM**

**COURSE CONTENTS**

**BE101 INTRODUCTION TO BIOENGINEERING (2-0)2 ECTS:3**

This course covers topics related to bioengineering and its sub-branches, areas of study, current status and future, and introducing research conducted by faculty in the department.

**CHEM121 GENERAL CHEMISTRY I (3-0)3 ECTS:5**

Atoms and atomic theory, mole concept, nomenclature, chemical reactions, aqueous solutions, gases and properties, thermochemistry, electrons in atoms.

**CHEM141 GENERAL CHEMISTRY LABORATORY I (0-2)1 ECTS:2**

Measurement and density, Stoichiometry of a reaction, titration of acids and bases, oxidation-reduction reaction, gas analysis based on molar volume, thermochemistry, precipitation reaction, gravimetric and volumetric analysis.

**ENG101 DEVELOPMENT OF READING AND WRITING SKILLS I (3-0)3 ECTS:3**

This is a course that aims to develop skills to analyze paragraphs and essays, reading skills and written and spoken communication skills.

**MATH141 BASIC CALCULUS I (3-2)4 ECTS:5**

Functions, Limits and continuity, Derivatives, Extreme values, the Mean Value Theorem and its applications, Graphing. Integration, Fundamental theorem of Calculus, L'Hopital's Rule, Techniques of integration, Area between two curves.

**MBG101 BIOLOGY I (3-0)3 ECTS:5**

Introduce students to the complex biological molecules and cellular structures and make them familiar with the underlying concepts of biological processes such as metabolism, inheritance, and cell communication at both molecular and cellular levels.

**PHYS121 GENERAL PHYSICS I (3-2)4 ECTS:7**

Scientific notation, length, time, mass, unit systems, accuracy and significance, dimensional analysis. Motion along a straight line. Motion in two and three dimensions. Force and Motion. Newton's Laws and their applications. Kinetic Energy, work, power, potential energy and energy conservation. Systems of particles. Linear momentum. Collisions and the center of mass. Rotation and Rotational kinetic energy, angular momentum and its conservation, Torque, work and energy in angular momentum. Equilibrium and elasticity. Gravitation. Newton's law of gravitation, gravitational potential energy, planets and satellites.

**BE102 INTRODUCTION TO PROGRAMMING (2-2)3 ECTS:5**

This course is designed as an introductory course in computational techniques for solving arithmetical applications from bioengineering students.

**CHEM122 GENERAL CHEMISTRY II (3-0)3 ECTS:6**

Chemical bonding, Liquids Solids and Intermolecular forces, Solutions and their physical properties, Chemical kinetics, Chemical equilibrium.

**CHEM142 GENERAL CHEMISTRY LABORATORY II (0-2)1 ECTS:2**

Determination of water hardness, soap synthesis, steam distillation, Molecular weight determination, kinetic study of reaction between ferric and iodide ions, Chemical equilibrium, weak acids weak bases and their salts, An investigation of voltaic cells

**ENG102 DEVELOPMENT OF READING AND WRITING SKILLS II (3-0)3 ECTS:3**

This is a course which aims to equip students with the skills to analyze essays and articles, to write an organized essay and article, to make presentations, to take notes while listening and reading skills, which will help them in their academic studies.

**MATH142 BASIC CALCULUS II (3-2)4 ECTS:7**

Integration Techniques, Improper Integrals; Tests for Convergence, Sequences and Infinite series; Tests for Convergence, Polar Coordinates, Multivariable Functions and Their Derivatives, Double integral, Double Integral in Polar Coordinates.

**PHYS122 GENERAL PHYSICS II (3-2)4 ECTS:7**

The course covers electricity, including charge, electrostatics, Gauss law, electric field, electric potential, simple circuits, and electric currents and magnetic fields including magnetic forces, induction, electromagnetic radiation, Ampere's law, Faraday's law and the origins of electromagnetic waves.

**BE201 MATTER AND ENERGY EQUATIONS IN ENGINEERING (3-0)3 ECTS:5**

This course will introduce the basics of material and energy conservation principles in engineering and their applications to bioengineering problems using examples of biochemical reactions, bioprocesses and biomedical systems.

**BE203 MOLECULAR BIOLOGY (3-0)3 ECTS:5**

Molecular biology deals with nucleic acids and proteins and examines how these molecules regulate proper growth, division and development in cells. In this course, students will learn the molecular mechanisms of DNA replication, repair, transcription, protein synthesis, and gene regulation in different tissues. The techniques that revealed these mechanisms and the experiments that are used to distinguish these mechanisms will also be in the course. Protein structure and function, and protein interactions with nucleic acids will also be discussed.

**BE205 FUNDAMENTALS OF ELECTRIC AND ELECTRONIC CIRCUITS (3-0)3 ECTS:3**

The course aims to inform and educate Bioengineering students about the fundamental electrical and electronic circuit theory concepts and their usages. The knowledge gained during the course will be helpful to the students at their undergraduate and postgraduate lives.

**CHEM221 ORGANIC CHEMISTRY (4+0)4 ECTS:5**

Carbon compounds & chemical bonds, alkenes, cycloalkanes, conformational analysis, stereo chemistry, nucleophilic substitution, alkenes, alcohols, ethers, radical reactions, aromatic compounds

**ECON205 PRINCIPLES OF ECONOMICS (3-0)3 ECTS:3**

The course offers students the knowledge on the definition of economics, macro and micro economics and monetary policy and fiscal policy.

**MATH255 DIFFERENTIAL EQUATIONS (4-0)4 ECTS:5**

First order equations and various applications. Higher order linear differential equations. Power series solutions: ordinary and regular singular points. The Laplace transform: solution of initial value problems. Systems of linear differential equations: solutions by operator method, by Laplace transform.

**BE202 NUMERIC METHODS IN ENGINEERING I (3-0)3 ECTS:5**

Introduction to numerical methods, finding roots of equations, numerical differentiation and integration, numerical solution of first ODE, Euler, modified Euler and Runge-Kutta methods, solution of the second order differential equations, interpolation, curve fitting with least square method, solution of elliptic PDE.

**BE204 THERMODYNAMICS (3-0)3 ECTS:5**

This course will convey the foundations of thermodynamics at introductory level along with the physicochemical basis at molecular level.

**BE206 FLUID MECHANICS (3-0)3 ECTS:5**

Definition of fluid and their types based on deformation rate. Concept of shear stress. Fluid statics. Stability of floating objects. Lagrangian and Eulerian approaches. Conservation of mass and momentum in integral sense.

**BE208 BIOCHEMISTRY (3-0)3 ECTS:5**

Metabolism and bioenergetics: basic principles, carbohydrates, carbohydrate metabolism, lipids, lipid metabolism, amino acids and proteins, digestion and degradation of proteins, enzymes, hormones and vitamins, coordination and control of metabolism.

**BE300 SUMMER PRACTICE I (NC) ECTS:7**

Internship requires an attendance of 4 weeks to a selected workplace for experience. During this time course, students practice applications, familiarize with workplace structure and join projects. Students should follow the instructions stated in İYTE Faculty of Engineering Internship Guide in order to successfully complete their internships.

**BE301 TRANSPORT PHENOMENA IN BIOLOGICAL SYSTEMS (3-0)3 ECTS:4**

This course will convey the foundations of heat, mass and momentum transfer and builds on this knowledge base to analyze the systems and problems related to bioengineering and physiological applications (**Prerequisite BE206**).

**BE303 BIOMEDICAL INSTRUMENTATION I (3-0)3 ECTS:4**

This course will cover the principles of biomedical instrumentation, including biochemical sensors, bio-potential amplifiers, bioelectrical signals (ECG, EEG), measurement of respiratory function, cardiac variables, blood pressure, blood flow (**Prerequisite BE205**).

**BE305 STATISTICAL TOOLS FOR BIOENGINEERS (3-0)3 ECTS:5**

This course is designed to equip bioengineering students with essential statistical tools to be used for the interpretation of data from biomedical research. Content include variation; probability; distributions; hypothesis testing; ANOVA; distribution free tests; correlation; regression; survival analysis

**BE307 CELL BIOLOGY (3-0)3 ECTS:4**

Following topics will be covered in this course; cell types, history and microscopy methods, cell membrane, membrane substance transport and protein transport, cell adhesion, extracellular matrix, cell wall, cell skeleton and movement, organelles and functions, cell nucleus, cell signal receptors and pathways, stem cells, mitosis and meiosis, cell cycle and cancer (**Prerequisite MBG101**).

**BE309 BIOMATERIALS (3-0)3 ECTS:3**

Following topics will be covered in this course; the history and classification of biomaterials, metal-ceramic-polymer and composite based biomaterials, properties of materials, surface modification and characterization methods, interactions of cell/tissue/body fluids with biomaterials, mechanical and biocompatibility tests, quality assessments, biomaterials used in tissue engineering and implant industry.

**ENG301 TECHNICAL WRITING AND COMMUNICATION (3-0)3 ECTS:2**

Introduction to Technical Writing, How to Write the Materials and Methods Section, How to Write the Results, How to Design Effective Tables and Illustrations, How to Write the Introduction, How to Cite the References, Use and Misuse of English. A technical Writing will be assigned to each student.

**ME231 MATERIALS SCIENCE AND ENGINEERING (3-0)3 ECTS:3**

Types of materials, crystal structures and atomic bonding, mechanical properties of metals, polymers and ceramics, phase transformations and diagrams, electrical, thermal and optical properties of materials

**BE302 BIOPROCESS ENGINEERING (3-0)3 ECTS:5**

This course contains fundamentals of bioprocess engineering, operation modes, types of bioreactors and bioreactor design, scale-up and separation & purification steps (**Prerequisite BE201**).

**BE304 PHYSIOLOGY (3-0)3 ECTS:5**

Functional mechanisms of various systems that constitute the human body at cellular, tissue and organ levels.

**BE306 BIOMEDICAL INSTRUMENTATION II (3-0)3 ECTS:5**

This course covers the principles of biomedical imaging. Particularly, students will study the physics, acquisition techniques and signal processing underlying conventional X-ray, Computerized Tomography (CT), Single Photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET), Ultrasound and Magnetic Resonance Imaging (MRI).

**BE308 MEDICAL SENSORS (3-0)3 ECTS:4**

This course covers the principles of medical sensors. Particularly, students will explore fundamental principles and methods used for physiological signal conditioning, techniques used to detect and convert physiological information's to electrical signals, biosensors and sensor technologies.

**BE310 BIOENGINEERING LAB I (0-4)2 ECTS:6**

Sterilization and preparation of nutrient media, pure culture techniques, staining of microorganisms, determination of biomass concentration, storage methods of microorganisms, transformation to *E.coli*, isolation of plasmid, cutting with restriction enzymes and gel running, biomass production with *E.coli*, production of microbial enzyme and activity test.

**BE400 SUMMER PRACTICE II (NC) ECTS:7**

Internship requires an attendance of 4 weeks to a selected workplace for experience. During this time course, students practice applications, familiarize with workplace structure and join projects. Students should follow the instructions stated in İYTE Faculty of Engineering Internship Guide in order to successfully complete their internships.

**BE401 DESIGN IN BIOENGINEERING I (3-0)3 ECTS:7**

Process design and adaptation of engineering systems to contemporary chemical systems. Cost analysis and project assessment. Unit design and operation. Equipment used in Chemical Industry. Momentum, mass and heat transfer application in Bioengineering. Optimization of constant and variable cost analysis. And control mechanisms.

**BE402 DESIGN IN BIOENGINEERING II (2-4)3****ECTS:10**

Process design and adaptation of engineering systems to contemporary chemical systems. Cost analysis and project assessment. Unit design and operation. Equipment used in Chemical Industry. Momentum, mass and heat transfer application in Bioengineering. Optimization of constant and variable cost analysis. And control mechanisms.

**BE403 BIOENGINEERING LAB II (2-4)3****ECTS:7**

Observing the cell morphology, cell counting, preparation of monolayer culture, cell preservation, storage, transportation and thawing procedures, determination of pressure loss in piped systems, gas diffusion, and mass transfer coefficient, learning separation and purification techniques, enzyme kinetics, immobilization, bioinformatics.

**BE404 BIOENGINEERING LAB III (0-4)2****ECTS:10**

Students perform theoretical or/and experimental study by using information obtained from undergraduate education of Bioengineering program. Course contains conduct of the given research problem, also, report and present.

**BE406 ETHICS IN BIOENGINEERING (2-0)2****ECTS:4**

Scientists and engineers in all areas will encounter ethical dilemmas in their professional practice. This course helps students develop a deeper understanding of what it means to be a responsible bioengineer. Topics include data misinterpretation, medical technologies, genetic modification, intellectual property, ownership of human material, privacy and access to data, and environmental issues.

**ELECTIVE COURSES****BE407 APPLICATIONS OF BIOTECHNOLOGY IN PHARMACEUTIAL SECTOR (3+0) 3****ECTS:3**

This course covers introduction to biotechnology, the role of biotechnology in drug development and production, related basic concepts and applications, process validation for biopharmaceuticals; posttranslational modifications for pharmaceutical development; chromatography-based separation of biopharmaceuticals; microarrays; formulation and delivery issues of biopharmaceuticals; pharmacokinetics and pharmacodynamics; gene therapy; biosimilar; clinical trials; individualized therapy; metabonomics.

**BE408 ENZYME KINETICS AND TECHNOLOGIES (3+0)3****ECTS:3**

This course will focus on: revision of the concepts of enzymatic catalysis, characteristics of enzymes, factors that influence the kinetic behavior of enzymes, activation and enzymatic inhibition, cofactors, catalytic mechanisms, purification techniques of enzymes, production and immobilization of biocatalysts, advantages and disadvantages, and enzyme applications in the food and chemical industry.

**BE409 INTRODUCTION TO BIOMOLECULAR ENGINEERING(3+0)3 ECTS: 3**

Biomolecular engineering deals with the application of biomolecules, that decode genomes and play a role in energy conversion in cells, in areas such as health care and medicine. This course includes primarily the structure and functioning of biomolecules, enzymatic catalysis, metabolism of macromolecules and molecular recognition. In addition to these, the design of proteins and nucleic acids will be introduced.

**BE410 INTRODUCTION TO TISSUE ENGINEERING (3+0)3****ECTS:3**

Following topics will be covered in this course; introduction to tissue engineering and ethics, cell and tissue types, extracellular matrix and its components, selection of natural and synthetic materials for tissue engineering applications, basics of animal cell culture, stem cell harvesting and applications in tissue engineering, scaffold design and 3-D tissue modelling, tissue engineering methods, artificial tissues and organs, controlled drug release mechanisms and applications in tissue engineering.

**BE411 BIOMECHANICS (3+0)3****ECTS:3**

Introduction to Biomechanics, Cell and its organelles, Cellular Biomechanics, Measurements of Cellular Biomechanical Behavior, Mechanotransduction, Hemodynamics, Cardiovascular system and circulation, Muscle Biomechanics, Skeletal Biomechanics, Clinical Biomechanics

**BE412 OPTIMIZATION (3+0)3****ECTS:3**

Optimization and engineering applications, graphical optimization, classical optimization techniques, multivariable optimization, geometric programming.

**BE413 SCIENTIFIC RESEARCH TECHNIQUES (3+0)3****ECTS:3**

This course will provide an opportunity for participants to establish or advance their understanding of research through critical exploration of research language, ethics, and approaches. The course introduces the language of research, ethical principles and challenges, and the elements of the research process within quantitative, qualitative, and mixed methods approaches.

**BE414 CONTROLLED DRUG DELIVERY TECHNOLOGIES (3+0)3 ECTS:3**

This course will introduce current drug delivery technologies along with engineering and materials science foundations affecting structural and functional properties. It will focus on topics at the interface between materials science and chemistry, biomaterials, pharmacokinetics, and transport phenomena.

## 2018-2019 CURRICULUM

First Semester			Credit	Prerequisite/corequisite	ECTS
MATH	141	Fundamental Analysis I	(3+2)4		5
PHYS	121	General Physics I	(3+2)4		7
CHEM	121	General Chemistry I	(3+0)3		5
CHEM	141	General Chemistry Lab. I	(0-2)1		2
ENG	101	English Reading and Writing Skills I	(3+0)3		3
MBG	101	Biology	(3+0)3		5
BE	101	Introduction to Bioengineering	(2+0)2		3
				<b>Total: 20 Credits</b>	<b>30</b>

Second Semester			Prerequisite/corequisite	ECTS	
MATH	142	Fundamental Analysis II	(3-2)4	7	
PHYS	122	General Physics II	(3-2)4	7	
CHEM	122	General Chemistry II	(3-0)3	6	
CHEM	142	General Chemistry Lab II	(0-2)1	2	
CS	102	Introduction to Programming	(2-2)3	5	
ENG	102	English Reading and Writing Skills II	(3-0)3	3	
				<b>Total: 18 Credits</b>	<b>30</b>

Third Semester			Prerequisite/corequisite	ECTS	
MATH	255	Differential Equations	(4-0)4	5	
BE	201	Matter and Energy Equations in Engineering	(3-0)3	5	
BE	203	Molecular Biology	(3-0)3	5	
CHEM	221	Organic Chemistry	(4-0)4	5	
BE	205	Fundamentals of Electrics and Electronic Circuits	(3-0)3	3	
ECON	205	Principles of Economics	(3-0)3	3	
HIST	201	Atatürk's Principles I	(2-0)Non-Credit	2	
TURK	201	Turkish Language I	(2-0)Non-Credit	2	
				<b>Total: 20 Credits</b>	<b>30</b>

Fourth Semester			Prerequisite/corequisite	ECTS	
BE	202	Numeric Methods in Engineering	(3-0)3	5	
BE	204	Thermodynamics	(3-0)3	5	
BE	206	Fluid Mechanics	(3-0)3	5	
BE	208	Biochemistry	(3-0)3	5	
ME	231	Material Science and Engineering	(3-0)3	3	
		Non-Technical Elective Course	(3-0)3	3	
HIST	202	Ataturk's Principles II	(2-0)Non-Credit	2	
TURK	202	Turkish Language II	(2-0)Non-Credit	2	
				<b>Total: 18 Credits</b>	<b>30</b>

<b>Fifth Semester</b>				<b>Prerequisite/corequisite</b>	
BE	301	Transport Phenomena in Biological Systems	(3-0)3		4
BE	303	Biomedical Instrumentation I	(3-0)3		4
ENG	301	Technical Writing and Communication	(3-0)3		2
BE	305	Statistical Tools for Bioengineers	(3-0)3		3
BE	307	Cell Biology	(3-0)3		4
BE		Non-Technical Elective Course	(3-0)3		3
BE	309	Biomaterials	(3-0)3		3
BE	300	Summer Internship I	Non-Credit		7
				<b>Total: 21 Credits</b>	<b>30</b>

<b>Sixth Semester</b>				<b>Prerequisite/corequisite</b>	
BE	302	Bioprocess Engineering	(3-0)3		5
BE	304	Physiology	(3-0)3		4
BE	306	Biomedical Instrumentation II	(3-0)3		5
BE	308	Medical Sensors	(3-0)3		4
BE	310	Bioengineering Lab I	(0-4)2		6
		Technical Elective Course	(3-0)3		3
		Non-Technical Elective Course	(3-0)3		3
				<b>Total: 20 Credits</b>	<b>30</b>

<b>Seventh Semester</b>				<b>Prerequisite/corequisite</b>	
BE	401	Design in Bioengineering I	(3-0)3		7
BE	403	Bioengineering Lab II	(2-4)3		7
		Technical Elective Course	(0-4)2		3
		Technical Elective Course	(3-0)3		3
		Technical Elective Course	(3-0)3		3
BE	400	Summer Internship II	(3-0)3		7
				<b>Total: 14 Credits</b>	<b>30</b>

<b>Eight Semester</b>				<b>Prerequisite/corequisite</b>	
BE	402	Design in Bioengineering II	(2-4)4		10
BE	404	Bioengineering Lab II	(0-4)2		10
BE	406	Ethics in Bioengineering	(2-0)2		4
		Technical Elective Course	(3-0)3		3
		Technical Elective Course	(3-0)3		3
				<b>Total: 14 Credits</b>	<b>30</b>
				<b>Total Credits: 145</b>	<b>240</b>