

Üsküdar University
Faculty of Engineering and
Natural Sciences

Department of Bioengineering

Compulsory English Preparatory Class

Curriculum and Course Content

YEAR ONE

1ST TERM

1st Term							
Code	Course Name	T	P	L	C	ECTS	Prerequisite
PHYS101	Physics I*	3	0	2	4	6	
MATH101	Calculus I*	3	2	0	4	6	
CHEM103	Fundamentals of Chemistry*	3	0	2	4	6	
TURK101	Turkish Language I	2	0	0	2	3	
RPSC109	Positive Psychology and Communication Skills	3	0	0	3	5	
RCUL101	University Culture I*	0	2	0	1	1	
ENG101	English I	3	0	0	3	3	
Total Credits		17	4	4	21	30	

YEAR ONE

2ND TERM

2nd Term							
Code	Course Name	T	P	L	C	ECTS	Prerequisite
PHYS102	Physics II*	3	0	2	4	6	
MATH102	Calculus II*	3	2	0	4	6	
CHEM104	Organic Chemistry*	3	0	2	4	6	
TURK102	Turkish Language II	2	0	0	2	3	
BEN102	Introduction to Bioengineering	2	0	0	2	3	
MBG154	General Biology*	2	0	2	3	4	
ENG102	English II	3	0	0	3	3	
RCUL102	University Culture II*	0	2	0	1	1	
Total Credits		18	4	6	23	32	

YEAR TWO

3RD TERM

3rd Term							
Code	Course Name	T	P	L	C	ECTS	Prerequisite
BEN205	Stoichiometry	3	0	0	3	4	
CHEM203	Physicalchemistry	3	0	0	3	4	
BEN209	Cell Biology*	3	0	2	4	5	
MATH203	Differential Equations*	2	2	0	3	5	
XXXXXX	Social Elective I	3	0	0	3	5	
ATA101	Principles of Atatürk and History of Revolutions I	2	0	0	2	3	
RPRE104	Entrepreneurship and Project Culture	2	0	0	2	3	
Total Credits		18	2	2	20	29	

YEAR TWO

4TH TERM

4th Term							
Code	Course Name	T	P	L	C	ECTS	Prerequisite
BEN202	Biochemistry	3	0	0	3	4	
BEN207	Bioengineering Laboratory I*	0	0	4	2	3	
CHE206	Fluid Mechanics and Applications	3	0	0	3	5	
ATA102	Principles of Atatürk and History of Revolutions II	2	0	0	2	3	
BEN216	Kinetics and Reactor Design	3	0	0	3	5	
COME102	Introduction to Algorithms and Programming*	2	0	2	3	4	
BEN284	Summer Practice I**	0	0	0	0	5	
Total Credits		13	0	6	16	29	

YEAR THREE

5TH TERM

5th Term							
Code	Course Name	T	P	L	C	ECTS	Prerequisite
BEN301	Heat and Mass Transfer	3	0	0	3	5	
COME211	Introduction to Programming for Engineers*	1	0	2	2	3	
BEN341	Human Physiology	2	0	0	2	3	
BEN333	General Microbiology*	2	0	2	3	5	
BENXXX	Departmental Elective I	3	0	0	3	5	
XXXXXX	Field Elective I	3	0	0	3	5	
XXXXXX	Social Elective II	3	0	0	3	5	
Total Credits		17	0	4	19	31	

YEAR THREE

6TH TERM

6th Term							
Code	Course Name	T	P	L	C	ECTS	Prerequisite
BEN304	Bioengineering Laboratory II*	0	0	4	2	3	
BEN326	Bioinformatics I	3	0	0	3	4	
XXXXXX	Social Elective III	3	0	0	3	5	
MATH204	Statistics	3	0	0	3	5	
BEN328	Genetic Engineering*	3	0	2	4	5	
BEN384	Summer Practice II**	0	0	0	0	5	
BENXXX	Departmental Elective II	3	0	0	3	5	
Total Credits		15	0	6	18	32	

YEAR FOUR

7TH TERM

7th Term							
Code	Course Name	T	P	L	C	ECTS	Prerequisite
BEN489	Graduation Project*	2	2	0	3	5	
BEN409	Process Dynamics and Control	3	0	0	3	5	
MBG408	Bioethics	2	0	0	2	3	
XXXXXX	Field Elective II	3	0	0	3	5	
BENXXX	Departmental Elective III	3	0	0	3	5	
BENXXX	Departmental Elective IV	3	0	0	3	5	
OHS401	Occupational Health and Safety I	2	0	0	2	2	
Total Credits		18	2	0	19	30	

YEAR FOUR

8TH TERM

8th Term							
Code	Course Name	T	P	L	C	ECTS	Prerequisite
BEN492	Graduation Thesis*	1	8	0	5	8	BEN489
BENXXX	Departmental Elective V	3	0	0	3	5	
BENXXX	Departmental Elective VI	3	0	0	3	5	
XXXXXX	Field Elective III	3	0	0	3	5	
XXXXXX	Field Elective IV	3	0	0	3	5	
OHS402	Occupational Health and Safety II	2	0	0	2	2	
Total Credits		15	8	0	19	30	

Elective Course Pool

Departmental Elective Courses		
Code	Course Name	Prerequisite
BEN206	Biomaterials	
BEN213	Biosensors	
BEN215	Engineering Economics	
BEN217	Bio-CAD Modeling	
BEN218	Introduction to Astrophysics	
BEN221	Biopolymers	
BEN302	Biotransport Process	
BEN310	Bioreactors	
BEN312	Downstream Processes	
BEN313	Biothermodynamics	
BEN314	Introduction to Pathology	
BEN315	Bioprocess Engineering	
BEN317	Introduction to Biotechnology	
BEN321	Medicinal Chemistry	
BEN322	Nanoneurobioscience	
BEN323	Metabolic Engineering	
BEN324	Measurement Techniques: Sensors	
BEN325	Bioelectromagnetic Interactions	
BEN327	Molecular Techniques in Bioengineering*	MBG314
BEN329	Biological Clocks	
BEN331	Genomics	
BEN332	History of Science	
BEN334	Introduction to Nanotechnology	
BEN335	Animal and Plant Physiology	
BEN337	Drug Delivery	
BEN339	Virology	
BEN342	Fundamentals of Immunology	
BEN346	Mathematical Modeling	
BEN351	Bioengineering Project-I	
BEN352	Bioengineering Project-II	
BEN354	Special Topics in Bioengineering	
BEN355	Biomedical Engineering Principles	
BEN402	Computational Bioengineering	
BEN403	Parallel Algorithms for Bioengineers	BEN326
BEN404	Protein Chemistry	
BEN405	Protein Engineering and Synthetic Vaccines	
BEN406	Tissue Engineering	
BEN407	Molecular Modeling	
BEN408	Quantum Chemistry	
BEN410	Basic Principles of Animal Experiments	
BEN412	Bioinformatics-II	
BEN413	Introduction to Radiation Physics	
BEN414	Artificial Intelligence Techniques in Bioengineering	
BEN415	Modelling in Process Safety	
BEN416	Introduction to Biomechanics	
BEN417	Bioengineering Laboratory III*	

BEN418	Molecular Mechanisms of Cancer	
BEN420	Bioprocess Design	
BEN421	Introduction to Cosmology	

Course Contents

YEAR ONE

1ST TERM

PHYS101-Physics I

4 (3+0+2) ECTS:6

Physics and Measurement, Motion in One Dimension, Vectors, Motion in Two Dimensions, The Laws of Motion, Circular Motion and Other Applications of Newton's Law, Energy of a System, Conservation of Energy, Linear Momentum and Collisions, Rotation of a Rigid Object About a Fixed Axis, Angular Momentum (Related experiments).

MATH101-Calculus I

4 (3+2+0) ECTS: 6

Introduction to basic mathematics, coordinates and vectors, functions, limits, continuity, derivative, tangent lines, the mean value theorem, graphs, critical points, maximum and minimum problems, linearization and differential, integral, Riemann sums and definite integrals, the fundamental theorem of mathematics, natural logarithms, exponential functions, inverse trigonometric functions, L'Hospital's rule, applications of integration.

CHEM103-Fundamentals of Chemistry

4 (3+0+2) ECTS:6

Chemical foundations, atomic structure, molecules and ions, modern atomic theory, chemical compounds and their nomenclature, chemical bonds, chemical calculations, chemical reactions, precipitation, acid-base neutralization and oxidation-reduction (redox) reactions, gases, thermodynamic, chemical kinetics, principles of chemical equilibrium, acids and bases. Laboratory experiments accompany the lectures.

ENG101-English I

3 (3+0+0) ECTS: 3

Reading texts and exercises. Listening exercises. Translation exercises. Writing essay. Speaking exercises, conversations.

TURK101-Turkish Language I

2 (2+0+0) ECTS: 3

Definition of language, the importance of the language as a social element, language-culture relation, the place of Turkish language in the world languages, the development of the Turkish language and historical periods, its status and its expansion, the voices in Turkish and classification, Turkish ' the audio features and rules related to phonetics, syllables, spelling rules and practices, punctuation marks and application, general information about composition, the plan will be used and implemented in essay writing, nouns and verbs, expression in composition form and implementation, usage of adverbs and prepositions.

RPSC109-Positive Psychology and Communication Skills

3 (3+0+0) ECTS: 5

The course includes subjects like the general framework of the basic concepts of communication sciences, solutions and recommendations to strengthen communication skills, interpersonal communication, group communication, organizational communication, mass communication, public communication, international communication and intercultural communication.

RCUL101-University Culture I

1 (0+2+0) ECTS: 1

The course consists of reports on seminars and conferences organized by the university.

YEAR ONE

2ND TERM

PHYS102-Physics II

4 (3+0+2) ECTS:6

Introduction to Physics, electric fields, Gauss law, electrical potential, capacitance and dielectrics, current and resistance, direct current circuits, magnetic fields, sources of magnetic field, Faraday's law, inductance, alternating current circuits, electro-magnetic waves.

MATH102-Calculus II

4 (3+2+0) ECTS: 6

Sequences and series, Taylor and Maclaurin series, lengths of plane curves, polar coordinates and complex numbers, lines in space, planes and quadratic surfaces, multivariate functions, limits and continuity, partial derivatives, the chain rule, directional derivatives, critical points, multiple integrals, polar, cylindrical and spherical coordinates, curve integrals and surface integrals.

CHEM104-Organic Chemistry

4 (3+0+2) ECTS: 6

Structure and properties of the compounds, alkanes, alkenes, alkynes, aromatic compounds, alkyl halogens and reactions of alkyl halogens, alcohols, phenols, ethers, aldehydes, ketones, carboxylic acids, nitrogenous compounds.

BEN102-Introduction to Bioengineering

2 (2+0+0) ECTS: 3

Definition of Bioengineering, working areas, other sciences related with bioengineering. Present situation and future. Discussion of how to combine engineering and biological science to solve scientific and technological problems. Ethics in Bioengineering. Recent developments in bioengineering.

MBG154-General Biology

3 (2+0+2) ECTS: 4

All biological concepts will be covered in this course. The topics include; the origin of living organisms and cellular basis, the chemical structural components of the cell, cell biology, the structure of cell membrane, functions of sub-cellular organelles, energy metabolisms, the basis of cellular information flow and cell signalling, DNA structure, chromosomes and nucleus.

ENG102-English II

3 (3+0+0) ECTS: 3

Reading texts about profession, grammar exercises, word activities, translation activities, listening and speaking exercises.

TURK102-Turkish Language II

2 (2+0+0) ECTS: 3

Elements of sentence, sentence analysis and implementation, reading and rhetorical applications of the works related to the literature, essay types, expression and sentence disorders, rules to be followed in the preparation of scientific writing.

RCUL102-University Culture II

1 (0+2+0) ECTS: 1

The course consists of reports on seminars and conferences organized by the university.

YEAR TWO

3RD TERM

BEN205-Stoichiometry

3 (3+0+0) ECTS: 4

Definitions, Measurements, Introduction to Engineering Calculations, Process and Process Variables, Process Classifications and Balances, Balances on Multiple-Unit Processes, Recycle and Bypass Balances on Reactive Systems, Combustion Reactions, Gases, Single Component Phase Equilibrium, Gibbs Phase Rule and Gas-Liquid Systems, Multicomponent Gas-Liquid Systems, Energy Balance for Closed and Open Systems.

CHEM203-Physicalchemistry

3 (3+0+0) ECTS: 4

Gases, ideal gas laws, the laws of thermodynamics, chemical equilibrium and chemical reactions, application of thermodynamics to biochemistry, the kinetics of chemical reactions, transport properties.

BEN209-Cell Biology

4 (3+0+2) ECTS: 5

This course will focus on the molecular and cellular biology of cells, structure and function of the cell, membrane structure and composition, transport, and trafficking. Detailed information about the intracellular structures, transcription, translation, cell architecture, metabolism, signal transduction pathways, cell division and cell cycle will be the topic of this course, as well. Students will be expected to have knowledge about molecules and the traffic of the cells and build up the molecular basis of biology for the further terms.

MATH203-Differential Equations

3 (2+2+0) ECTS: 5

Matrices, Concept of Differential Equation and Fundamental Definitions, Ordinary Differential Equations of the First Order, Existence and Uniqueness Theorems, Exact Differential Equations and Integrating Factors, Second-Order Differential Equations, High Order Linear Differential Equations, Series Solutions of Linear Differential Equations, Laplace Transform Solutions of Linear Differential Equations, Systems of First-Order Linear Differential Equations, Non-linear Differential Equations, Sturm-Liouville Problems.

ATA101-Principles of Atatürk and History of Turkish Revolution I

2 (2+0+0) ECTS: 3

Historical importance of Turkish Revolution; conditions for the Turkish Revolution, National Liberation War under the leadership of Mustafa Kemal Paşa; establishment of the new fully independent Turkish State based on the sovereignty of nation; Atatürk's genius soldier, great statesman and reformer personality.

RPRE104-Entrepreneurship and Project Culture

2 (2+0+0) ECTS: 3

This course introduces students to the world of entrepreneurship through the development of the entrepreneurial mindset. The focus will be on both starting a new business as well as on the advancement of entrepreneurial thinking within a large corporation. Students will analyze the entrepreneurial process of formulating, planning, and implementing new business ventures and opportunities from domestic and international viewpoints.

XXXXXXX-Social Elective I

3 (3+0+0) ECTS: 5

YEAR TWO

4TH TERM

BEN202-Biochemistry

3 (3+0+0) ECTS: 4

Amino acids / peptides / proteins, enzymes, enzyme kinetics, inhibition, nucleic acids, replication transcription and translation, metabolism, carbohydrates, glycolysis, citric acid cycle, electron transport and oxidative phosphorylation, lipid metabolism, nitrogen metabolism, photosynthesis.

BEN207-Bioengineering Laboratory I

2 (0+0+4) ECTS: 3

Media preparation, spectrophotometric measurement, quantification determination of the substance, protein determination methods, examination of the physical properties of polymers, optical methods used for the examination of cell enzyme kinetics and immobilization, enzyme activity assay methods.

CHE206– Fluid Mechanics and Applications

3 (3+0+0) ECTS: 5

Introduction to Fluid Mechanics (Dimensions and Units). Newton's law of viscosity. Fluid Statics (Pressure at a Point, Hydrostatic Pressure). Incompressible and compressible fluids. Buoyancy, Flotation and Stability. Fluid Dynamics: Conservation of Mass, Conservation of Momentum, and Conservation of Energy. Friction Loss. Bernoulli Equation. Inviscid Flow, Viscous Flow. Mixing and Agitation. Dimensional analysis. Applications in chemical engineering.

BEN216-Kinetics and Reactor Design

3 (3+0+0) ECTS: 5

Thermodynamics, kinetics: rate laws and mechanisms, determination of rate parameters, material and energy balances, ideal and real reactors, catalysis.

ATA102-Principles of Atatürk and History of Turkish Revolution II

2 (2+0+0) ECTS: 3

The efforts of the Turkish nation with all the institutions and values to go above contemporary civilization, Ataturk's principles and revolutions; Ataturk's thought system; Turkey's domestic and foreign policy of Atatürk's period; Second World War and Turkey; the transition to multi-party era in Turkey.

COME102-Introduction to Algorithms and Programming

3 (2+0+2) ECTS: 4

Basic computer literacy: terminology, system components and operation. Fundamentals of computer programming: sequence, decision, repetition, syntax, compilation, debugging and maintenance, procedures, parameters, arrays, searching, sorting, top-down structured design, and style. Recursion, pointers and dynamic memory allocation; strings and string processing; advanced file processing; programmer-defined types; Introduction to Object Oriented Programming; classes and data abstraction: behaviour/state (data) model, member scope and access, constructors/destructors, object assignment.

BEN284-Summer Practice I

0 (0+0+5) ECTS: 5

Students transform the theoretical knowledge acquired during the semester into practice.

YEAR THREE

5TH TERM

BEN301-Heat and Mass Transfer

3 (3+0+0) ECTS: 5

The First Law of Thermodynamics, Thermodynamics and Heat Transfer, Heat Transfer Mechanisms (Conduction, convection and radiation), Simultaneous Heat Transfer Mechanisms and Problem Solving Techniques, One-Dimensional Heat Conduction Equation, Transient Heat Conduction, Fundamentals of Convection, Basics of Mass Transfer.

BEN341-Human Physiology

2 (2+0+0) ECTS: 3

This course is designed to provide students with an understanding of comparative human physiology. This course introduces the students the function and regulation of the human body and physiological integration of the organ systems to maintain homeostasis. Several biological systems are considered, including respiratory, circulatory, digestive and metabolic, renal, nervous, musculoskeletal, hormonal, and sensory.

BEN333-General Microbiology

3 (2+0+2) ECTS: 5

This course will focus on the main features of the anatomy of the microbial cell, physiology, nutrition and growth of microorganisms important to various industries, chemical reactions that occur in the microbial cell, reproduction of microorganisms, synthesis of bioproducts, cultivation of important organisms encountered in medicine and pharmacy, control of microbial growth in industrial production process.

COME211-Introduction to Programming for Engineers

2 (1+0+2) ECTS: 3

Main objective is to support students' programming abilities using Matlab. The content will be presented as follows; Use of workspace and the interface, Arrays: basic data structure, Basic plotting in Matlab, Simple data analysis, Introduction to automation of tasks, More program flow control, Writing your own functions and project applications, Simulink applications.

BENXXX-Departmental Elective I

3 (3+0+0) ECTS: 5

XXXXXX- Field Elective I

3 (3+0+0) ECTS:5

XXXXXXXX-Social Elective II

3 (3+0+0) ECTS: 5

YEAR THREE

6TH TERM

BEN304-Bioengineering Laboratory II

2 (0+0+4) ECTS: 3

Sterilization, cell culture techniques: The determination of the viability of the cell, the cell count, cryo-preservation techniques, biosensors, protein analysis, peptide synthesis, bioreactor, PCR, DNA isolation. optical methods for the study of cells, enzyme kinetics, enzyme immobilization, enzyme activity.

BEN326-Bioinformatics I

3 (3+0+0) ECTS: 4

Graphs, algorithms and complexity; parallel and distributed computing; biological sequences: string algorithms, sequence alignment, clustering of biological sequences, sequence repeats, genome analysis: gene finding, genome rearrangement, haplotype inference; introduction to biological networks: metabolic networks, gene regulation networks, protein interaction networks.

BEN328-Genetic Engineering

4 (3+0+2) ECTS: 5

Introduction to genetic engineering, gene expression analysis, microarray analysis, labeling and hybridization, gene mapping, DNA fingerprinting, cloning strategies, DNA and cDNA libraries, transgenic animals and plants, novel therapies for genetic diseases, gene therapy.

MATH204- Statistics

3 (3+0+0) ECTS: 5

Introduction to Statistics, Descriptive Statistics, Probability, Random Variables and Expectation, Discrete Probability Distributions, Continuous Probability Distributions, Distributions of Sampling Statistics, Parameter Estimation, Hypothesis Testing, Simple Linear Regression and Correlation, Analysis of Variance.

XXXXXXX-Social Elective III

3(3+0+0) ECTS: 5

BENXXX-Departmental Elective II

3 (3+0+0) ECTS: 5

BEN384-Summer Practice II

0(0+0+5) ECTS: 5

Students transform the theoretical knowledge acquired during the semester into practice.

YEAR FOUR

7TH TERM

BEN489-Graduation Project

3 (2+2+0) ECTS: 5

Preparation of consultants together with the graduation Project.

BEN409-Process Dynamics and Control

3 (3+0+0) ECTS: 5

Incentives for Chemical/Biochemical Process Control, Design Aspects of a Process Control System, Hardware of a Process Control System, Development of Mathematical Modeling, Modeling Consideration for Control Purposes, Computer Simulation and Linearization of Non-linear Systems, Laplace Transforms and Use of Them in Process Control, Solution of Linear Differential Equations Using Laplace Transform, Transfer Functions and Input-Output Models, Dynamics of First-Order Systems, Introduction to Feedback Control and Design of Feedback Controllers, Frequency Response Analysis of Linear Systems, Design of Feedback Control Systems Using Frequency Response Technique.

MBG408-Bioethics

2 (2+0+0) ECTS: 3

This course presents a basic understanding of ethical theories and a wide range of social and bioethical issues.

OHS401-Occupational Health and Safety I

2(2+0+0) ECTS:2

Occupational health and safety concept, holistic approach to occupational health and safety, culture of risk prevention in the workplace. The importance of safety culture and its place in everyday life, Establishment of safety culture and ensuring its continuity, Basic principles of occupational health and safety, the place of business of the management of occupational health and safety, healthy and safe life.

BENXXX-Departmental Elective III

3 (3+0+0) ECTS: 5

BENXXX-Departmental Elective IV

3 (3+0+0) ECTS: 5

XXXXXX-Field Elective II

3 (3+0+0) ECTS:5

YEAR FOUR

8TH TERM

BEN492-Graduation Thesis

5 (1+8+0) ECTS: 8

Experimental or theoretical work to use the synthesis of knowledge gained in vocational training.

OHS402-Occupational Health and Safety II

2(2+0+0) ECTS:2

Occupational health and safety concept, holistic approach to occupational health and safety, culture of risk prevention in the workplace. The importance of safety culture and its place in everyday life, Establishment of safety culture and ensuring its continuity, Basic principles of occupational health and safety, the place of business of the management of occupational health and safety, healthy and safe life.

BENXXX-Departmental Elective V

3 (3+0+0) ECTS: 5

BENXXX-Departmental Elective VI

3 (3+0+0) ECTS: 5

XXXXXX-Field Elective III

3 (3+0+0) ECTS:5

XXXXXX-Field Elective IV

3 (3+0+0) ECTS:5

ELECTIVE COURSE-POOL

BEN206-Biomaterials

3 (3+0+0) ECTS: 5

Biological materials and classification of biomaterials, bioceramics and biological glass, metal materials, characterization of biomaterials, medical applications of biomaterials, shoulder prosthesis, acrylic bone cement, dental materials and implants, sterilization and infection, tissue engineering, auxiliary materials, environmental interaction of biomaterials, biocompatible materials, medical-compatible titanium, medical adhesives, polyurethanes, medical, orthopedic implants, neurological implants, cardiac implants.

BEN213-Biosensors

3 (3+0+0) ECTS: 5

Biosensors have revolutionized the care and management of diabetes and have had important impacts in several other areas of clinical diagnostics. This course provides a comprehensive study on the different types of biosensors, including DNA-based, enzymatic, optical, self-assembled monolayers and third generation of biosensors. As well as many scientific developments on bioanalytical microsystems and new materials for biosensors, antibody and immunoassay developments have a prominent place in the course. We will do a comprehensive analysis on different types of biosensors, also cover applications include biological analysis, bioprocess monitoring and biomedicine, different techniques for biomolecule immobilization, the interaction of biomolecules with sensor surface, and interfacial properties are treated comprehensively with respect to their impact on the performance of a biosensor.

BEN215-Engineering Economics

3 (3+0+0) ECTS: 5

Application of economic principles to engineering problems, role of engineers in business the finance function in an industrial enterprise, time value of money; estimation of cash flows, quantitative measurements of profitability, Concepts of cost engineering.

BEN217-Bio-CAD Modeling

3 (2+0+2) ECTS: 5

CAD based bio-tissue informatics, bio-CAD modeling and application in computer-aided tissue engineering, biomimetic design, analysis, simulation and freeform fabrication of tissue engineered substitutes, methodology to generate bio-CAD models from high resolution non-invasive imaging, the medical imaging process and the 3D reconstruction technique, utilization of the bio-CAD model for the description and representation of the morphology, heterogeneity, and organizational structure of tissue anatomy, Sample drawing applications

BEN218- Introduction to Astrophysics

3 (3+0+0) ECTS: 5

Basic concepts, Telescope, Time, Parallax, Distances of stars, Stellar atmospheres, Spectral classification of stars, Properties of stars, Star clusters, Binary stars.

BEN221-Biopolymers

3 (3+0+0) ECTS: 5

Description of polymer, classification, raw Materials, structural mechanical, thermal, electrical, optical and chemical properties of polymer, molecular weight concept and molecular weight determination methods, synthesis of polymers, industrial production methods, processing techniques.

BEN302-Biotransport Process**3 (3+0+0) ECTS: 5**

Mass, heat and momentum transfer, physical and mathematical descriptions of transport in biological systems.

BEN310-Bioreactors**3 (3+0+0) ECTS: 5**

Biochemical reactions and classification of biochemical reactions, characteristics of the bioreactors, mixing apparatus, biotechnological manufacturing techniques.

BEN312-Downstream Processes**3 (3+0+0) ECTS: 5**

Properties of biological products, pre-processing, chromatographic and electrolytic separation methods, purification processes (chromatography and electrophoresis), cell lysis methods, solid-liquid separation, concentration processes, the use of the Intelligent polymer systems and polyelectrolyte complexes creator in separation process.

BEN313-Biothermodynamics**3 (3+0+0) ECTS: 5**

Law of thermodynamics, work and heat concepts, thermodynamic properties of pure substances and state equations, second law of thermodynamics and entropy, processes applied to the ideal gas, generalized state properties, stability criterion, fugacity and activity concepts, mixtures and thermodynamic concepts, Gibbs free energy and Gibbs Duhem equation, multi-component systems.

BEN315-Bioprocess Engineering**3 (3+0+0) ECTS: 5**

The definition of bioprocesses, characteristics of biological materials, bioprocess kinetics, basic principles of bioreactors, modeling of bioprocess, transport phenomena in bioprocess, sterilization, design of bioprocesses, evaluation of bioprocesses waste.

BEN317-Introduction to Biotechnology**3 (3+0+0) ECTS: 5**

An introduction to genes and genomes, genomics, proteins as products, recombinant DNA technology, medicinal biotechnology, microbial biotechnology, plant and animal biotechnology, ethics and biotechnology.

BEN321-Medicinal Chemistry**3 (3+0+0) ECTS: 5**

Introduction to the chemistry of therapeutically active compounds, general aspects of medicinal chemistry, pharmacokinetics and drug metabolism, molecular mechanisms of drug action, molecular modeling in drug design, natural products as pharmaceuticals.

BEN322-Nanoneurobioscience**3 (3+0+0) ECTS: 5**

Introduction to the field of nanoscience and nanotechnology which is an inter- and multi-disciplinary science and engineering. Some topics that will be discussed during the course are: Bio-nanotechnology, Carbon Nanotubes, Transport in nanostructures, Nanopolymers, Nanoconjugates, Nanosensors, imaging agents for cancer, Nanomedicine, immune based targeting for cancer and application of nanotechnology in neurodevelopmental diseases.

BEN323-Metabolic Engineering**3 (3+0+0) ECTS: 5**

Introduction to metabolic pathways, engineering concepts for metabolic pathways, cell metabolism, metabolic flux analysis, molecular metabolic engineering, genetic modification of metabolic pathways, bioprocess development.

BEN324-Measurement Techniques: Sensors**3 (3+0+0) ECTS: 5**

General structure of sensors, Thermal sensors, Pressure sensors, Motion and acceleration sensors, Photo sensors and their fundamental properties, Fundamental biosensors, Gas sensors.

BEN325-Bioelectromagnetic Interactions**3 (3+0+0) ECTS: 5**

Introduction to electromagnetic fields, effects of electromagnetic fields on biological systems, biomedical application of electromagnetic fields, techniques, electrochemotherapy, diagnostic and therapeutic applications of electromagnetic fields.

BEN327-Molecular Techniques in Bioengineering**3 (2+0+2) ECTS: 5**

The majority of this course will be to build upon the molecular biological skills that students learned in Molecular Biology and Biotechnology. Principles and practice of basic bacterial culture techniques, transformation, agarose gel electrophoresis, nucleic acid purification (plasmid and genomic DNA, RNA), nucleic acid quantification, DNA restriction digestion and analysis, polymerase chain reaction (PCR), and basics of computer- based bioinformatics analysis and data acquisition.

BEN329-Biological Clocks**3 (3+0+0) ECTS: 5**

Terminology, basic concepts and a brief history of the field, fundamental properties of rhythms, the molecular mechanisms of circadian clocks in various organisms, mammalian circadian clock, importance of circadian timing for cancer, repair and aging, circadian clock disruption, chronotherapy, the link between clocks, sleep and metabolism.

BEN331-Genomics**3 (3+0+0) ECTS: 5**

Genome and genomic architecture, genomic variations, and regulatory mechanisms of the genome, mutations, large-scale DNA sequencing, and data analysis, microarray based studies, personal genomics, ethical issues in genomics.

BEN332-History of Science**3 (3+0+0) ECTS: 5**

Basic definitions about science and information, Developments in science, Inventions, Discoveries.

BEN334-Introduction to Nanotechnology**3 (3+0+0) ECTS: 5**

Nanoparticles, Nanotubes, Nanomaterials, Nanofluid, Nanotransporters, Nanocapsules, Nanocables, Nanotransistors, Nanofibers, Nanocrystals, Nanostructured metals/alloys, Magnetic nanomaterials, Nanocomposites, Nanolayers.

BEN335-Animal and Plant Physiology**3 (3+0+0) ECTS: 5**

Overview of the diversities in the animal world, life processes of multicellular organisms, structure and function of animal organ and organ systems, adaptations of animals and animal organ systems to the environment, correlations between cellular mechanisms, form, function and the organism's environment, plant cell structure, organ systems within plants, growth and differentiation processes, photosynthesis, metabolism, stress physiology, gene regulation, plant hormones and natural products, plant model systems are included in the course content.

BEN337-Drug Delivery**3 (3+0+0) ECTS: 5**

This course will cover biopharmaceutics, chemical and physical drug stability, drug diffusion in/from reservoir, matrix, hydrogel, degradable, particulate and responsive drug delivery systems, liposomes,

nanoparticles, polymers for drug delivery, site-specific targeted drug delivery systems, radiopharmaceuticals and novel stimuli-responsive delivery systems.

BEN339-Virology

3 (3+0+0) ECTS: 5

This course will cover viral morphology, structure, classification and taxonomy, viral replication, life cycles and diversity, bacteriophage, archaeal viruses, plant viruses, animal viruses (including zoonotic viruses), aquatic viral ecology, therapeutic viruses, industrial applications of viruses, human-viral interactions, virus vaccines, antiviral drugs.

BEN342- Fundamentals of Immunology

3 (3+0+0) ECTS: 5

Overview of field of immunology by providing fundamental concepts of immune system and its mechanisms as well as key roles of immune system in various disease/conditions and treatments.

BEN346- Mathematical Modeling

3 (3+0+0) ECTS: 5

Description of Mathematical Modeling and Simulation/Graphical and Numerical Solutions of Equations/Solutions of Equations by MATLAB/Presentation of Data and Deep Considerations/Plotting Nonlinear Functions in Linear Form. Mathematical Formulations of Processes/Multivariable Systems/Modeling of Steady-State and Dynamic Systems/Development of Ordinary and Partial Differential Equations and Their Solution Methods/Modeling of Bioengineering Processes and Applications.

BEN351-Bioengineering Project I

3 (3+0+0) ECTS: 5

The course will cover how to prepare a scientific research report in accordance with the scientific writing rules about an original topic in the field of Bioengineering.

BEN352-Bioengineering Project II

3 (3+0+0) ECTS: 5

The course will cover how to prepare a scientific research report in accordance with the scientific writing rules about an original topic in the field of Bioengineering.

BEN354-Special Topics in Bioengineering

3 (3+0+0) ECTS: 5

Recent developments in bioengineering will be discussed.

BEN355-Biomedical Engineering Principles

3 (3+0+0) ECTS: 5

Medical Instruments and Devices, Biomedical Signal Analysis, Medical Imaging, Medical Informatics, Biomechanics, Biomaterials, Prostheses and Artificial Organs, Biophotonics and Biomedical Optics, Biomedical Lasers.

BEN402-Computational Bioengineering

3 (3+0+0) ECTS: 5

Computational approaches to biological problems on the cellular level, genetic networks and gene expression, hypothesis generation from large-scale data source, micro-array data analysis, computational molecular design of pharmaceuticals, computer simulations of proteins, peptides, An overview of the brain structure, from neurons to circuits to regions, different neuroimaging techniques and standard steps of preprocessing and basic analysis, computational approaches to model the brain, MATLAB applications.

BEN403-Parallel Algorithms for Bioengineers

3 (3+0+0) ECTS: 5

Parallel programming platforms: SIMD, MIMD computers, message-passing; parallel algorithm design: decomposition, mapping, models; communication: one-to-all broadcast, all-to-all broadcast, ring, mesh, hypercube architectures; message-passing model: MPI programming; shared memory model: POSIX threads; matrix algorithms, graph algorithms, parallel biological sequence algorithms: string and sequence algorithms; parallel biological network algorithms: centrality algorithms, network motif and alignment algorithms, phylogenetic tree formation.

BEN404-Protein Chemistry

3 (3+0+0) ECTS: 5

The course seeks to describe the structure, organization and functions of protein in molecular terms. The topics in this course include amino acids, peptides, Three-dimensional structure of proteins, protein motifs and foldings, protein folding disorders, functions of proteins, protein detection and analysis methods, protein databases.

BEN405-Protein Engineering and Synthetic Vaccines

3 (3+0+0) ECTS: 5

Chemical synthesis of peptides by solid state methods (Merrifield method), biosynthesis of peptides and proteins, DNA technology, hybridoma technology, fusion of myeloma and spleen cells, monoclonal immunoglobulins (antibodies), modification of biomolecules, peptides and protein immobilization, binding techniques to synthetic micelles latex and liposomes, microencapsulation and binding to polymeric matrix (water soluble bioconjugates, interpolymer-protein complexes) preparation method of an adjuvant, modifying the immunology of antigens, synthetic vaccines, viral vaccines, polymeric immunogens based on peptide and vaccines prototypes, synthetic vaccine development methods against the several diseases: alum (Foot-Mouth) hepatitis, tuberculosis, influenza, salmonellosis, AIDS, etc.

BEN406-Tissue Engineering

3 (3+0+0) ECTS: 5

Extracellular matrix analogues, extracellular matrix, synthetic polymers and natural polymers as support material, regulation of cell functions, cell construct, cell-biomaterial interactions, cellular movement and metabolism, tissue development-tissue modeling, tissue Renewal, controlled drug release, tissue engineering approaches, biohybrid organs therapy, tissue engineering products: patents, rules, recent Developments.

BEN407-Molecular Modeling

3 (3+0+0) ECTS: 5

General information about molecules, basic concepts molecular modeling (Valence Bond Theory, Molecular orbital theory (Schrödinger equation, LCAO method), Huckel theory and applications of Huckel theory (analysis of secular determinant; delocalization energy, charge density, bond orders, free valence index calculations, Frost circle, alternant-nonalternant systems), PMO theory (Interpretation of organic reactions orbital interactions), orbital symmetry (Woodward-Hoffmann approaches), molecular mechanical methods, Hartree-Fock method, classification of basis sets, optimization of the geometric structure of molecules, density function theory, electron correlation methods, implementation of QM / MM hybrid models to systems.

BEN408-Quantum Chemistry

3 (3+0+0) ECTS: 5

Black-body radiation, photoelectric effect, atomic spectra, Schrödinger equation, characteristics of the operator, postulates of quantum mechanics, the application of principles of quantum mechanics to simple systems, two-particle systems, the electronic structure of atoms, introduction to molecular structure.

BEN410-Basic Principles of Animal Experiments**3 (3+0+0) ECTS: 5**

Applications of basic animal experiments and ethics, anatomy of test animals, handling techniques, injection and blood collection.

BEN412-Bioinformatics II**3 (3+0+0) ECTS: 5**

Algorithms for biological sequences, introduction to biological networks, analysis of biological networks: centrality, network models; network motif search: network centric and motif centric algorithms; network alignment: bipartite graph matching, PathBlast, IsoRank, MaWish, GRAAL; phylogenetics: phylogenetic trees: maximum parsimony, maximum likelihood; phylogenetic trees.

BEN413-Introduction to Radiation Physics**3 (3+0+0) ECTS: 5**

Radioactive sources, Interaction of radiation with matter, Radioactivity and radiation units, Conservation principles of radiation, Shielding principles, Radioactive wastes.

BEN414-Artificial Intelligence Techniques in Bioengineering**3 (3+0+0) ECTS: 5**

Introduction to the "Artificial Intelligence" area, biological data, biological foundations of neural networks, modeling bioengineering systems using neural networks, optimization algorithms.

BEN415-Modelling in Process Safety**3 (3+0+0) ECTS: 5**

Safety and risk management, methods for risk management, models for risk management, risk evaluation, decision-making, safety measures.

BEN416-Introduction to Biomechanics**3 (3+0+0) ECTS: 5**

Introduction to biomechanics and human movement, muscle actions, response of tissues to forces, biomechanics of bone, neuromuscular control, linear motion, angular motion, clinical biomechanics, sports biomechanics.

BEN417-Bioengineering Laboratory III**3 (2+0+2) ECTS: 5**

Separation and purification processes, chromatographic techniques, size exclusion chromatography, thin layer chromatography, SDS-PAGE, western blot, biomedical measurements.

BEN418- Molecular Mechanisms of Cancer**3 (2+0+2) ECTS: 5**

The course provides an overview of the basic biology of cancer, including the cellular processes, whose alteration leads to uncontrolled cell proliferation. The topics in this course include cancer cell profile, growth factors and cell cycle, Oncogenes and tumor suppressor genes, angiogenesis, invasion and metastasis, apoptosis, DNA damage and repair, chemical carcinogens, cancer screening, cancer diagnostics and treatments; current and new therapies, current methods and technologies used in cancer diagnostics and research.

BEN420-Bioprocess Design**3 (3+0+0) ECTS: 5**

This course will cover the perspective of bioprocess engineering, design of innovative microbial fermentations, for bio-products, bioprocessing kinetics, bioenergetics, bioprocess scale-up strategies, product recovery, statistical optimization, biosafety and good manufacturing practices.

BEN421-Introduction to Cosmology

3 (3+0+0) ECTS: 5

Introduction to differential geometry, Einstein's equation, Introduction to cosmology, Inflation theory, Black holes.