

Üsküdar University
Faculty of Engineering and Natural Sciences

**Department of Molecular Biology and
Genetics**

**Compulsory English
Preparatory Class**

Course Contents

Course Contents

Year One

1st Term

MBG 101-General Biology-I

4 (3+0+2) ECTS: 7

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 signaling, DNA structure, chromosomes and nucleus.

MATH 101-Calculus-I

4 (3+2+0) ECTS: 6

Foundations, coordinates and vectors, functions, limits, continuity, derivative, tangent lines, the mean value theorem, graphing, extreme values, optimization problems, linearization and differentials, integration, Riemann sums and definite integrals, the fundamental theorem of calculus, natural logarithm, exponential functions, inverse trigonometric functions, L'Hospital's rule, methods of integration, applications of integrals.

PHYS 101-Physics-I

4 (3+0+2) ECTS:6

Measurement and vectors, kinematics, Newton's laws, circular motion, gravitation, work and energy, conservation of energy, momentum, statics, rotational Motion, simple harmonic motion, wave motion, heat, the first law of thermodynamics, kinetic theory of gases, the second law of thermodynamics, entropy (Related experiments).

CHEM 101-General Chemistry-I

4 (3+0+2) ECTS:6

A basic course emphasizing the metric system, introduction to stoichiometry, the structural and physical properties of matter, i.e. electronic structure of atoms, chemical binding, molecular geometry, hybridization, and molecular orbital and the states of matter, i.e. gases, liquids and solids.

ENG 101-English-I

3 (3+0+0) ECTS: 3

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

RCUL 101 – University Culture

1 (0+2+0) ECTS : 1

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

RPSC 109 – 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.

Year One

2nd Term

MBG 102-General Biology-II

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.

MATH 102-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, planes and quadric surfaces in space, functions of several variables, limits and continuity, partial derivatives, differentiability, the chain rule, directional derivatives, extreme values, multiple integrals, integrals in polar, cylindrical and spherical coordinates, line integrals and surface integrals.

PHYS 102-Physics -II

4 (3+0+2) ECTS: 6

Electric charge and matter, electric field, electric flux and Gauss's law, potential, capacitors, current in materials, DC circuits, magnetic field and magnetic force, Ampere's and Faraday's laws, inductance, electromagnetic waves, geometrical optics, interference, diffraction and polarization, the particle and wave nature of EM radiation (Related experiments).

CHEM 102-General Chemistry-II

4 (3+0+2)

ECTS:6

Continuation of CHEM 101. Discussion of physical properties of solutions in aqueous solution, chemical kinetics, chemical equilibrium, chemical thermodynamics and electrochemistry.

ENG 102-English -II

2 (2+0+0) ECTS: 3

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

RCUL 102 – University Culture

1 (0+2+0) ECTS : 1

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

Year Two

3rd Term

MBG 209 - Microbiology

4 (3+0+2) ECTS: 6

In this course, a survey of bacterial morphology, biochemistry and physiology with special emphasis on the cultivation, identification and control of microorganisms is intended. Basic laboratory skills in microbiology subject is one of the learning outcomes.

MBG 211 - Genetics

4 (3+0+2) ECTS: 7

The aim of this course is to overview the molecular genetic mechanisms and the conventional Mendelian genetics, and transmission genetics as well. The topics include organization of cell nucleus, DNA and chromosome organization, protein synthesis and genetic code, heredity types, molecular medicine, techniques used in detection of genetic diseases. Laboratory work related to the course topics is obligatory.

MBG 213 – Histology and Embryology

3 (2+0+2) ECTS : 4

The course consists of two section – histology and embryology. The study of histology is taught in order to provide an appreciation of the cellular basis of physiology and pathology. Emphasis is

placed on the relationship between structure and function. The aim of the embryology section is to provide students with the essential facts of human development from conception to birth. The course develops an understanding of both normal and abnormal embryological development and is taught with clinical examples of relevance to the student.

MBG 205 - Plant Biology

3 (3+0+0) ECTS: 5

An introductory course on plant sciences, which covers mainly the elementary aspects of plant morphology (forms and structures of plant parts), plant physiology (functional processes), plant ecology (relationships between plants and their environment) and plant genetics (inheritance of traits in plants).

COME 211-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.

TURK 101-Turkish Language -I

2 (2+0+0) ECTS: 3

Definition of "language", social role and importance, language-culture relationships, Turkish language and its place and relationships amongst the global languages, the history and development of Turkish language, current position and the hinterland of Turkish language. Phonetics and classification, characteristics of Turkish phonetics and the rules related to phonetics. Spelling rules and applications, punctuations marks and applications, general rules about essay writing, planning of essay writing, words and verbs, adverbs and prepositions with applications.

ATA 101-Principles of Atatürk and History of Reforms-I

2 (2+0+0) ECTS: 3

In this course the meaning and the importance of the Turkish Revolution, the conditions which led to the Turkish Revolution, the environment and the developments, the National War of Independence under the leadership of Mustafa Kemal Pasha, the founding of the new Turkish State that is totally independent that rests upon national sovereignty, Atatürk as a genius soldier, as a great statesman, as a reformer and as a perfect organizer are presented.

Year Two

4th Term

MBG 212- Molecular Genetics

3 (3+0+0) ECTS: 4

This course includes genome organization, chromosome structure and classifications, gene structure, mutations and SNPs, transcription and posttranscriptional modifications, RNA types and functions, ribozymes, gene expressions. One of the learning outcomes of this course is the basic genetic nomenclature used in gene metabolisms. The medium of the course instruction is English.

MBG 204 – Introduction to Bioinformatics

3 (2+2+0) ECTS: 5

The objective of this course is to help the students use the bioinformatics tools to solve the problems on their own research in molecular biology. Topics include (but not limited to) bioinformatics databases, sequence and structure alignment, protein structure prediction, protein folding, protein-protein interaction. The course involves student application during which emphasis will be put on the understanding and utilization of these concepts.

CHEM 104- Organic Chemistry**3 (3+0+2) ECTS: 6**

The course includes structure and bonding in organic compounds, covalent bonding and chemical reactivity, hybrid orbitals. Aliphatic hydrocarbons (Alkanes and cycloalkanes). Alkenes, Alkynes. Compounds with halogen. Alcohols, diols and ethers. Aromatic compounds; chemistry of aromatic compounds. Carbonyl compounds; Aldehydes and ketones. Carboxylic acids and their derivatives. In addition, Laboratory work is an essential part of organic chemistry courses.

MBG 210 - Physiology**4 (3+0+2) ECTS: 6**

This course is designed to provide students with an understanding of comparative animal physiology with emphasis on the functions of the human body. This course introduces the students the function and regulation of the mammals 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. The weekly laboratory session will complement the lecture.

TURK 102-Turkish Language -II**2 (2+0+0) ECTS: 3**

Components of a sentence, analysis and applications of the sentence, reading and investigating of the literature and philosophy examples from the world and rhetoric applications. Arts of written essay and applications, expression and grammar defaults and their corrections, the rules to prepare scientific articles.

ATA 102-Principles of Atatürk and History of Reforms-II**2 (2+0+0) ECTS: 3**

The struggle of the Turkish Nation to go above the level of the contemporary nations with all its institutions and values, Principles and Revolutions of Ataturk, Ataturk's School of thought, Turkey's national and international politics during Ataturk's leadership, Second World War and Turkey and the transition period to the multi political party era in Turkey.

Year Three**5th Term****MBG 309- Biochemistry- I****4 (3+0+2) ECTS: 7**

In this course will be covered functional group reactions and properties of biologically and organic chemistry of macromolecules (proteins, carbohydrates, nucleic acids and lipids. Basic laboratory skills in biochemical subject is one of the learning outcomes.

MBG 311 -Molecular Cell Biology**4 (3+0+2) ECTS: 7**

This is an introductory course focusing on fundamentals of the molecular biology of the cell. Cell chemistry, transcription, translation, cell architecture, metabolism, signal transduction pathways, cell division, and the cell cycle will be covered. Relevant applications of molecular biology techniques are obligatory for each student as a laboratory activity during this course.

MBG 315 - Bioethics**2 (2+0+0) ECTS: 3**

The results of scientific and technological developments related to living things, limits and usage policies of biological material in researches will be discussed. The aim of this course is to discuss topics as the results of scientific and technological developments of gene technology, cloning, artificial reproduction which are related to living organisms and the limits, terms of use.

MBG 307-Neurobiology**3 (3+0+0) ECTS: 5**

This course will focus on molecular and cellular neurobiology. Topics include structure of ion channels, synaptic transmission, synaptic development, molecular mechanisms of synaptic plasticity, learning and memory and neurological diseases.

XXXXXX-Field Elective-I**3 (3+0+0) ECTS: 5****RPRE 104 – Entrepreneurship and Project Culture****3 (3+0+0) ECTS: 5****Year Three****6th Term****MBG 310 - Biochemistry II****4 (3+0+2) ECTS: 7**

Biochemistry seeks to describe the structure, organization and functions of living matter in molecular term. The goal of this course is describing the metabolism the totality of chemical reactions that occurs living matter. Basic laboratory skills in biochemical subject is one of the learning outcomes.

MBG 304-Recombinant DNA Technology**3 (3+0+2) ECTS: 7**

Recombinant DNA technology is fundamental to genetic engineering and molecular biotechnology applications which have been founded on the ground of multiple disciplines such as molecular biology, microbiology, biochemistry, immunology, genetics, and cell biology. The course includes the recombinant DNA techniques which involve the utilization of prokaryotic and eukaryotic organisms and the manipulation of DNA in order to generate relevant clones, examine gene regulation, and express proteins. Relevant application of some of these techniques (cloning, and in detail- the restriction and ligation of DNA fragments, transformation of competent cells with recombinant DNA vectors, screening of positive bacterial clones, PCR, site directed mutagenesis...) will be exposed to students besides to their applications in the industry (drugs, vaccines, crops,...).

MBG 312 - Biotechnology**3 (3+0+0) ECTS: 4**

The topics of the course include: introduction to biotechnology, the principles of bioreactors and fermentation, biotechnological products, plant, animal, medical, food, environmental biotechnologies and biofuel cell technologies will be generally covered.

MBG XXX-Departmental Elective-III**3 (3+0+0) ECTS: 5****XXXXXXXX-Social Elective-II****3 (3+0+0) ECTS: 5****MBG 382 - Summer Practice**

The aim of summer practice is to recognize the work area of molecular biology and genetics and apply theoretical knowledge from university on practical work area. The students practice in the fields that they are interested.

Year Four**7th Term****MBG 405 – Immunology****2 (2+0+0) ECTS : 3**

This course covers cells and tissues of the immune system, lymphocyte development, the structure and function of antigen receptors, the cell biology of antigen processing and presentation, including molecular structure and assembly of MHC molecules, the biology of cytokines, leukocyte-

endothelial interactions, and the pathogenesis of immunologically mediated diseases. The course is structured as a series of lectures and tutorials in which clinical cases are discussed with faculty tutors.

MBG 407 - Seminar

1 (0+2+0) ECTS: 2

In this course, students are expected to present information about a subject that they are interested from selected journals.

MBG 491 – Graduation Project

3 (0+0+6) ECTS: 10

This standalone course will provide students a more comprehensive “how to” implementation of a graduation product rather than a project. The course will involve student-centered, lifelong learning that will combine academics with real-life goal setting, an exploration of learning something new, problem-solving, time management skills and community service.

MBG XXX-Departmental Elective-IV

3 (3+0+0) ECTS: 5

MBG XXX- Departmental Elective -V

3 (3+0+0) ECTS: 5

XXXXXXX- Social Elective-III

3 (3+0+0) ECTS: 5

Year Four

8th Term

MBG 492-Graduation Thesis

3 (0+0+6) ECTS: 14

Students are expected to conduct research study on a certain area of Molecular Biology and Genetics department that cover all components of subject matter.

MBG XXX-Departmental Elective-VI

3 (3+0+0) ECTS: 5

XXXXXXX-Field Elective-II

3 (3+0+0) ECTS: 5

XXXXXXX- Elective (Foreign Language)

3 (3+0+0) ECTS: 5

ELECTIVE COURSES POOL

MBG 203- Biostatistics

3 (1+2+0) ECTS: 4

This course introduces statistics, data and information related to the basic concepts, distribution types and distribution criteria, sampling techniques and sample selection, principles of data collection, the table and chart types, basic concepts of hypothesis and hypothesis testing, main parametric and non-parametric hypothesis tests, basic concepts of regression and correlation, hospital statistics.

MBG 313-Cancer Molecular Biology

3 (3+0+0) ECTS: 5

Cancer Molecular Biology is a course that provides an overview of the biological basis of cancer with an emphasis on cell biology relevant to the understanding of treatment strategies, past, present, and future. Foundation courses in either cell biology or molecular biology are important for comprehension of cell level processes that underlie the cancer process. In the molecular biology of cancer; mechanisms, targets, and therapeutics gives a fresh approach to the study of the

molecular basis of cancer. In this course, students will have a molecular level of cancer and focus on how our understanding of the defective mechanisms, which drive cancer, is leading to the development of new-targeted therapeutic agents. The topics in this course include carcinogens, tumor virology, oncogenes, tumor suppressor genes, cell cycle regulation, angiogenesis, invasion and metastasis, cancer genomics, cancer epidemiology, and cancer therapies.

MBG 316-Genes, Environment and Behavior

3 (3+0+0) ECTS: 5

Behavior is a phenomenon arising from the complex interplay of nature and nurture. This course will try to elucidate how diversity of environmental factors and the nature of genetic makeup contribute to the differences in behavioral response patterns as a function of individual genetic variations. Supported by published studies about serotonin transporter gene variation and others, a special priority will be given to psychiatric conditions on which genetic variations are 'risk factors' in the presence of unfavorable environmental stressors. Lectures are provided with the introduction of relevant research papers and interactive discussions with students.

MBG 317- Memory

3 (3+0+0) ECTS: 5

The course focuses on the underlying neural systems and neural communication in learning and memory processes. After an introduction of the basic concepts about the topic and a brief tour of brain and neuron, the different types of learning and memory will be analyzed over the involved brain regions. The most recent research findings as well as methods will also be discussed.

MBG 318-Microbial Metabolism

3 (3+0+0) ECTS: 5

The topics include: Metabolic reactions occurring in microorganisms; energy metabolism of the various groups of microorganisms; anaerobic and aerobic respiration pathways of microorganisms; bacterial photosynthesis; Nitrogen metabolism of anaerobic microorganisms; degradation of organic compounds; synthesis of structural components of the cell; regulation of microbial metabolism.

MBG 319-Functional Genomics and Transcriptomics

3 (3+0+0) ECTS: 5

Functional genomics and transcriptomics attempts to answer questions about the function of DNA at the levels of genes, RNA transcripts, and protein products. This course focuses on the functional analysis of expressed genes and their products. Course will cover the construction and screening of normalized cDNA libraries, Regulation of gene expression, RNAi-mediated gene silencing, functional analysis by gene knock-outs, micro-RNAs and small RNAs, site-directed mutagenesis, genomics as a systems biology.

MBG 321-Plant Genetics and Biotechnology

3 (3+0+0) ECTS: 5

The structure of cytoplasmic and nuclear genomes, the techniques of gene transfer, genetic expression and arrangement in development of phanerogam, transgenic plants and their usage in biotechnology.

MBG 323-Special Topics in Neuroscience

3 (3+0+0) ECTS: 5

For those with a background and interest in neurobiology and growing field of neuroscience, certain topics of molecular, cellular and behavioral neuroscience subjects will be covered with lectures and interactive seminars. Topics are not fixed and subjected to change depending on the faculty members and guest speakers.

MBG 330-Epigenetics

3 (3+0+0) ECTS: 5

This course includes the regulation of developmental genes, control of transcription by DNA methylation, methylated DNA, HDACs and chromatin remodeling, chromatin remodeling factors for DNA, introduction to small RNAs, genomic imprinting in mammals and environmental effect on

inheritable phenotypes. Students are expected to understand the differences between genetic and epigenetic influences on gene expression and the range of epigenetic mechanisms, how epigenetic modifications are propagated, and the phenotypic consequences of normal and abnormal epigenetic regulation on the genesis of diseases, development and evolution.

MBG 411-Animal Behavior

3 (3+0+0) ECTS: 5

This course concentrates on the subject of animal behavior from different perspectives: evolutionary biology, psychology and neuroscience. Topics to be covered include learning and memory, predation and foraging behavior, mating behavior and parental care, sociality, communication, and aggression etc.

MBG 415-Industrial Microbiology

3 (3+0+0) ECTS: 5

The topics of the course include: Industrial microorganisms and product, gaining of biotechnological product through industrial processes, general fermentation technology and scaling-up, isolation and characterization of antibiotics, obtaining of food compounds from microorganisms such as vitamins, amino acids, enzymes, etc.

MBG 417 – Computational Neuron Models

3 (3+0+0) ECTS: 5

This course gives a mathematical introduction to single neuron models. Topics include basics of neural coding, main types of single neuron models, Hodgkin-Huxley and other related models of neural excitability, stochastic models of ion channels, cable theory, and models of synaptic transmission.

MBG 418-Pharmacogenetics

3 (3+0+0) ECTS: 5

This course includes, introduction to pharmacogenetics and the significance of it, the effects of polymorphic changes in drug metabolizing enzymes on pharmacokinetics of drugs, transport systems and due to genetic differences in drug receptors, pharmacodynamics of drugs and on account of this possible changes for drug effects, the incidence of side effects the importance of pharmacogenetics for to evaluate risks of treatment and basic methods.

MBG 419-Sports and performance Genetics

3 (3+0+0) ECTS: 5

Predisposition to sports, performance enhancing genes and their distribution through populations, polymorphisms leading to superior sportsman, gene doping will be the topics of this newly established scientific field.