

İZMİR INSTITUTE OF TECHNOLOGY
MOLECULAR BIOLOGY AND GENETICS DEPARTMENT
UNDERGRADUATE COURSE CONTENTS
(2025 UNDERGRADUATE CURRICULUM)

MBG 101 Biology I (4+0)4 ECTS: 6

Chemical context of life, water and the fitness of the environment, carbon and the molecular diversity of life, the structure and function of macromolecules, membrane structure and function, metabolism, cellular respiration, photosynthesis, cell communication, the cell cycle, meiosis and sexual life cycles, Mendel and the gene idea, the chromosomal basis of inheritance, from gene to protein, the genetics of viruses and bacteria, eukaryotic genomes, DNA technology and genomics, the genetic basis of development.

MBG 111 Biology Lab I (0+4)2 ECTS: 2

Experiments are related to the topics covered by Biology I course. Corequisite: MBG 101

CHEM 101 General Chemistry I (4+0)4 ECTS: 5

Matter-its properties and measurement. Atoms and atomic theory. Chemical compounds. Chemical reactions. Introduction to reactions in aqueous solutions. Gases. Thermochemistry. Electrons in atoms. The periodic table and some atomic properties. Chemical bonding. Liquids, solids and intermolecular forces. Solutions and their physical properties.

CHEM 131 General Chemistry Laboratory I (0+4)2 ECTS: 2

Experiments are related to the topics covered by CHEM 101 Course. Corequisite: CHEM 101

PHYS 101 General Physics I (4+0)4 ECTS: 5

Scientific notation, length, time, mass, unit systems, 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, and potential energy. Systems of particles. Linear momentum and collisions. Rotation, angular momentum and its conservation. Equilibrium and elasticity. Gravitation.

PHYS 111 General Physics Lab I (0+2)1 ECTS: 2

Experiments complementary to the course material related to the topics discussed in PHYS 101 General Physics I lectures will be carried out in this laboratory section.

MATH 141 Basic Calculus I (3+2)4 ECTS: 5

Functions. Limits and continuity. Derivatives. Applications. The definite integral. The indefinite integral. Logarithmic, exponential, inverse trigonometric functions. Inverse hyperbolic functions. Integral and its applications.

ENG 101 Development of Reading and Writing Skills I (3+0)3 ECTS: 3

This is a compulsory course for all freshmen students. It is a three-credit course with 3 ECTS credits offered in the fall term. This course teaches skills and structures for reading, interpreting and creating academic writing. It involves a careful examination of a variety of reading texts with examples of discipline-specific structures needed while writing. Academic English reading and writing skills develop through research and composition. Authentic lectures, in-class activities and presentations improve listening and speaking proficiency. At

the end of the course, students will be able to: carry out research; recognize scientific writing; evaluate the reliability of sources; analyze data in written context; recognize the relationship between ideas in a text; paraphrase, quote and synthesize sources; cite sources; write a response to a written text; write a well-organized essay; express critical thoughts in oral and written context; prepare and deliver an effective presentation; avoid plagiarism. Throughout the semester, the students evaluate scientific articles, submit one essay and give an academic talk. At the end of the semester, they take a final exam.

MBG 102 Biology II (4+0)4 ECTS: 5

Evolution, biological diversity, biological organisms anatomy and physiology, ecological principles, population growth and communities, ecosystems, contemporary ecological issues.

CHEM 102 General Chemistry II (4+0)4 ECTS: 5

Chemical kinetics. Principles of chemical equilibrium. Acids and bases. Solubility and complex ion equilibria. Entropy and free energy. Electrochemistry. Nuclear chemistry. Main group elements I: metals, main group elements II: nonmetals. Complex ion and coordination compounds. Transition metals.

CHEM 132 General Chemistry Laboratory II (0+4)2 ECTS: 2

Experiments are related to the topics covered by CHEM 102 Course. Corequisite: CHEM 102

PHYS 102 General Physics II (4+0)4 ECTS: 5

Electric charge: Coulomb's law, Electric field and field lines. Gauss' law. electric potential and electric potential energy. Capacitors and dielectrics. Currents in materials. Direct current circuits. The effects of magnetic fields. The production and properties of magnetic fields: Ampere's law, Gauss' law for magnetism, and the Bio-Savart law. Faraday's law of induction. Magnetism and matter.

PHYS 112 General Physics Lab II (0+2)1 ECTS: 2

Experiments complementary to the course material related to the topics discussed in PHYS 102 General Physics II lectures will be carried out in this laboratory section.

MATH 142 Basic Calculus II (3+2)4 ECTS: 6

Polar coordinates and conic sections. Infinite series, parametric curves and vector in the plane. Vectors, curves and surfaces in space. Sequences and Infinite series. Multiple integral and its applications. Vector analysis.

ENG 102 Development of Reading and Writing Skills II (3+0)3 ECTS: 3

This is a compulsory course for all first year undergraduate students. It is a three-credit course with 3 ECTS credits offered in the spring term. This course teaches skills and structures for reading, interpreting and creating academic writing. It involves a careful examination of a variety of reading texts with examples of discipline-specific structures needed while writing. Academic English reading and writing skills develop through research and composition. Authentic lectures, in-class activities and presentations improve listening and speaking proficiency. At the end of the course, students will be able to: write an academic paper as response to a given article; express critical thoughts in oral and written context; read and understand research articles; prepare and deliver an effective presentation; use critical and creative thinking skills; analyze scientific or technical articles; find solutions to scientific or

technical problems and present them. Throughout the semester, the students take notes on scientific articles, submit one paper and give an academic talk. At the end of the semester, they take a final exam.

GCC 101 Career Planning and Development (2+0)NC ECTS: 2

The purpose of this course is to support and guide students to plan and determine their careers in accordance with their abilities, skills, competencies, personalities, and knowledge. In the light of uncertain global future, the course also aims to introduce the students to different career paths, different working environments, different worklives in various sectors-public corporations and institutions, private sector, academy, non-governmental organizations (NGOs)- and the variety of career opportunities in each different disciplines. Therefore, in the content of this course, along with lectures, guest speakers are invited from among professionals in the private sector, public sector, academia, NGOs, as well as among entrepreneurs.

MBG 201 Cell Biology I (3+0)3 ECTS: 5

This course is designed for second year MBG-students who have taken introductory biology course. This course aims to cover the universal feature of cells and tree of life, cell visualization methods, organization and function of the cell membrane and the role of cellular organelles.

MBG 203 Genetics (4+0)4 ECTS: 5

Introduction to genetics, mitosis and meiosis, Mendelian genetics, extensions of Mendelian genetics, gene mapping, quantitative genetics, chromosomal and gene mutations, extranuclear inheritance, population genetics, evolutionary genetics, conservation genetics.

MBG 213 Genetics Lab (0+4)2 ECTS: 4

Introduction to genetic model systems, monohybrid and dihybrid crosses, Chi-square analysis, sex linkage, human pedigree analysis, linkage mapping, human karyotyping, quantitative genetics and artificial selection, cytoplasmic inheritance, mutation in model systems, Hardy-Weinberg equilibrium analysis. Corequisite: MBG 203

CHEM 221 Organic Chemistry (4+0)4 ECTS: 5

Carbon compounds & chemical bonds. Alkanes. Cycloalkanes conformational analysis. Stereo chemistry. Nucleophilic substitution. Alkenes. Alcohols. Ethers. Radical reactions. Aromatic compounds. Prereq: CHEM 101, 102

CHEM 241 Organic Chemistry Laboratory (0+4)2 ECTS: 4

Corequisite: CHEM 221

TURK 201 Turkish Language I (2+0)NC ECTS: 2

Definition of the language and the place and importance of language as a social institution in life, relationship with culture-language, language-society and thought-language, place among the world languages of Turkish, exchange of words between languages, vocabulary, basic grammatical features and evaluated the current status of present state.

HIST 201 Principles of Atatürk I (2+0)NC ECTS: 2

The modernization of the Ottoman Empire during the nineteenth and early twentieth centuries, the spread of nationalism, and the revolutionary changes in Ottoman institutions and society that led to the Empire's demise, the transitional period from the Empire to the

national state and the foundation of the Turkish Republic following the national struggle led by Mustafa Kemal Atatürk.

MBG 202 Molecular Biology (4+0)4 ECTS: 5

The main objective of this course is to cover maintenance of the genome, expression of genome and regulation.

MBG 212 Molecular Biology Lab (0+4)2 ECTS: 4

The main objective of this course is to teach molecular biology techniques. Corequisite: MBG 202

MBG 206 Cell Biology II (3+0)3 ECTS: 5

This course aims to cover topics including the organization and components of cytoskeleton, cell cycle, signal transduction pathways and apoptosis.

MBG 211 Cell Biology Lab (0+4)2 ECTS: 4

The lab will consist of experiments covering the structure of the cell and basic cellular events. It will start with the comparison of different cell types and then focus on the structure and the function of some of the organelles including nucleus, mitochondria and chloroplast. Corequisite: MBG 206

MBG 205 Biostatistics (2+2)3 ECTS: 5

We will start with the nature of statistics. Then we will continue with organizing data, descriptive measure, probability concepts, random variable, normal distribution and sampling distribution of mean.

TURK 202 Turkish Language II (2+0)NC ECTS: 2

Turkish writing expression, identification, discussion and practical training for oral and written expression.

HIST 202 Principles of Atatürk II (2+0)NC ECTS: 2

The foundation of Turkish Republic, Principles of Atatürk and major events and changes that have taken place in politics, society, economy, and culture as a result of revolution for reorganization of state and society.

MBG 301 Biochemistry I (3+0)3 ECTS: 6

The Scope of Biochemistry, Weak Interactions in Aqueous Environment-Biochemical Bonds-The Energetics of Life-Thermodynamics-, Nucleic acids, Peptides, The 3-D Structure of Proteins, Translation, Carbohydrates, Lipids, Membranes and Cellular Transport, Enzymes

MBG 311 Biochemistry Lab (0+4)2 ECTS: 4

Pipetting Precision and Accuracy, Biological Buffers, pH, and pK_a, Spectroscopic Properties of Biological Molecules, Chromatographic Methods, Amino Acid Analysis, Peptide Sequencing, Protein Purification and analysis by SDS-PAGE, Catalysis and in vitro Enzyme Assays, Determination of K_m and V_{max}, Ligand Binding. Corequisite: MBG 301

MBG 303 Molecular Genetics of Prokaryotes (3+0)3 ECTS: 5

Fundamental microbial processes such as gene regulation, recombination, DNA repair, DNA replication and mutagenesis will be reviewed. Topics include: the transmission of genetic material by conjugation, transduction, and transformation; genomic plasticity: movable genes

and phase variation; genetic techniques for investigating bacteria; and the molecular techniques used to analyse microbial processes.

MBG 305 Applied Bioinformatics (2+2)3 ECTS: 5

Subjects include: searching sequence databases for genes by name, similarity and homology, restriction mapping, and PCR primer design, statistical analysis of pairwise and multiple alignment, locating promoters in DNA and functional motifs in proteins, data managements and mining, DNA sequencing, phylogenetics, in-silico methods in molecular biology.

MBG 302 Biochemistry II (3+0)3 ECTS: 7

Introduction to Metabolism, Carbohydrate Metabolism-1, Photosynthesis, Lipid Metabolism, Metabolism of Amino acids, Porphyrins, and Neurotransmitters, Nucleotide Metabolism, Metabolic Coordination, Metabolic Control and Signal Transduction, DNA replication, Restriction, Repair, Recombination, Rearrangement and Amplification, Transcription and Gene Expression.

MBG 304 Molecular Genetics of Eukaryotes (3+0)3 ECTS: 8

The biochemistry of the genetic phenomenon that constitutes the eukaryotic gene expression and regulation. Transcription in eukaryotes, eukaryotic RNA polymerases, general transcriptional factors, transcriptional activators, the effects of chromatin structure on transcription, mRNA, rRNA and tRNA processing, translational mechanisms in eukaryotes, ribosomes and tRNA.

MBG 411 Scientific Career Development (2+0)2 ECTS: 2

This course will introduce various paths for our graduates and how to position oneself for a successful and fulfilling career in science. Students will learn how to i) correspond with potential employers/professors, ii) generate impressive CV/resumes for specific positions they are interested in, iii) write a powerful reference letter draft for oneself, iv) prepare for interviews, v) write effective research grant proposals, and vi) give effective elevator pitches to convey key ideas convincingly. Through a combination of lectures and hands-on practical sessions, this course will help students make the right career choices for themselves and excel at various disciplines of science.

MBG 413 Evolution, Ecology and Biodiversity (3+0)3 ECTS: 5

The course will cover Evolution of species, Mutation, Recombination, Natural (and artificial) Selection, Migration, Drift, Phylogenetic Analysis, Adaptations to environment, Population Ecology, Species Interactions, Species abundance and diversity, Community Ecology, Nutrient Cycles, Landscape Ecology, Aquatic Ecology, Global Ecology, Biodiversity.

MBG 390 Summer Practice ECTS: 8

During summer practice students must work minimum 30 labor days at universities, government, public or private institutions in molecular biology and genetics related topics. Compulsory internships can only be undertaken at the end of the third year.

MBG 402 Seminars in Molecular Biology and Genetics (2+0)2 ECTS: 5

Presantation regarding molecular biology and genetics concept.

MBG 408 Bioethics (2+0)2 ECTS: 5

In this course we will discuss about introduction to bioethics, universal declaration on bioethics, human rights, religions and bioethics, the ethics of research, the ethics of

publication, the ethics of drug discovery, the ethics of medicine and medical practice, the ethics of reproductive issues, the ethics of genetically modified organisms, the ethics of cloning, the ethics of prenatal life, the ethics of stem cells, the ethics of decision on life-sustaining treatment, universal access to health care and essential medicines.

AREA ELECTIVE COURSES

MBG 321 Immunology (3+0)3 ECTS: 5

The main objective of this course is to cover cells of immune system, innate and adaptive immunity, generation of lymphocytes and antigen receptors, immune response and failures of host defense mechanisms.

MBG 322 Cytogenetics (3+0)3 ECTS: 5

Somatic Cell cycle, Molecular mechanism of cell cycle, Mitosis and cell division Meiosis and gamete formation, Chromosome morphology and number, Chromosome packaging, Chromatin remodeling, Structural chromosome changes, Changes in chromosome number and chromosome engineering, mapping.

MBG 323 Human Genetics (3+0)3 ECTS: 5

Topics include recent molecular developments in the genetics of Mendelian disorders, chromosome abnormalities and denomination, principles of genetic disease analysis, importance of genetic mapping and mapping methods, various genetic diseases and their inheritance, mitochondrial DNA, maternal inheritance and related diseases, cytogenetics, genetic diagnosis, segregation and linkage analysis, cancer, carcinogens, mutagens, evolutionary genetics, and the genetics of common diseases. Survey of human genetic conditions with an emphasis on the underlying molecular biology.

MBG 324 Plant Molecular Biology and Genetics (3+0)3 ECTS: 5

This course emphasizes genetic transformation methodology, gene expression systems and strategies for increasing productivity. Analyzing Plant Gene Expression with Transgenic Plants, Transcription, Control of Plant Gene Expression by Cis-Acting Elements and Trans-Acting Factors, Genes Controlling Flower Development in Plants: Mendelian Genetics to Molecular Sequence.

MBG 325 Molecular Evolution and Population Genetics (3+0)3 ECTS: 5

This course covers the principles of population genetics, molecular evolution and phylogenetics. Topics include mutation, population genetics, sequence alignment, patterns and analyses of DNA polymorphism, genetic evolutionary trees, molecular clocks, the evolution of multigene families, gene duplication and shuffling.

MBG 326 Plant Biology (3+0)3 ECTS: 5

Plant evolution and diversity, plant structure and function, the plant cell, leaf anatomy, photosynthesis, pigments, transpiration, transport of water and photosynthate, interactions with plants and the environment, nutrition and nutrient uptake, pathogens and predators, defense mechanisms, economic botany.

MBG 327 Human Physiology (3+0)3 ECTS: 5

Investigation of the functional mechanisms of various organs that constitute the human body at cellular, tissue and organ levels.

MBG 328 Digital Cell (3+0)3 ECTS: 5

The Digital Cell Philosophy, Dealing with Data, Imaging Data, Image Processing and Analysis, Statistics, Coding, Compilation.

MBG 329 Microbiology (3+0)3 ECTS: 5

Introduction to microbiology, microbial nutrition, growth, and control, microbial molecular biology and genetics, DNA technology and genomics, viruses, diversity of the microbial world, ecology and symbiosis, nonspecific (innate) resistance and immune response, microbial diseases and their control, food, environmental and industrial microbiology.

MBG 401 Recombinant DNA Technologies (3+0)3 ECTS: 5

Part I: The basis of genetic engineering: Introducing molecular biology, Working with nucleic acids, The tools of the trade, Part II: The methodology of gene manipulation: Host cells and vectors, Cloning strategies, The polymerase chain reaction, Selection, screening and analysis of recombinants, Part III: Genetic engineering in action: Understanding genes and genomes, Genetic engineering and biotechnology, Medical and forensic applications of gene manipulation, Transgenic plants and animals.

MBG 403 Developmental Biology (3+0)3 ECTS: 5

Molecular and genetic analysis of mechanisms involved in differentiation and determination in biological systems; germ cell determination, sex determination, gametogenesis, fertilization.

MBG 404 Computational Biology (2+2)3 ECTS: 5

This course is designed to teach students the basics of R programming and its utilization in biological data analysis. The first few weeks of the course focus on data structures in R, how to create and manipulate different types of data, creating statistical summaries in data subsets, and plotting exploratory graphics. In the subsequent weeks, RNA sequencing data will be analyzed using two R packages (DESeq2 and limma), single cell RNA sequencing data will be explored using Seurat R package, and lastly data from The Cancer Genome Atlas (TCGA) will be downloaded and examined for finding associations between gene expression and clinical parameters.

MBG 405 Current Techniques in Molecular Biology (3+0)3 ECTS: 5

Intoduction to recent molecular biology techniques and advances.

MBG 406 Genomics and Proteomics (3+0)3 ECTS: 5

Transition from genetics to genomics, genome sequence acquisition and analysis, evolution of genomes and genome identification, genomic variations, basic and applied research with DNA microarrays, proteomics, whole genome perspective, integrated genomic circuits.

MBG 407 Signal Transduction (3+0)3 ECTS: 5

All cells undergo an important switch during their lifetime, changing from unspecialized cells undergoing rapid growth into specific cell types that perform the duties of specific tissues and organs, a process called differentiation. Student will learn the different topics to understand the inner workings of the cell that lead to this important change. Course topics include signalling molecules and their receptor, cytokines and cytokine receptors, intracellular signal transduction events, the cell cycle and regulators of cell cycle progression, apoptosis and regulation of apoptosis, autophagy and differentiation of stem cells.

MBG 409 Cognitive Neuroscience (3+0)3 ECTS: 5

The main objective of this course is to familiarize students with the basic concepts of cognitive neuroscience. Topics of interest include attention, learning, memory, decision making and social cognition. Neurophysiological basis underlying these aspects and the current research methods used to study these areas will be discussed.

MBG 421 Molecular Medicine (3+0)3 ECTS: 5

The main objective of this course is to cover basics of molecular biology, tools of recombinant technology, cytometry-cell analysis, infectious diseases, genetic diseases, HLA typing, stem cells and cancer.

MBG 422 Neurobiology (3+0)3 ECTS: 5

Organization of nervous system, membrane potential, synaptic transmission, neural control of muscle contraction, spinal cord and brain motor mechanisms, sensorimotor mechanisms, autonomic nervous system, somatic, hearing and chemical senses, neural development, synaptic plasticity, language and cognition.

MBG 423 Biophysics (3+0)3 ECTS: 5

Cell: Its organelles and Molecules, Physics of Biomolecules, Physics of Bio-membranes, Thermodynamics and Bio-systems, Bioenergetics, Neurobiophysics.

MBG 424 Biotechnology (3+0)3 ECTS: 5

An Introduction to Genes and Genomes, History of Genetic Manipulation: Recombinant DNA Technology, Proteins as Products, Microbial Biotechnology, Agricultural Biotechnology, Animal Biotechnology, DNA Fingerprinting and Forensic Analysis, Bioremediation, Aquatic Biotechnology, Medical Biotechnology, Regulatory Biotechnology.

MBG 425 Virology (3+0)3 ECTS: 5

Replication strategies of the RNA and DNA viruses, principles of the viral structures and the cellular biology of the viral replication, cellular entry of the viruses, gathering of viral particles, control mechanisms of viral translocation and transformation. Pathology and nature of viruses and the evaluation of the viral diseases including Bovine Spongiform Encephalopathy.

MBG 426 Bioentrepreneurship (3+0)3 ECTS: 5

Entrepreneurship in Biotechnology and Life Sciences, Business and Product Development Processes in Biotechnology, Biotechnological Pharmaceuticals Market, Innovation in life sciences, Developing a business idea, What is a business plan?, Project management, Intellectual Property, Presentation and communication skills, Finance, accounting, investment, Negotiation.

MBG 427 Industrial Perspectives on Molecular Biology and Genetics (3+0)3 ECTS: 5

This course is designed to widen students' perspectives by introducing them to the many ways in which knowledge in molecular biology and genetics can be applied to careers in industry. The students will benefit from presentations by industry experts who will discuss their career paths and their fields of expertise. Students will also understand how their knowledge can be applied to solve real world problems in fields including the pharmaceutical and food industries; plant, animal and medical biotechnology.

MBG 498 Supplementary Curricular Courses (0+6)3 ECTS: 5

Enabling the students to substitute the activities that support the education plan of the undergraduate program they are registered as a technical elective course.

MBG 499 Cooperative Education (0+6)3 ECTS: 5

Gaining experience in a real business environment by working in an industrial or commercial enterprise and balancing theoretical knowledge with practical, hands-on experience prior to graduation.

MBG 351 Research Project I (0+6)3 ECTS: 5

Conducting experimental studies in a scientific research project.

MBG 352 Research Project II (0+6)3 ECTS: 5

Conducting experimental studies in a scientific research project.

MBG 451 Research Project III (0+6)3 ECTS: 5

Conducting experimental studies in a scientific research project.

MBG 452 Research Project IV (0+6)3 ECTS: 5

Conducting experimental studies in a scientific research project.

**MOLECULAR BIOLOGY AND GENETICS DEPARTMENT
COMMON COURSE CONTENTS**

MBG 121 Biology I (3+0)3 ECTS: 5

Chemical context of life, water and the fitness of the environment, carbon and the molecular diversity of life, the structure and function of macromolecules, membrane structure and function, metabolism, cellular respiration, photosynthesis, cell communication, the cell cycle, meiosis and sexual life cycles, Mendel and the gene idea, the chromosomal basis of inheritance, from gene to protein, the genetics of viruses and bacteria, eukaryotic genomes, DNA technology and genomics, the genetic basis of development.