

IZMIR INSTITUTE OF TECHNOLOGY
MOLECULAR BIOLOGY AND GENETICS DEPARTMENT
UNDERGRADUATE COURSE CONTENTS

MBG 101 Biology I (3+0)3

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 Laboratory I (0+4)2

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

CHEM 111 General Chemistry I (4+0)4

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 Lab. I (0+4)2

Experiments are related to the topics covered by CHEM 111 Course. Corequisite : CHEM 111

PHYS 101 General Physics I (2+2) 3

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

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

MATH 141 Basic Calculus I (3+2)4

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

The reinforcement of reading and writing skills through reading selections with review of structural patterns and paragraph and summary writing.

MBG 102 Biology II (3+0)3

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

CHEM 112 General Chemistry II (4+0)4

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 114 General Chemistry Lab. II (0+4)2

Experiments are related to the topics covered by CHEM 112 Course. Corequisite : CHEM 112

PHYS 102 General Physics II (2+2) 3

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

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

MATH 142 Basic Calculus II (3+2)4

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. Prereq MATH 141

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

A continuation of ENG 101 with emphasis on essay writing.

MBG 201 Cell Biology (3+0)3

This course is designed for second year MBG-students who have taken introductory biology course. The main objective of this course is to introduce all the components of the animal eukaryotic cells including Plasma membrane structure and functions, nucleus, protein sorting and transport, energy conversion, cell cycle and apoptosis.

MBG 211 Cell Biology Lab (0+4)2

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.

MBG 203 Genetics (3+0)3

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 Laboratory (0+4)2

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 205 Organic Chemistry I (4+0)4

Carbon Compounds and Chemical Bonds. Alkenes. Cycloalkanes Conformational Analysis. Stereo Chemistry. Nucleophilic Substitution. Alkenes. Alcohols. Ethers. Radical reactions.

Aromatic Compounds. Reactions of Aromatic Compounds. Phenols. Aldehydes, Ketones. Carbonyl Compounds. Carboxylic Acids and Derivatives. Prereq CHEM 111, 112

MBG 205 Biostatistics (2+2)3

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.

MBG 202 Molecular Biology (3+0)3

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

MBG 212 Molecular Biology Laboratory (0+4)2

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

MBG 204 Microbiology (3+0)3

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 214 Microbiology Lab (0+4)2

Isolation of microorganisms, teaching of various inoculation techniques and their application. Staining of microorganisms and their observation by microscopy. Preparation of bacterial culture media, bacterial cultivation techniques, investigation of the effects of environmental factors on bacterial growth and methods for the controlling of microbial growth. Enumeration methods for bacteria and viruses and bacterial counts of food and water resources. Methods used for the identification of bacteria.

CHEM 206 Organic Chemistry II (4+0)4

Reactions of aromatic compounds. Spectroscopic methods. Phenols. Oxidation-reduction reactions. Organometallic compounds. Aldehydes & ketones. Carbonyl compounds. Carboxylic acids & derivatives. Amines. Amino acids and proteins. Prereq CHEM 205

MBG 301 Biochemistry I (3+0)3

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 Laboratory (0+4)2

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

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

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

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

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 403 Genes and Development (3+0)3

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

MBG 407 Signal Transduction (3+0)3

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 390 Summer Practice

During summer practice students must work minimum 30 labor days at universities, government, public or private institutions in molecular biology and genetics related topics.

MBG 402 Seminars in Molecular Biology and Genetics (0+2)1

Presantation regarding molecular biology and genetics concept.

MBG 408 Bioethics (0+2)1

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

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

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

Topics include recent molecular developments in the genetics of Mendelian disorders, chromosome abnormalities and denotation, 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

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 (3+0)3

This course covers the principles of molecular evolution and phylogenetics. Topics include patterns and analyses of DNA polymorphism, genetic evolutionary trees, molecular clocks, the evolution of multigene families, gene duplication and shuffling, transposition and horizontal gene transfer, gene number and genome size, organellar and nuclear genetic markers, genetic mutation and selection, genes in populations, viral evolution, human evolution, and the theoretical background for molecular phylogenetics.

MBG 326 Plant Biology (3+0)3

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

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

MBG 401 Recombinant DNA Technologies (3+0)3

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 404 Computational Biology (2+2)3

Computational gene hunting and restriction mapping, comparative genomics and proteomics, map assembly and sequencing, multiple filtration, mathematical models of sequence comparison and multiple alignment, distances and parsimony of the trees and sequences, finding signals in DNA and gene prediction, alternative splicing and cancer.

MBG 405 Current Techniques in Molecular Biology (0+6)3

Introduction to recent molecular biology techniques and advances.

MBG 406 Genomics and Proteomics (3+0)3

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.

MBG409 Cognitive Neuroscience (3+0)3

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

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

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

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

MBG 424 Biotechnology (3+0)3

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

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 351 Research project I (0+6)3

Conducting experimental studies in a scientific research project.

MBG 352 Research Project II (0+6)3

Conducting experimental studies in a scientific research project.

MBG 451 Research project III (0+6)3

Conducting experimental studies in a scientific research project.

MBG 452 Research project IV (0+6)3

Conducting experimental studies in a scientific research project.

MBG 490 Graduation Project (0+6)3

Presenting report results by performing experimental studies in the frame of a research project that is chosen according to the interest field of the student. To be registered for this course, students should have passed two research projects (6 credits) and should have a GPA of at least 3.00.