(It will be applied from 2018-2019 Fall)

IZMIR INSTITUTE OF TECHNOLOGY
GRADUATE SCHOOL OF ENGINEERING AND SCIENCES
DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS
CURRICULUM OF THE GRADUATE PROGRAMS

M.S. in Molecular Biology and Genetics

Core Courses			ECTS
MBG 500	M.S. Thesis	(0-1)NC	26
MBG 513	Seminar in Molecular Biology*	(0-2)NC	8
MBG 522	Ethics in Scientific Research and Publication**	(2-0)NC	3
MBG 8XX	Special Studies	(8-0)NC	4

*All M.S. students must register Seminar in Molecular Biology course until the beginning of their 4th semester.
** "MBG 522 Ethics in Scientific Research and Publication" course should preferentially be taken within the first 2 semesters.

All M.S. students must take at least three courses from core electives.

Core Elective Courses			ECTS
MBG 501	Microbial Genetics	(3-0)3	8
MBG 507	Advanced Cell Biology	(3-0)3	8
MBG 516	Eukaryotic Gene Regulation	(3-0)3	8
MBG 537	Genome Organization and Structure	(3-0)3	8
MBG 550	Advanced Biochemistry	(3-0)3	8
MBG 570	Advanced Genetics	(3-0)3	8

Total credit (min.) :21
Number of courses with credit (min.): 7

Ph.D. in Molecular Biology and Genetics

Core Courses			ECTS
MBG 522	Ethics in Scientific Research and Publication*	(2-0)NC	3
MBG 600	Ph.D. Thesis	(0-1)NC	26
MBG 613	Seminar in Molecular Biology	(0-2)NC	8
MBG 8XX	Special Studies	(8-0)NC	4

*"MBG 522 Ethics in Scientific Research and Publication" course should preferentially be taken within the first 2 semesters.This course must be taken by all Ph.D. students who didn't register during M.S. program.

3 core electives must be taken from the courses given below. (All registered PhD students who took these courses during their MSc education do NOT need to register again)

Core Elective Courses			ECTS
MBG 501	Microbial Genetics	(3-0)3	8
MBG 507	Advanced Cell Biology	(3-0)3	8
MBG 516	Eukaryotic Gene Regulation	(3-0)3	8
MBG 537	Genome Organization and Structure	(3-0)3	8
MBG 550	Advanced Biochemistry	(3-0)3	8
MBG 570	Advanced Genetics	(3-0)3	8

Total credit (min.) : 21 (for students with M.S. degree)
Number of credited courses (min.) : 7 (for students with M.S. degree)
Total credit (min.) : 42 (for students with B.S. degree)
Number of credited courses (min.) : 14 (for students with B.S. degree)

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Elective Courses			**ECTS**
MBG 502	Molecular and Cellular Biophysics	(3-0)3	7
MBG 503	Microbial Physiology	(3-0)3	7
MBG 504	Microbial Pathogenesis	(3-0)3	7
MBG 505	Cell Physiology	(3-0)3	7
MBG 508	Molecular Phylogenetics	(3-2)4	7
MBG 509	Nanotechnology and Cancer	(3-0)3	7
MBG 510	Molecular and Cellular Mechanics	(3-0)3	7
MBG 511	Macromolecular X-Ray Crystallography	(3-0)3	7
MBG 512	Applıed Macromolecular X-Ray Crystallography	(3-0)3	7
MBG 514	Plant Cell Culture	(3-0)3	7
MBG 515	Advanced Immunology	(3-0)3	7
MBG 517	Algorithms in Bioinformatics	(3-0)3	7
MBG 518	Fluorescence Microscopy	(3-0)3	7
MBG 519	Biological Macromolecules	(3-0)3	7
MBG 520	Biophysical Methods	(3-0)3	7
MBG 521	Neurobiology of Disease	(3-0)3	7
MBG 525	Proteins and Enzymes	(3-0)3	7
MBG 533	Current Topics in Molecular Biology	(3-0)3	7
MBG 545	Molecular Biology of Cancer	(3-0)3	7
MBG 546	The Biology of Metastasis	(3-0)3	7
MBG 547	Plant Biotechnology	(3-0)3	7
MBG 555	Cell Cycle and Apoptosis	(3-0)3	7
MBG 556	Molecular Genetics of Plant Development	(3-0)3	7
MBG 557	Applied Microbiology	(3-0)3	7
MBG 560	DNA Mutagenesis and Repair	(3-0)3	7
MBG 565	Advanced Virology	(3-0)3	7
MBG 566	Gene Therapy	(3-0)3	7
MBG 567	Genome Analysis in Plants	(3-0)3	7
MBG 568	Current Topics in Plant Molecular Genetics	(3-0)3	7
MBG 572	Yeast Genetics	(3-0)3	7
MBG 573	Mouse Genetics and Laboratory Applications	(2-2)3	7
MBG 575	Redox Biology	(3-0)3	7
MBG 580	Genomics	(3-0)3	7
MBG 581	Proteomics Data Analysis	(2-2)3	7
MBG 583	Animal Models in Medical Research	(3-0)3	7
MBG 584	Current Topics in Medical Genetics	(3-0)3	7
MBG 585	Immunogenomics	(3-0)3	7
MBG 593	Glycobiology	(3-0)3	7

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COURSE DESCRIPTIONS **ECTS**

MBG 500 M.S. Thesis (0-1)NC 26
Program of research leading to M.S. degree arranged between student and a faculty member. Students register to this course in all semesters starting from the beginning of their second semester.

MBG 501 Microbial Genetics (3-0)3 8
Genetic phenomena, gene transfer, recombination, gene fusion and modern concepts in the genetics of microorganisms.

MBG 502 Molecular and Cellular Biophysics (3-0)3 7
Protein and cell structure and dynamics, biophysical forces, thermodynamics, membranes, enzymes.

MBG 503 Microbial Physiology (3-0)3 7
Modern concepts in physiology and structure of microorganisms.

MBG 504 Microbial Pathogenesis (3-0)3 7
This course includes the subjects of general molecular principles of microbial pathogenesis, adhesion and invasion strategies, intracellular survival strategies, epidemiology, virulence factors, antibiotic resistance, bacterial toxins, fungal pathogenesis, parasite pathogenesis, biofilms, and quorum sensing. Most of the emphasis will be on bacterial pathogens of mammals and plants, but there will be some discussion of viral and protozoan pathogens.

MBG 505 Cell Physiology (3-0)3 7
The course will initially introduce basic cell structure and function in mammalian cells. Then, it will focus on the properties of cell membrane. This will be followed by cell-cell and also cell-ECM interactions. After the introduction of electrical properties of membranes, special systems e.g. nervous and muscular, will be covered. The course will finish with an overview of the semester

MBG 507 Advanced Cell Biology (3-0)3 8
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 508 Molecular Phylogenetics (3-2)4 7
The course will start with a review of basic concepts in molecular evolution including discussion of substitution and codon models. Sequence alignment will also be reviewed. Various methods of phylogenetic tree reconstruction will be covered including distance, parsimony, maximum likelihood and Bayesian methods. The course will also address the problems of sequence/gene selection, outgroup selection, gene trees vs. species trees, tree reliability and the molecular clock hypothesis. During laboratory sessions, students will analyze sequence data with various phylogenetic tools including: BioNJ, DNApars, PhyML and MrBayes.

MBG509 Nanotechnology and Cancer (3-0)3 7
Covers applications of nanotechnology in the cancer field. Emphasis is on research at the cellular level. Primary focus is microfluidics.

MBG510 Molecular and Cellular Mechanics (3-0)3 7
Covers molecular mechanics of proteins such as molecular motors and cytoskeletal proteins in addition to cellular mechanics.

(It will be applied from 2018-2019 Fall)

MBG 511 Macromolecular X-Ray Crystallography (3-0)3 7
Crystals, theoretical aspects of crystal symmetry, theoretical aspects of X-ray diffraction phenomenon, X-ray diffraction experiments, theoretical aspects of phasing methods, solving and refining the structure, building and interpreting a molecular model.

MBG 512 Applıed Macromolecular X-Ray Crystallography (3-0)3 7
Sample preparation for crystallographic studies, crystallization methods, advanced crystallization methods (i.e., membrane proteins, DNA/RNA complexes), practical/advanced aspects of symmetry, practical/advanced aspects of X-ray diffraction experiments, practical/advanced aspects of phasing, practical/advanced aspects of determining and refining the structure, practical/advanced aspects of building and interpreting a molecular model, use of molecular structures to address problems in molecular biology and biochemistry.

MBG 513 Seminar in Molecular Biology (0-2)NC 8
A seminar about a research subject will be presented by each student. Departmental seminars must be attended by students.

MBG 514 Plant Cell Culture (3-0)3 7
An overview of plant cell culture, principles and techniques for the genetic manipulation of cultured plant cells.

MBG 515 Advanced Immunology (3-0)3 7
Discussion of the modern concepts in immunology. Emphasis on areas of current interest.

MBG 516 Eukaryotic Gene Regulation (3-0)3 8
Structure, synthesis and biochemical properties of nucleic acids, protein biosynthesis, control of gene expression and molecular genetics

MBG 517 Algorithms in Bioinformatics (3-0)3 7
This course is a follow-up course for Bioinformatics and will introduce students to algorithmic Algorithms used in various areas of biological research, sequence alignment, pattern matching, and distance calculations for various topics, some of the algorithms will be implemented into working software.

MBG518 Fluorescence Microscopy (3-0)3 7
Covers basic and advance fluorescence microscopy techniques in addition to image analysis methods.

MBG 519 Biological Macromolecules (3-0)3 7
Physical/chemical theory and techniques with emphasis on proteins and nucleic acids, solutions, chromatography, electrophoresis, viscosity, diffusion, sedimentation, spectroscopy, and isotopes.

MBG 520 Biophysical Methods (3-0)3 7
This course includes biophysical chemistry, structure of proteins, structure of nucleic acids, other biological molecules, the forces determining protein and nucleic acid structure and conformational analysis, absorption spectroscopy, other optical methods, introduction to magnetic resonance, the structure and shape of macromolecules, ultracentrifuge, other hydrodynamic techniques and X-ray crystallography.

MBG 521 Neurobiology of Disease (3-0)3 7
Fundamental aspects of developmental, degenerative, neurologic and psychiatric disorders of the nervous system will be examined. Anatomical basis of each condition, observed neuropathologies, survey of current research into mechanism of disease by animal models, and therapeutic strategies will be discussed.

MBG 522 Ethics in Scientific Research and Publication (2-0)0 3
Scientific research techniques, human ethics, animal ethics, stem cell ethics, authorship and collaboration.

(It will be applied from 2018-2019 Fall)

MBG 525 Proteins and Enzymes (3-0)3 7
Properties of proteins and polypeptides. Structural analysis and molecular interactions, enzyme structure, kinetic mechanisms and control.

MBG 533 Current Topics in Molecular Biology (3-0)3 7
Special topics in molecular and cell biology.

MBG 537 Genome Organization and Structure (3-0)3 8
The class will cover the structure and variation of nuclear genomes including changes in genome size, centromere and telomere structure, DNA packaging, transposable elements, DNA methylation, mutations (point, translocations, inversions, deletions, duplications), genomic sequencing, and comparative and functional genomics.

MBG 545 Molecular Biology of Cancer (3-0)3 7
Studies on cellular and molecular mechanisms of cancers with emphasis on current literature in cancer research.

MBG 546 The Biology of Metastasis (3-0)3 7
The course will focus on the molecular mechanisms involved in metastatic course, invasion, leaving the primary tumor, surviving the circulation and finally settling and growing in a distant organ. Experimental systems used to study metastasis will be introduced and discussed in the context of the recent research papers.

MBG 547 Plant Biotechnology (3-0)3 7
Discussion of genetic transformation methodologies, gene expression systems and analysis techniques will provide a foundation for study of current research in the area of plant genetic engineering and biotechnology. The uses of genetic engineering including strategies for obtaining transgenic plants that are resistant to insects, diseases and herbicides, that produce useful products or have improved health, nutritional or food processing characteristics will be discussed. Regulatory and social issues related to plant biotechnology will also be addressed.

MBG 550 Advanced Biochemistry (3-0)3 8
Chemistry of carbohydrates, lipids and membranes. Biosynthesis and metabolism of nucleic acids. Protein function and evolution.

MBG 555 Cell Cycle and Apoptosis (3-0)3 7
The topics will include cell cycle, cell cycle control mechanisms, microtubules, cytokinesis, control of cell proliferation and growth, cellular response to dna damage, cell cycle in cancer, apoptosis, internal and external apoptotic stimuli, apoptotic pathways.

MBG 556 Molecular Genetics of Plant Development (3-0)3 7
Topics will include cell lineages and positional information, embryogenesis, seedling, shoot, leaf, root, flower, fruit and seed development, the transition to flowering and pollination

MBG 557 Applied Microbiology (3-0)3 7
The first section aims to explain why development of the new strains is necessary in the exploitation of biodiversity and relevant strategies. In the second section, construction and the use of environmental DNA libraries are covered. In the final section, laboratory evolution studies are introduced.

MBG 560 DNA Mutagenesis and Repair (3-0)3 7
Action of physical and chemical environmental agents on genetic material. DNA repair. Mutagenic and carcinogenic consequences.

MBG 565 Advanced Virology (3-0)3 7
A general view of the multiplication strategies of viruses, their interactions with the host and immune response to viruses.

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MBG 566 Gene Therapy (3-0)3 7
Gene therapy is the attempt to replace a defective gene which causes disease with a good copy. The overall purpose of gene therapy course is to expose student to a comprehensive and detailed overview of the whole field of gene therapy, ranging from vector development to the results of the most recent clinical trials. In this course, currently employed methods, successes and ongoing trials, challenges and future approaches will also be introduced. Gene and cell therapies for neurologic and metabolic diseases will be mainly discussed. Therefore, the knowledge of the molecular pathology of genetic diseases is required to take this course.

MBG 567 Genome Analysis in Plants (3-0)3 7
The application of DNA markers to the identification, manipulation and isolation of genes important to plant productivity will be discussed.

MBG 568 Current Topics in Plant Molecular Genetics (3-0)3 7
Special topics in plant molecular genetics.

MBG 570 Advanced Genetics (3-0)3 8
The course will focus on the how genetic information is organized, changed and transmitted. We will cover the basis of genetic concepts and principles. We will study the mechanisms and tools to understand the function of genes. We will then focus on developmental and population genetics and focus on the mechanisms of gene regulation in eukaryotes and prokaryotes.

MBG 572 Yeast Genetics (3-0)3 7
Yeast cell biology, metabolism, genome and genomics, gene manipulations, complementations and mutagenesis

MBG 573 Mouse Genetics and Laboratory Applications (2-2)3 7
To introduce the mouse first as an organism and then an an model system for genetics research. Mutagenesis methods of the mouse germline will be reviewed. Mouse phenotypes and phenotypic analysis of prenatal lethality as well as postnatal effects will be discussed. Properties of mouse core husbandry will be introduced. The course will cover ethic rules concerning mice utilization. Available electronic database will be introduced. Details of mouse health monitoring and the social behaviours will be discussed Helpful guide for performing basic reseach with mice will be also provided in laboratory applications.During laboratory sessions, students will learn various methods including anesthesia, analgesia, euthanasia methods, necropsy protocols and storage, collection of body fluids perfusion and fixation methods.

MBG 575 Redox Biology (3-0)3 7
Free radicals, antioxidants, oxidative damage to biomolecules, repair mechanisms, redox control of gene expression, redox signaling

MBG 580 Genomics (3-0)3 7
Genome structure and organization, sequencing genomes, micro array and chip technology, genome-wide genotyping, functional genomics, arrays, metabolomics and proteomics topics will be included.

MBG 581 Proteomics Data Analysis (2-2)3 7
Mass spectrometry is currently the tool of choice in many areas of proteomics. For successful studies a thorough understanding of mass spectrometry is important. It is furthermore crucial to have a clear appreciation of algorithms and statistics used to infer knowledge from mass spectrometry. This course will review important aspects of mass spectrometry and will detail several algorithms and statistical measures in proteomics with mass spectrometry. Students will be able to analyze limited mass spectrometric experiments after taking this course.

(It will be applied from 2018-2019 Fall)

MBG583 Animal Models in Medical Research (3-0)3 7
Animal models are extensively used to study in vivo gene function as well as to model human diseases. The generation of animal models permits the evaluation of therapeutic strategies in models of human disease as well as the investigation of disease progression in a manner not possible in human subjects. The technology for producing transgenic animal models and the utilization of these models for medical research in different diseases will be mainly discussed. Beside mammalian, non mammalian organism used in genetic diseases research will be also introduced.

MBG 584 Current Topics in Medical Genetics (3-0)3 7
Recent developments in the field of medical genetics will be introduced and discussed.

MBG 585 Immunogenomics (3-0)3 7
The main objective of this graduate level course is to teach students genome-wide approaches on immune system, immune response and molecular mechanisms of diseases

MBG 593 Glycobiology (3-0)3 7
Glycobiology is the study of the structure, biosynthesis, biology of sugar chains (glycans) that are widely distributed in nature in all living life forms. Glycobiology is now one of the more rapidly growing fields in the natural sciences, with broad relevance to many areas of basic research, biomedicine, and biotechnology. The field includes the chemistry of carbohydrates, the enzymology of glycan formation and degradation, the recognition of glycans by specific proteins, roles of glycans in complex biological systems. This course provide basic overview of Glycobiology, directed towards the advanced undergraduate and graduate-level student of molecular and cellular biology and biomedicine.

MBG 600 Ph.D. Thesis (0-1)NC 26
Original research work done by the student under supervision of an advisor and written in the graduate thesis format.

MBG 613 Seminar in Molecular Biology (0-2)NC 8
A seminar about a research subject will be presented by each student. Departmental seminars must be attended by students

MBG 8XX Special Studies (8-0)NC 4
Graduate students supervised by the same faculty member study advanced topics under the guidance of their advisor.