BIOENGINEERING (TURKISH) MASTER'S DEGREE PROGRAM

COURSE CONTENTS

BM501 Biokinetics:

In this course, topics such as reaction engineering, reaction kinetics, biochemical reactions, biokinetic degrees and biokinetic constants will be covered, and the subject of growth kinetics for microorganisms will be discussed in order to provide a basis for the bioreactor design course.

BM505 Advanced Biochemistry:

In this course, topics such as metabolism reactions, biocatalysis, inorganic and organic biochemical components, bioenergy (ATP synthesis), vitamins, hormones, metabolic pathways will be covered and students will be able to understand and interpret current publications on these topics.

BM506 Bacterial Molecular Genetics:

In this course, genetic materials and structures, thermodynamics of the double helix, DNA conformation types, viral chromosomes, bacterial chromosomes, DNA organization in eukaryotic chromosomes, DNA replication, replication origin, replication enzymes, gene regulation, operons, introns and exons, mutations, DNA repair, topics such as recombination, protein synthesis, transformation, transduction, plasmids will be covered.

BM514 Nanobioengineering:

In this course, comprehensive information that will shed light on the production of futureoriented nanobioengineering materials will be discussed by examining nano-materials, their production, properties and characteristics, usage areas in biological sciences and their forms.

BM515 Seminar:

The aim of this course is to investigate, present and discuss current bioengineering issues. Seminars; It is offered by lecturers, invited speakers and students enrolled in the course. Thesis studies can be presented within the scope of student presentations.

BM516 Biomimetics:

In this course, chemical and physical techniques used in the preparation of man-made biological items and devices and systems imitating nature will be discussed. Biological or specific biomimetic materials or nanocomposites used in the biomimetic process and instrumental analysis of biomimetic materials are the topics of this course.

BM519 Fundamentals of Bioengineering I:

In this course, basic information about chemical reactions, macromolecules, stoichiometry, bioprocess engineering, protein biochemistry, enzyme kinetics which form the basis of the Bioengineering profession will be given.

BM520 Fundamentals of Bioengineering II:

As a continuation of the Fundamentals of Bioengineering I course in bioengineering, mass transfer, heat transfer, microbial growth kinetics, bioreactor design, separation and purification are the topics to be covered in this course.

BM523 Programming for Bioengineering:

The main aim of this course is to improve the programming skills of bioengineering graduate students using Matlab. Basic data structures, data analysis on Matlab, drawing graphics, writing functions will be covered in the course.

BM524 Applied Enzyme Modeling:

Basic structures of enzymes, three-dimensional structures of enzymes, active region and its importance, enzyme-substrate relationship, enzymatic reactions and effects of amino acids on reaction mechanisms, modeling enzymes, reaction mechanisms, ONIOM model, mutant enzyme modeling.

BM525 Molecular Modeling Techniques:

In this course, the basic concepts of molecular modeling (valence bond theory, molecular orbital theory (Schrödinger equation, LCAO method)), Huckel theory, PMO theory, orbital symmetry, molecular mechanical methods, Hartree-Fock method, optimization of the geometric structures of molecules.

BM526 Enzymology:

In this course, applications of enzymes in food, textile, detergent, leather, animal feed and pharmaceutical sectors will be widely discussed. The following topics will be covered in this course: Introduction to industrial enzymology; enzymes in alcohol fermentation; analytical applications of enzymes: biosensors and diagnostic tools; enzymes used in alcoholic beverage production; utilization of enzymes in chemical transformations; industrial enzymes in the leather industry; enzymes used in detergents; enzymes used in fruit processing; enzyme applications in the textile industry.

BM527 Bioseparation Engineering:

In this course, the techniques used in the purification of biomolecules, especially enzymes and other proteins, will be discussed in detail. The following topics will be covered in the course. An overview of bio-decomposition; features of purification techniques; removal of insoluble substances; centrifuge techniques; product isolation; cell disruption; extraction; product purification; principles of chromatographic separations; ion exchange chromatography; gel permeability chromatography; hydrophobic interaction chromatography; adsorption chromatography; affinity chromatography; high performance liquid chromatography; Ultrafiltration; electrophoresis; analysis of protein purity.

BM528 Advanced Molecular Docking:

The topics of the course are interaction surfaces of macromolecules and ligands, binding regions, structure-activity relationship, binding energy, docking studies in AutoDock program, determination of active amino acids in binding region, examples of rigid and flexible docking.

BM529 Cell and Tissue Culture:

In this lesson; cell culture conditions, cell lines, *in vitro* cytotoxicity tests, gene transfer (transfection) in cell culture (transfection), design of reporter plasmids, use of RNA technologies in cell culture, retroviral infection, reporter retrovirus design, creating single cell colony, RNA isolation from cells, RNA quality analysis methods. In addition, analysis methods in Flow Cytometry, RT-PCR and microarray analysis methods will be discussed.

BM530 Current Developments in Bioengineering:

Within the scope of the course, seminars on special topics of bioengineering, which are gaining importance today, will be given by lecturers, invited speakers and students.

BM531 Protein Structure and Function:

In this course, the biological process starting from the synthesis of the important biological macromolecules, starting from the synthesis to the maturation and gaining its function in the cell will be discussed. Intracellular synthesis of proteins, protein folding, hierarchical structures of proteins (primary, secondary, tertiary and quaternary structures), post-translational mechanisms and intracellular functions, secretion of proteins into extracellular environment, factors affecting protein structure and function, techniques for determining protein function. The topics such as functional analysis (in silico mutation analysis) of mutations made up of proteins using databases, protein modeling databases based on homology, protein sequence comparison are the topics of this course.

BM532 Bioreactors:

In this course, the design of bioreactor systems used in bioengineering on a laboratory and industrial scale will be covered. Within the scope of the course, the following topics will be covered in terms of its use in fermentation in bioengineering: Growth in discrete and continuous systems; microbial inoculation; raw materials; kinetics of cell growth in batch and continuous systems; mass transfer; mixture theories; bioreactor design; bioreactor types; scale up; modelling; sterilization.

BM533 Advanced Spectroscopic Techniques:

Ultraviolet and visible region spectroscopy (UV-VIS), fluorescence spectroscopy, infrared spectroscopy (FT-IR), nuclear magnetic resonance spectroscopy (NMR), atomic absorption spectroscopy, mass spectroscopy, high performance liquid chromatography (HPLC), gas chromatography (GC) are the topics to be covered in the course.

BM534 Pharmaceutical Biotechnology:

The role of biotechnology in drug development and production, recombinant DNA technology and its applications in medicine, hybridoma technology and monoclonal antibody production, gene therapy and gene carrier systems, cell-based treatment, plant tissue and organ culture techniques, production of drug active substances, fermentation techniques and applications in the pharmaceutical industry are the topics covered in the course.

BM535 Mathematical Methods in Bioengineering:

In this course, complex numbers, differential equations, first order ordinary differential equations, first order linear differential equations, higher order constant coefficient linear

differential equations, introduction to linear algebra, vector spaces, definition of a vector space, subspaces, arrays, limit definition in sequences, convergence and applications of topics such as divergence, series, harmonic, geometric series, P-series, alternating, power series, Taylor, McLaurin, Binom series, in bioengineering.

BM536 Food Biotechnology:

Giving basic information about food biotechnology, the use of traditional and modern biotechnological methods in food production, the use of biotechnological methods in the production of raw materials and additives are the topics covered in this course.

BM537 Metabolic Engineering:

The practical and theoretical aspects of changing metabolic pathways to produce products of interest will be covered in this course. After reviewing the basic principles of metabolism and the scope of the field of metabolic engineering, metabolic engineering studies will be examined, including a detailed assessment at the genetic level. Then metabolic modeling techniques and applications will be considered. Exemplary applications include the production of major metabolites, amino acids, pharmaceutical proteins.

BM538 Plant Biotechnology:

In this course, the role and development of plant biotechnology, DNA markers used in plant biotechnology, plant growth regulators, methods used in plant tissue culture, applications of plant tissue cultures, genome stability of plants propagated by plant tissue culture, short and long term storage of plants, secondary metabolite production, bioreactor systems used in mass reproduction of plants, phytoremeditation will be discussed.

BM539 System Biology:

Basic concepts in system biology, metabolic pathways, computational methods in the processing of ohmic data, cell metabolism modeling techniques, analysis of new generation sequencing data are the topics to be covered in this course.

BM540 Microbial Bioprocesses:

Within the scope of this course, the use of microorganisms in biotechnology, microbial biomass production, microbial enzymes, primary metabolites, secondary metabolites, industrial use of microbial resources, the use of microbial biomass in biofuel production will be covered.

BM541 Genetic Engineering and Synthetic Biology:

The aim of this course is to have an idea about general and current approaches and application areas in genetic engineering and to search the literature. Within the course, isolation of nucleic acids and detection techniques based on hybridization, enzymatic techniques used in modification of nucleic acids, directed mutagenesis and CRISPR, recombinant DNA technology, expression of recombinant proteins, techniques used in isolation and purification, application areas of synthetic biology in health, agriculture, food and industry will be discussed in the light.

BM542 Biochemical Reaction Engineering:

The main topics of this course are the basics of microbial and biochemical kinetics used in the analysis and design of biological systems, the mathematical modeling of biological kinetics and systems, and the development of microbial kinetic models for batch and continuous reactor design.

BM543 Advanced Molecular Cell Biology:

In this course, it is aimed to teach the molecular properties of the cell and related mechanisms in more detail. For this reason, the students who take the course are expected to have basic molecular cell biology knowledge. Genetic and epigenetic mechanisms regulating gene expression, basic molecular rules of cellular communication, cell morphology and cellular behavior, molecular regulation of the cell cycle, receptor tyrosine kinases. And cancer relationship, cell death mechanisms and ER stress, cell differentiation, tissue renewal, stem cells and current application Areas, cell cultures and cellular therapies are the main topics of this course.

BM544 Advanced Computational Bioengineering:

Genetic networks and gene expression, hypothesis from big data, microarray data analysis, computational drug design, computer simulation of proteins and peptides, modeling biological systems with computational methods, matlab applications will be covered in this course.

BM545 Determination of Antioxidant Activity by Quantum Methods:

Blackbody radiation, photoelectric effect, atomic spectrum, Schrödinger equation, molecular structure, electronic structure of atoms, application of quantum mechanics to simple systems are the topics that will be covered in the course.

BM546 Artificial Intelligence Techniques in Bioengineering:

Biological data, modeling of biological systems by using artificial neural networks, classification and clustering techniques, optimization algorithms, genetic algorithms, bioinformatics applications will be covered in this course.

BM547 Molecular Techniques in Bioengineering:

In this course, DNA isolation, total RNA isolation, PCR, agarose gel electrophoresis, RFLP, DNA sequencing, next generation DNA sequencing techniques, bioinformatic analysis will be covered as basic molecular techniques.

BM548 Applied Bioinformatics:

In this course, analysis of biological sequences, biological databases and their use, structural and functional genomic and gene expression studies, protein structure, folding and proteinprotein interactions will be covered.

BM549 Special Topics in Bioengineering I:

Investigation, presentation and discussion of current professional topics are within the scope of this course. Within the scope of the course, seminars on specific topics in bioengineering will be given by lecturers, invited speakers and students. Student Presentations can also be within the scope of thesis studies.

BM550 Cancer Bioengineering:

In this course the definition and causes of cancer, molecular signal pathways that play a role in the emergence and development of cancer, oncogenes and tumor suppressor genes, metastasis and invasion, cancer-causing mutation types, current molecular approaches and methods used in cancer treatment, obtaining immortal cell lines, regulation of cell death at the molecular level will be covered.

BM551 Gene Expression and Regulation:

In this course, molecular background of gene expression in eukaryotes will be explained. Mechanisms will be explained comparatively with prokaryotes. This course covers genome structure, RNA genes and RNA polymerases, RNA processing, transcriptional control mechanisms in eukaryotes and prokaryotes, genetic recombination, transposons, protein processing and targeted protein degradation, tissue-specific gene expression during development, cloning and expression vectors.

BM552 Introduction to Machine Learning in Computational Bioengineering:

In the scope of this course, basic topics of machine learning such as decision trees, linear regression, artificial neural networks, bayes theorem will be discussed and their applications in the field of bioengineering will be examined.

BM553 Applied Project-I:

The aim of this course is to gain laboratory skills for students from different fields to adapt to Molecular Biology-Genetics and Bioengineering sub-fields before master's thesis study. Basic laboratory techniques required to be able to make experiments independently will be taught to the students.

BM554 Special Topics in Bioengineering II:

This course, which is essential for updating the knowledge of students who have understood the basics of bioengineering in undergraduate bioengineering courses, will mainly cover the latest developments in bioengineering. Within the scope of the course, seminars on specific topics in bioengineering will be given by lecturers, invited speakers and students.

BM556 Green Bioengineering:

In this course, the scientific, technological, engineering, and mathematical principles applied for the protection of the natural environment and the development of the existing environment at the local, regional, and global level will be explained. Green engineering and sustainability, environmental and health problems, green chemistry and engineering measurements, bioprocesses, catalysts in bioprocesses, reaction conditions in bioprocesses, reactors in green engineering, life cycle inventory, effects of energy production in environmental life cycle, environmental risk assessment, renewable resources are the topics will be covered in the scope of the course.

BM558 Bioprocess Engineering:

The objective of this course is to gain understanding of properties of biocatalysts and biochemical reactions, examination of the kinetics of bioconversions and heat and mass transfer calculations of bioprocesses.

BM560 Applied Project-II:

The aim of this course is to gain laboratory skills for students from different fields to adapt to Molecular Biology-Genetics and Bioengineering sub-fields before master's thesis study. Basic laboratory techniques required to be able to make experiments independently will be taught to the students.

BM591 Master's Thesis-I:

It is an experimental or theoretical study that can be used to synthesize and apply the knowledge gained in vocational education. During the thesis studies, it is aimed to teach literature review in a field of Bioengineering, design an experiment, prepare thesis and make a presentation about the thesis.

BM592 Master's Thesis-II:

It is an experimental or theoretical study that can be used to synthesize and apply the knowledge gained in vocational education. During the thesis studies, it is aimed to teach literature review in a field of Bioengineering, design an experiment, prepare thesis and make a presentation about the thesis.

ENS501 Research Methods and Scientific Ethics:

Science, knowledge, scientific research, paradigms, quantitative research approach, qualitative research approach, the effect of approaches on educational research, research process, ethical and scientific ethics, writing of research, producing hypothesis, content of thesis, article and thesis sections, giving information about scientific research methods, completion of the preparation for the dissertation stage, project opportunities, project writing topics are topics covered in the course.

ENS502 Applied Biostatistics:

Basic concepts of statistical models, variation, statistical criteria, distributions, significance tests, variance analysis, basic experimental design, regression and correlation, covariance, multiple regression, curvilinear regression are among the topics to be covered in the course. The topics covered in the course will be supported using a computer laboratory and statistical software for computational topics.