# ISTANBUL OKAN UNIVERSITY
## ENGINEERING AND NATURAL SCIENCES FACULTY
## GENETICS AND BIOENGINEERING COURSE CONTENTS

**Semester 1**
**MATH113 Mathematics I (3-2)4**

Functions and Their Graphs, Combiring Functions; Shifting and Scaling Graphs, Trigonometric Functions. Rates of Change and Tangents to Curves, Limit of a Function and Limit Laws, The Precise Definition of a Limit, One-Sided Limits, Continuity, Limits Involving Infinity; Asymptotes of Graphs. Tangents and the Derivative at a Point, The Derivative as a Function, Differentiation Rules, The Derivative as a Rate of Change, Derivatives of Trigonometric Functions, The Chain Rule, Implicit Differentiation, Related Rates, Linearization and Differentials. Extreme Values of Functions, The Mean Value Theorem, Monotonic Functions and the First Derivative Test, Concavity and Curve Sketching, Applied Optimization, Antiderivatives. Area and Estimating with Finite Sums, Sigma Notation and Limits of Finite Sums, The Definite Integral, The Fundamental Theorem of Calculus, Indefinite Integrals and the Substitution Method, Substitution and Area Between Curves, Volumes Using Cross-Sections, Volumes Using Cylindrical Shells, Arc Length, Areas of Surfaces of Revolution. Inverse Functions and Their Derivatives, Natural Logarithms, Exponential Functions, Indeterminate Forms and L'Hopitai's Rule, Inverse Trigonometric Functions, Hyperbolic Functions.

**PHYS113 Physics I (2-2)3**

Vectors. Kinematics. Newton's Law of Motion. Work and energy. Conservation of energy. Linear momentum and its conservation. Rotation of rigid bodies about a fixed axis. Rotational kinetic energy.

**ATA111 Atatürk Principles and The History of Turkish Revolution I (2-0)2**

This course covers the analysis of the causes and the consequences of the First World War; the searches for independence of the Turkish nation in Anatolia and salvation of the Turkish lands that were occupied after the Armistice of Montrose; the development and activities of Nationalist militias and the societies against them; the evaluation of the congress administrations that were formed after 19 May 1919 in terms of their form and content; the structure of the Grand National Assembly and the process through which it gained legitimacy; the leadership of Turkish War of Independence; Treaty of Lausanne, and the Establishment of the Republic.

**TRD111 Turkish Language I (2-0)2**

What is language? Importance of language and its place in a nation's life, language-culture relationship. Definition of grammar, function of grammar, and departments of grammar. Phonetics: sounds and audio features of Turkish. Morphology: formal properties of Turkish (roots-adds). Words and word phrases. General information about composition, subject, perspective, ideas, main and ancillary ideas, paragraphs, and intellectual order. Written

expression, paragraph, content, and types (introduction, development, and conclusion paragraphs). Expression forms: explanatory, descriptive, argumentative, and narrative expression. Written expression: petition writing, quoting, footnotes, and bibliography writing. Oral expression, speech, and speech types (prepared speeches, panel, and discussion policies). Literary types: artistic (poetry, short stories, novels, theater and intellectual (articles, paragraphs, essays, criticism, interviews…). Reading and studying the works about literature and idea world. Analyzing an editing text (story, novel, theater).

### GBE101 Introduction to Genetic and Bioengineering (2-0)2

Discuss the terms molecular biology, genetics and bioengineering, describe the molecular structure of the DNA, RNA, and proteins, explain the importance of DNA, discuss the relation between DNA, RNA, and proteins, explain how DNA damage occurs and how cells repair the DNA damage, describe transcription and discuss the differences of transcription between eukaryotic and prokaryotic cells, describe the translation and gene expression studies, explain what the stem cells are and main properties of stem cells

### CHM103 Chemistry (3-0)3

Properties of Matter, Fundamental Laws Of Chemistry, The Atomic Theory, Electron configuration, The concept of the mole, The Periodic Table, Chemical Compounds, Thermochemistry-enthalpy-entropy, internal energy, Solutions and their physical properties, Chemical Kinetics-Determination of the rate of reaction, Chemical equilibrium, Acids and Bases, Electrochemistry, Batteries and Electrolysis, Redox reactions

### Elective Foreign Language (2-2)3
### Semester 2
### MATH114 Mathematics II (3-2)4

Integration by Parts, Trigonometric Integrals, Trigonometric Substitotions, Integration of Rational Functions by Partial Fractions, Improper Integrals. Sequences, Infinite Series, The Integral Test, Comparison Tests, The Ratio and Root Tests, Alternating Series, Absolute and Conditional Convergence, Power Series, Taylor and Maclaurin Series, Convergence of Taylor Series. Three-Dimensional Coordinate Systems, Vectors, The Dot Product, The Cross Product, Lines and Planes in Space, Cylinders and Quadric Surfaces. Functions of Several Variables, Limits and Continuity in Higher Dimensions, Partial Derivatives, The Chain Rule, Directional Derivatives and Gradient Vectors, Tangent Planes and Differentials, Extreme Values and Saddle Points, Lagrange Multipliers. Double and Iterated Integrals over Rectangles, Double Integrals over General Regions, Area by Double Integration, Double Integrals in Polar Form, Triple Integrals in Rectangular Coordinates, Triple Integrals in Cylindrical and Spherical Coordinates, Substitutions, Integration, fundamental theorem integral calculus. Application of definite integrals; area between curves, volumes calculation,

lengths of plane curves, area of surfaces of revolution. Transcendental functions; exponential functions, logarithms, hyperbolic functions. Techniques of integration.

### PHYS114 Physics II (2-2)3

Charge and matter. The electric field. Gauss' Law. Electrostatic potential. Capacitance. Current and resistance. Electromotive force and circuits. RC circuits. The magnetic field. Ampéré's law. Faraday's Law of Inductance.

### ATA112 Atatürk Principles and The History of Turkish Revolution II (2-0)2

Lausanne Peace Treaty resulting success that is being converted to a modern state via announcement of Republic, and being gained to this state a modern, convenient to development identity, and placing Ataturk's Thought System to the memories precisely by the following revolutions of this process, so that our young people are made conscious and durable against to the threats to their personalities and to their countries.

### TRD112 Turkish Language II (2-0)2

The place of Turkish language among the world languages, alphabet that Turks use. The historical development of Turkish language, dialects of Turkish language. Turkish's syntax features, sentence analysis studies. Etymology, Semantics I (basic meanings, connotations), and Sense Events (meaning contraction, meaning expansion, meaning shift), Words' meaning relationship. Semantics II, metaphors, transfers (name transfer, phrase transfer) words, idioms, proverbs, slogans, and terms. Expression (language) mistakes and applications. Oral expression, speech, and speech types (panel, discussion principles). Written expression; business letters, minutes, reports, and news writing techniques. Ways to improve thinking in the paragraph, identification, sampling, comparison, utilization of numerical data, and producing a witness. Literary types: artistic( poetry, short stories, novels, theater) and intellectual (articles, paragraphs, anecdotes, essays, criticism, travel, biography, memoirs, letter…). Reading and studying the selected sample texts from the literature and idea world. Reviewing a scientific text.

### GBE102 Molecular Cell Biology I (2-0)2

Describe the basics of molecular biology, explain the fundamental processes of molecular cell biology, describe the terminology of life sciences, describe the cellular matrices and discuss how important they are for living cells, explain basic structures and functions of cellular membranes, describe the role of the cytoskeleton and how it interacts with cellular components, review the roles of organelles, describe energy production and types of energy productions in cells, describe the communication and transport in/between cells.

## CLP001 Carrier and Life Planning (0-2)1

Professional and personal development, seminars, workshops, specialized certification programs, industry and business-field demonstrations, meetings with professionals, on-site training sessions, and social-sporting events.

## Elective Foreign Language (2-2)3
## Semester 3
## GBE208 Analytical Chemistry (3-0)3

This course gives an introduction to analytical chemistry and an overview of important analytical methods and their range of application within the detection of inorganic and organic compounds. Important analytical quantitative techniques from classical methods, electrochemical methods, spectrochemical/spectrophotometric methods, mass spectrometry, and separation techniques are reviewed. The course also includes theory on sampling, analyses of real samples, risk assessment of chemical experiments, important steps and procedures in analytical chemistry, and evaluation/interpretation of results. The course gives an overview of the important use of selected classical and instrumental chemical quantitative analytical methods and a short introduction to their basic theory.

## GBE201 Molecular Cell Biology II (2-2)3

This course defines the detailed structure and function of DNA, explain the mechanisms of chromosomal DNA packaging, discuss genome organization, define DNA replication, repair, and recombination, explain how cells read the genome: from DNA to protein, indicate the similarities and differences of transcription and translation mechanisms in prokaryotes and eukaryotes, identify gene expression control mechanisms, underline epigenetics, explain the cell cycle and justify the importance of cell-cycle control system, differentiate cell death mechanisms, describe and differentiate most commonly used molecular biology techniques.

## GBE205 Microbiology (2-2)3

This course describes the content of the microbiology and classification of microorganisms, discuss of structure, physiology, and culture conditions of the bacteria, describe the general features of fungus, viruses, and parasites, genetic structures of bacteria and other microorganisms, understand the microorganism-host interaction, basic immunology, and immune response mechanism, describe antimicrobial agents and resistance mechanism, understand the concept and application of sterilization and disinfection.

## MATH265 Probability and Statistics I (3-0)3

Set Theory, Random Variable, Sample Space, Important Theorems on Probability, Conditional Probability, Bayes' Theorem, Tree Diagrams, Permutations, Combinations, Binomial Coefficients, Stirlings Approximation, Discrete and Continuous Probability Distributions, Mathematical Expectation, Variance and Standard Deviation, Joint Distributions, Normal, Binomial, Poisson, Multinomial, industrial applications.

**MATH215 Mathematics III (2-2)3**

Systems of linear equations; Solution sets of linear equations; Linear dependence and independence; Matrix Algebra; Inverse of a matrix and its characterization; Partitioned matrices; Determinants and their properties: Calculation of determinants; Column and row expansions; Minor and cofactors and inverse matrix; Cramer's rule; Vector spaces: Subspaces, null spaces and column spaces (Image); Basis and coordinate transformations; Linear transformations and their representations; Representation of coordinate transformation; Eigenvalues and eigenvectors: Characteristic polynomial and Cayley-Hamilton Theorem; Diagonalization of linear transformations and matrices; Matrix polynomials; Diagonalizaton of symmetric matrices and projections; Generalized eigenvectors and eigenspaces; Inner product spaces: Orthonormal sets, Gram-Scmidt process; Singular value decomposition; Pseudo inverse; Least squares

**Elective Foreign Language (2-2)3**
**Semester 4**
**CMPE152 Computer Programming (2-2)3**

Fundamentals of Python programming including basic data types, input/output operations, control statements, branching and iteration structures. Program design using functions, decomposition, abstraction, and recursion. Core data structures such as strings, lists, tuples, and dictionaries, along with mutability, cloning, and list comprehensions. Problem solving, testing, debugging, and exception handling techniques. Object-Oriented Programming concepts including classes, methods, and inheritance. Algorithmic thinking, complexity analysis, sorting algorithms, hashing, simulations, basic file handling, and development of practical real-world applications.

**GBE210 Organic Chemistry (3-0)3**

The scope of organic chemistry and atomic properties of carbon, chemical bonding, hybrid orbitals, aliphatic hydrocarbons (alkane, cycloalkane), alkenes, alkynes, halogenated compounds, alcohols, diols, ethers, aromatic compounds, aldehyde, ketone, carboxylic acids and derivatives, amines, and polymers

**GBE216 Biomaterials (3-0)3**

This course provides a comprehensive introduction to biomaterials and their significance in human health. It covers the molecular structures of major classes of biomaterials and emphasizes the importance of interdisciplinary collaboration to enhance comfort and quality of life. Students will explore the evolving field of biomaterials in the modern era and learn how the biosynthesis and structural assembly of materials, such as bone, cartilage, basement membrane, wool, silk, and cellulose, contribute to desirable functional properties, including mechanical strength, adhesion, and lubrication. The course also addresses various

characterization methods used to evaluate biomaterials for specific applications, introduces the concepts of biocompatibility and biodegradation, and explains their relevance in the field of biomaterial science. Emphasis is placed on understanding how laboratory parameters influence the development of suitable biomaterials, alongside discussions on laboratory safety, sterilization methods, ethical considerations, and complex legal issues such as animal testing. Additionally, the course provides insight into the economic aspects and market dynamics of biomaterials.

### GBE202 Bioengineering Laboratory (0-4)2

Learn the safety and general rules of a laboratory, how to use basic laboratory instruments, learn how to use basic measurement devices, and make calculations with them, prepare basic buffers, mediums, and mixes of biological samples, learn bacterial growth, staining, imaging, describe molecular tools such as PCR, isolation, ligation, etc. and learn how to use them.

### MATH266 Probability and Statistics II (3-0)3

The relationship among Normal, Binomial, Poisson, Multinomial, Hypergeometric etc Distributions, Population and Sample, Statistical Inference, Population Parameters, Sample Statistics, Sampling Distribution of Means, Sampling Distribution of Proportions, Sampling Distribution of Variances, Frequency Distributions, Statistical Decisions, Statistical Hypotheses, Test of Hypotheses and Significance, Type I and Type II Errors, One-Tailed and Two-Tailed Tests, Special Test of Significance for Large Samples

### MATH216 Mathematics IV (2-2)3

Introduction and Classification of Differential Equations; First Order Differential Equations: Solution of Separable and Linear Differential Equations; Substitution Methods and Exact Differential Equations; Order Reduction; Higher Order Differential. Equations: Linear, homogeneous Equations with Constant Coefficients; Nonhomogeneous Equations and Method of Undetermined Coefficients; Method of Variation of Parameters; Laplace Transform: Solution of initial value problems; Linear Systems of Differential Equations; Homogeneous Differential equations in R2; Solution via eigenvalues and eigenvectors; Homogeneous Differential equations in R3; Matrix exponential and Fundamental matrix solution; Solution of Nonhomogeneous Equations; Laplace transform methods; Power Series Method: Series Solution Near Ordinary Points; Regular Singular Points; Method of Frobenius

### GBE222 Biotransport (3-0)3

This course introduces the fundamental concepts of transport phenomena within biological systems, focusing on momentum, mass, and heat transfer in living organisms. Students explore diffusion and convection mechanisms, conservation laws, and mass transport in porous media such as tissues and membranes. Special emphasis is placed on fluid dynamics in blood circulation, including pressure and flow characteristics, and the factors affecting

vascular transport. The course also covers biochemical interactions, cell adhesion, and drug or macromolecule transport in solid tumors. In addition, students examine mechanisms of heat transfer and energy conservation in biological contexts. Through theoretical knowledge, practical examples, and biologically relevant case studies, students gain the ability to analyze and interpret transport phenomena in bioengineering and biomedical applications.

## Semester 5

### GBE301 Cell and Tissue Engineering (2-4)4

Discuss the terms of cell and tissue engineering, recognize its applications, describe the subjects, tools, and protocols used in cell and tissue engineering, explain the characteristics of cells, tissues, and microenvironments used for tissue engineering, describe the technological requirements for *in vitro* cell, tissue, and biomaterial development, explain molecular and cellular engineering, describe the applications of cell and tissue engineering in medicine and recognize the complications, understand the ethical, legal and quality aspects of cell and tissue engineering applications.

### GBE323 Biochemistry I (2-2)3

Describe general cell structure and subcellular organelles, describe the structure and metabolic function of carbohydrates, lipids, proteins, and nucleic acids, describe the functions, properties, and mechanisms of enzymes, describe the biochemical function of vitamins, describe the biochemical function of membrane, describe the metabolism in cytoplasm, mitochondria and nucleus, summarize the metabolism of amino acid and proteins, carbohydrates and lipids in different compartments of the cell, describe metabolic disorders of amino acid and proteins, carbohydrates and lipids, understand the principles of laboratory tests.

### GBE313 Physiology (3-0)3

This course provides a comprehensive theoretical foundation in human physiology, covering the key organ systems and cellular mechanisms that maintain homeostasis and support life. Topics begin with an introduction to the general principles of physiology, followed by an exploration of cell membrane potentials and transport mechanisms essential for signal transmission and cellular function. The course includes in-depth coverage of muscle physiology, cardiovascular and circulatory physiology, respiratory system function, and neurophysiology. Additional focus is given to the gastrointestinal system, hematological components and functions, endocrine regulation, and genitourinary physiology. Students will gain a systems-level understanding of how various physiological processes integrate and respond to internal and external stimuli. The course emphasizes conceptual understanding, physiological mechanisms, and system interactions, preparing students for more advanced studies in biomedical or health sciences.

### GBE315 Bioinformatics (2-2)3

This course provides a comprehensive introduction to bioinformatics, focusing on fundamental concepts, tools, and applications in the analysis of biological data. Students explore key topics such as biological databases, sequence alignment algorithms (e.g., BLAST, Needleman-Wunsch, Smith-Waterman), molecular evolution, and phylogenetic tree construction. The course also includes hands-on training in multiple sequence alignment tools (e.g., Clustal Omega, MUSCLE, MAFFT), protein structure and interaction analysis, motif and domain prediction, and transcriptomic data interpretation using RNA-Seq. Additional topics include genome analysis and annotation, quality control and assembly of sequencing data, protein modeling, metagenomics, and bioinformatics approaches to genetic diseases. Through both theoretical instruction and computer-based exercises, students gain practical skills to analyze, interpret, and visualize DNA, RNA, and protein data for research in genomics, molecular biology, and systems biology.

**Faculty Elective Course (3-0)3**
**Semester 6**

### GBE302 Genetic Engineering (2-4)4

Underline how genetic engineering can be used to edit the genome to set up experimental models, recognize the methods of genetic engineering, perform DNA cloning, differentiate the vectors for protein expression, design a recombinant DNA via using bioinformatics tools, express a recombinant protein, explain how genetic editing is done in cell lines, discuss the applications of genetic engineering in different fields of industry.

### GBE306 Quality and Safety Management (1-0)1

Quality-Quality Control-Quality Management-Quality Engineering, Total Quality Management, Quality management system standards, Processes-Processes Management-Statistical Processes Control, Processes capability analysis and control schemes, Quantitative control charts, Qualitative control charts, Other special control schemes (CUSUM, EWMA, Regression), Acceptance Sampling, One and two-stage sampling, Multi-stage and serial sampling, Quality improvement – Kaizen and Six Sigma, Quality economics.

### GBE324 Biochemistry II (3-0)3

This course is designed to provide advanced knowledge and understanding of key topics in biochemistry related to metabolism. Building upon the foundational concepts covered in Biochemistry I, this course delves deeper into the intricacies of cellular metabolism, with a focus on carbohydrate metabolism, the citric acid cycle, electron transport, photosynthesis, lipid metabolism, energy metabolism, amino acid metabolism, and signal transduction. Through comprehensive lectures and case studies, students will gain a deeper understanding of the molecular mechanisms and regulatory processes that underlie cellular energy

production and signaling pathways. This course requires a strong foundation in biochemistry and a thorough understanding of the basic principles covered in Biochemistry I. It is recommended that students have completed courses in introductory biochemistry and molecular biology.

### GBE326 Industrial Genetics and Bioengineering I (1-4)3

The goal is to teach the interrelation of plant design and research in bioengineering. Students will learn how to approach solving problems in the manufacture of industrially important products by using genetically modified materials or microorganisms and significantly using bioengineering tools. They will be coached in the skills needed to thrive in the research industry and to accomplish their projects efficiently. By making them work in the class, they will also learn the importance of understanding the context of their work with respect to their colleagues, their society, and their world. During the course, they will learn enzyme kinetics, bioreactor and fermenter design, and separation techniques in upstream and downstream processing. This course is the application of all the learning from previous years.

### GBE395 Seminar (1-2)2

This course is designed to equip students with essential skills for career readiness, focusing on CV and cover letter preparation. The course will also feature a series of seminars with invited speakers from academia and industry, providing insights into current research trends, career opportunities in biotechnology, effective job searching, and future biotechnological trends. This course will provide students with practical skills and professional insights essential for transitioning from academic to professional life as a fourth-grade student and offer a comprehensive understanding of career paths and industry expectations.

### IE367 Occupational Health and Safety (3-0)3

Worker health and safety of the historical development, general information, business security concept, work-related accidents definition, causes and methods of prevention, safety studies, labor productivity in terms of importance, job security studies economic significance, the occurrence of industrial accidents and classification, hazards and dangers varieties accident research methods and solutions.

### Semester 7

### GBE425 Industrial Genetics and Bioengineering II (1-4)3

In the context of this course, the students will practically learn how to prepare a preliminary plant design by using the bioengineering methods, the criteria for selecting the appropriate genetically modified materials or microorganisms, possible bioreactor or fermenter design, the selection or design of each unit in the plant, final financial analysis, and feasibility report, according to the whole knowledge they recovered in the previous years.

### GBE411 Biomedical Engineering (3-0)3

To explain and discuss what biomedical engineers do in their professional activities, understand the fundamental principles used by bioengineers in cellular and molecular biotechnology, biomaterials, tissue engineering, biomechanics, and biomedical imaging, explain the developing profession of biomedical engineering in the modern era, describe the economical perspective and market of biomedical instruments, explain ethical principles, and describe the complex legal issues.

### GBE497 Genetic and Bioengineering Design (0-2)1

This course consists of the design of a complex system, process, device, or product, within the framework of preferably a multi-disciplinary engineering problem, under realistic constraints, and taking into consideration social, economic, and environmental conditions as well as relevant national and international standards and characteristics of sustainability and manufacturability, without compromising ethical principles, the student is required to document the requirements specification and the design in conformance with international standards.

### BBA222 Entrepreneurship Applications (2-0)2

Principles of entrepreneurship, Strategic management for entrepreneurship, creativity, human resources management and communication for entrepreneurs, Business Planning, Entrepreneurship in Turkey / Success stories.

### Departmental Elective Course (3-0)3

### University Elective Course (3-0)3

### Semester 8

### GBE498 Genetics and Bioengineering Graduation Project (0-4)2

This course consists of the implementation based on accessible resources, then testing and validation of the level of satisfaction of the requirements followed by the documentation of all this process in conformance with international standards, and its defense in front of a jury, of a complex system, process, device or product, designed within the framework of preferably a multi-disciplinary engineering problem, under realistic constraints, and taking social, economic and environmental conditions as well as relevant national and international standards and characteristics of sustainability and manufacturability into consideration, without compromising ethical principles.

### INT001 Internship I (0-0)0

Our students have to work for 20 work days in research laboratories of universities, hospitals, or research laboratories related to hospitals, R&D companies, drug-producing research centers, private companies, or research laboratories of universities abroad in order to gain practice.

**Departmental Elective Course (3-0)3**
**Departmental Elective Course (3-0)3**
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### GBE420 Protein Engineering (3-0)3 (Departmental Elective Courses)

Underline the importance of protein biotechnology, discuss the therapeutic usage of hormones and growth factors such as insulin, LH, FSH, EPO, IGF, etc., explain interferons, interleukins, and additional regulatory factors, comprehend protein purification methods, define enzyme biosynthesis, activity, catalysis, specificity, and inhibition, and discuss the tools of gene expression analysis.

### GBE424 Molecular Signalling Pathways and Cancer (3-0)3 (Departmental Elective Course)

Imagine the basics of signal transduction, discuss the signaling pathways in which signaling proteins interact with each other in vast interconnected networks, describe the cellular effects of signaling molecules, describe the nature of cancer, comprehend the maintenance of genomic integrity and development of cancer, and recognize the underlying molecular biology and genetics in anti-cancer therapies.

### GBE412 Interdisciplinary Bioengineering (3-0)3 (Departmental Elective Course)

It aims to combine the bioengineering discipline with other disciplines such as molecular biology, genetics, biochemistry, neurobiology, evolutionary biology, structural biology, cell biology, immunology, developmental biology, cancer biology, stem cell biology, and biophysics via reading, examining, analyzing, and discussing popular novel papers in order to be a bioengineer with an interdisciplinary point of view.

### GBE 417 Forensic Technologies (3-0)3 (Departmental Elective Course)

This course aims to discuss the fundamental concepts of forensic science. In this course, the history of forensic science, crime scene investigation, types of evidence and collection, analysis of fingerprints, and collected evidence will be evaluated by several techniques, including chemistry, molecular biology, and criminology.

### GBE 436 Thermodynamics for Bioengineers (3-0)3 (Departmental Elective Courses)

Introduce the students to basic concepts of thermodynamics, such as properties of pure substances with phase changes, energy transfer by heat, work, and mass, 1st Law of

Thermodynamics in open and closed systems, 2nd Law of Thermodynamics, and Entropy. This course is designed to provide the knowledge necessary to cover the fundamentals of thermodynamics and their applications to bioengineering problems and thermodynamic analysis of bioreactors.

### GBE 438 Introduction to Nanoscience and Nanotechnology (3-0)3 (Departmental Elective Courses)

Provides a general introduction to the field of Nanoscience and Nanotechnology. Explores the multidisciplinary nanotechnology research field, nanomaterial properties, nanostructure synthesis, and characterization techniques. Evaluate the application of nanotechnology to both process nanomaterials and to build nanodevices in biotechnology, environmental, medicinal, and food science. Evaluate applied nanotechnology products and discuss the future of nanotechnology and its effect on our future lives.

### GBE 427 Nutrigenomics (3-0)3 (Departmental Elective Course)

This course in nutrigenomics discusses nutrient: gene interactions. The course focuses on modern advances in knowledge related to how nutrients from the food we eat interact with our genetic material and how this impacts health and lifespan. This course will provide in-depth information on modern techniques in genomics, as well as a discussion of how small changes in the genetic code lead to changes in our bodies 'interpretation of incoming nutrients.

### GBE440 Immunology (3-0)3 (Departmental Elective Course)

"Immunology" is a department elective lecture designed specifically for genetics students, aiming to provide a comprehensive understanding of the immune system and its role in maintaining health and combating diseases. This course explores the fundamental principles of immunology, including the components of the immune system, immune cell development, and activation, immune responses to pathogens, immunological disorders, and the application of immunological principles in genetics research. Through lectures, case studies, and discussions, students will gain a deep appreciation of the complex and dynamic nature of the immune system and its impact on genetic factors and diseases.

### GBE488 Epigenetics in Human Health (3-0)3 (Departmental Elective Course)

This course is a faculty elective course and aims to provide students with a deep understanding of the concepts used in understanding epigenetic health and the factors that determine epigenetic health. This course will enable students to question and criticize current life experiences and lifestyles within the framework of epigenetic health, and to be aware of lifestyle choices to improve epigenetic health. Lectures will be combined with lectures, scientific studies, presentations, and project studies.

### GBE434 Recent Topics in Biotechnology (3-0)3 (Departmental Elective Course)

This course aims to provide students with an in-depth understanding of emerging trends, advancements, and applications in the field of biotechnology. Through a comprehensive exploration of cutting-edge topics, such as gene editing, synthetic biology, personalized medicine, and bioprocessing, students will gain valuable insights into the latest developments in biotechnology and their implications for genetics and bioengineering research and applications. This course combines lectures, journal club studies, and interactive discussions to foster critical thinking and inspire students to explore the vast potential of biotechnology in addressing current challenges and shaping the future of genetics.

**GBE419 Evidence and Investigation Technologies (3-0)3 (Departmental Elective Course)**
This course delves into the cutting-edge advancements and emerging technologies that are revolutionizing the field of forensic science. Students will explore the latest methodologies used in crime scene investigation, DNA analysis, digital forensics, and biometric identification. The content covers innovative tools such as 3-dimensional crime scene reconstruction, advanced spectrometry, and artificial intelligence applications in forensic analysis. Through comprehensive content of lectures and case study analysis, students will gain a deep understanding of how these innovations are applied to solve real-world criminal cases. By examining contemporary research and technological developments, students will be equipped with the theoretical knowledge necessary to understand and evaluate the impact of state-of-the-art forensic technologies, preparing them for advanced study or careers in forensic science and related fields.

**GBE470 Biostatistics (3-0)3 (Departmental Elective Course)**
The biostatistics course aims to provide students with an in-depth understanding of statistical methods applied to biological and health sciences. The course begins with an introduction to statistics and progresses through the exploration of data using tables and graphs, describing and comparing datasets, and estimating parameters with appropriate sample sizes. Students will gain practical skills in hypothesis testing, making inferences from two samples, and applying correlation and regression techniques. Advanced topics include goodness-of-fit tests, contingency tables, and analysis of variance, alongside nonparametric methods for data that do not meet traditional assumptions. The course also covers survival analysis, equipping learners with essential tools to analyze time-to-event data in genetics and bioengineering research.

**GBE472 Plant Physiology and Plant Tissue Culture Techniques (3-0)3 (Departmental Elective Course)**
This course provides students with a comprehensive understanding of the fundamental concepts of plant physiology and plant tissue culture. It covers topics such as photosynthesis, respiration, water relations, mineral nutrition, plant hormones, and stress physiology, as well as the theoretical principles of in vitro culture techniques, including callus formation,

organogenesis, somatic embryogenesis, and micropropagation. The course focuses on explaining the physiological mechanisms underlying plant growth and development and introduces the conceptual basis of plant tissue culture applications in biotechnology. Through lectures and interactive discussions, students will gain theoretical knowledge on how physiological and cellular processes can be utilized in plant biotechnology and genetic engineering.