

**ISTINYE UNIVERSITY**

**FACULTY OF ARTS AND SCIENCES**

**DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS**

**COURSE DESCRIPTIONS**

**1<sup>st</sup> SEMESTER**

**Professional English I**

This course is a learner-centered, integrated-skills based course that will develop students in the four skills (reading, writing, listening and speaking) in an academic and professional context.

**Differential and Integral Calculus**

Analytic geometry, functions and limits, derivatives, techniques and applications of differentiation, logarithmic and trigonometric functions. Definite and indefinite integrals, techniques of integration, with applications in sciences and engineering. PREREQUISITES: Freshman standing in physical sciences and engineering and the knowledge of MATH 10.

**General Biology I**

The content of this course includes a general introduction to biologic sciences while presenting different organisms (prokaryotes, eukaryotes, fungi, animals, virus); information about basic macromolecules that form the building block of organisms and a brief introduction of cells.

**General Chemistry**

Properties of Matter and Measurement, Atoms and Atomic Theory, Chemical Reactions, Introductions to Aqueous Solutions, Gases, Chemical Bonding, Molecular Geometry, Acids and Bases, Common Ion Effect -Buffered solutions, Solution Concentration, Chemical Kinetics, Liquids and Solids, OxidationReduction and Electrochemistry.

**Turkish Language I**

Definition and characteristics of language. Languages of the world, The place of the Turkish language among world languages, Historical development of Turkish language. Turkish grammar and parts of Turkish grammar, expression types: written expression and verbal lecture, spelling rules and practice, punctuation marks.

### **Ataturk's Principles and History of Turkish Revolution I**

The declaration of the Republic; The importance of the leader and the staff in the revolution; Constitutional solutions to the problems related to the Lausanne Conference; The participation of Turkey in pacts and in international organizations; Reactions to the new governmental structure; Trials in the multi-party system; The Home and foreign policy of the Republic of Turkey; Atatürk's foreign policy to inspire confidence in the future of Turkey; Kemalism the Principles of Atatürk.

### **Introduction to Molecular Biology and Genetics Program**

The course aims to introduce molecular biology and genetics. Each week different scientists/speakers will be invited to the seminars and thus students will be informed about the studies performed in molecular biology and genetics field.

### **Manifest of Istinye I**

This course is led by Student Center. Students are required to participate social activities, social responsibility projects, part-time jobs.

## **2<sup>nd</sup> SEMESTER**

### **Professional English II**

This course is a learner-centered, integrated-skills based course that will develop students in the four skills (reading, writing, listening and speaking) in an academic and professional context.

### **General Biology II**

This course covers plant biology (transport, nutrition, hormones, reproduction), animal systems (endocrine system, immune system, nervous system, digestive system, urinary system, reproductive system, respiratory system and circulation system), cellular respiration, photosynthesis, cell cycle, mitosis and meiosis, brief introduction to central dogma.

### **Fundamental Physics**

This course covers Standards and units; vectors and coordinate systems; kinematics; dynamics; work, energy and power; conservation of energy; dynamics of system of particles; collisions; rotational kinematics and dynamics; oscillations; Charge and matter; electric field and Gauss' law; DC circuits; magnetic field; Ampere's law; Faraday's law; inductance; magnetic properties of matter; Maxwell's equations.

### **Manifest of Istinye II**

This course is led by Student Center. Students are required to participate social activities, social responsibility projects, part-time jobs.

### **History of Molecular Biology**

The aim of the course is to raise awareness and give point of a view to the students through the developments in the field of molecular biology from the past to the present as well as its relation with other disciplines in this process and current news in this field that they will need for their career development.

### **Linear Algebra**

Matrices and System of Equations, Systems of Linear Equations, Row Echelon Form, Matrix Algebra, Elementary Matrices, Determinants, The Determinant of a Matrix, Properties of Determinants, Cramer's Rule, Vector Spaces, Definition of Vector Space, Subspaces, Linear Independence, Basis and Dimension, Change of Basis, Row Space and Column Space, Linear transformations, Matrix Representations of Linear Transformations, Orthogonality, The Scalar Product, Orthogonal Subspaces, Inner Product Spaces, Orthonormal Sets, The Gram-Schmidt Orthogonalization Process, Eigenvalues and Eigen vectors, Diagonalization.

### **Turkish Language II**

Definition and characteristics of language. Languages of the world, The place of the Turkish language among world languages, Historical development of Turkish language. Turkish grammar and parts of Turkish grammar, expression types: written expression and verbal lecture, spelling rules and practice, punctuation marks.

### **Ataturk's Principles and History of Turkish Revolution II**

The declaration of the Republic; The importance of the leader and the staff in the revolution; Constitutional solutions to the problems related to the Lausanne Conference; The participation of Turkey in pacts and in international organizations; Reactions to the new governmental structure; Trials in the multi-party system; The Home and foreign policy of the Republic of Turkey; Atatürk's foreign policy to inspire confidence in the future of Turkey; Kemalism the Principles of Atatürk.

## **3<sup>rd</sup> SEMESTER**

### **Academic English I**

Students undertaking this course will develop their skills in reading, writing, and speaking English in an intensive study situation. They will read selected English literary texts (or extracts from them), learn skills for understanding these texts, and develop written and spoken responses to them. The selected texts will be appropriate for both students whose first language is not English and for native speakers of English. Students will develop transferable skills in critical thinking, research, the evaluation of secondary sources, and the planning and drafting of academic essays.

### **Organic Chemistry I**

Atomic and molecular Orbitals, hybridization, molecular geometry, Resonance and inductive effect, acid base, dipole moment, Saturated Hydrocarbons (Alkane, Cycloalkane and conformation), Unsaturated hydrocarbons (Alkenes, Alkynes), Stereo chemistry, Alcohols and Ethers, Aldehydes and Ketones, Amines, Carboxylic Acids and derivatives, Aromatic Compounds and related reactions.

### **Computational Thinking**

### **Basic Genetics**

Basic concepts of Mendelian genetics; chromosome theory in heredity; structure and function of genes; gene expression and its regulation; mutations and chromosomal defects; mutation types; DNA repair mechanisms, development, behaviour and population genetics and basic principles of evolutionary genetics.

### **Cell Biology**

Details of prokaryotic and eukaryotic cells; Molecular analysis of cellular structure and function; Specific functions of cellular compartments and organelles; cytoskeleton and cellular movement; molecular mechanisms of cell cycle and division; cellular adhesion; structure and function of extracellular matrix; cell signaling and differentiation.

### **Manifest of Istinye III**

This course is led by Student Center. Students are required to participate social activities, social responsibility projects, part-time jobs.

## **4<sup>th</sup> SEMESTER**

### **Academic English II**

Students undertaking this course will develop their skills in reading, writing, and speaking English in an intensive study situation. They will read selected English literary texts (or extracts from them), learn skills for understanding these texts, and develop written and spoken responses to them. The selected texts will be appropriate for both students whose first language is not English and for native speakers of English. Students will develop transferable skills in critical thinking, research, the evaluation of secondary sources, and the planning and drafting of academic essays.

### **Organic Chemistry II**

Detailed structures of amines, aromatic compounds, radicals, amino acids, peptides and proteins, carbohydrates; composition of natural compounds.

### **Human Genetics**

This course is designed to provide students with a basic understanding of the concepts of human genetics and genomics, in preparation for later application in the context of human development and congenital and acquired disease.

### **Microbiology**

Structure of microorganisms (bacteria, yeast, fungi and viruses); bacterial and viral growth; classification of microorganisms; physiology, metabolism and genetics of microorganisms; identification and control of microorganisms; microorganism-environment interactions; microbial pathogenesis and immunology; human-microorganism interactions; microbial diseases and treatments; microbial cultures.

### **Cytogenetics**

This course covers human chromosome structure, methodology, and techniques for the visualization of chromosome aberrations. Chromosome abnormalities will be discussed from the clinical and cytogenetic viewpoint. The course will also cover current topics in Cytogenetics, including new methodologies and their use in clinical genetics and research.

### **Manifest of Istinye IV**

This course is led by Student Center. Students are required to participate social activities, social responsibility projects, part-time jobs.

## **5<sup>th</sup> SEMESTER**

### **Biochemistry I**

Molecules of life; Structure and functions of amino acids; protein structure and function, enzymes and the basis of enzyme kinetics; enzymatic catalysis mechanisms; Structure and functions of carbohydrates, lipids and nucleic acids; DNA as genetic material; detailed structure of DNA and RNA; structure and functions of membranes.

### **Biophysics**

Microscopic and sub-microscopic methods in analysis of biological structures and functions; medical scanning techniques; radiation biophysics; molecular organizations and dynamics of membranes; thermodynamic principals of life processes; biophysics of neural system and neuronal transduction.

### **Molecular Genetics**

Chemistry and structure of the gene; DNA replication and recombination; transcription; translation; mutation; DNA repair mechanisms; control of gene regulation in prokaryotes and eukaryotes; transposable elements; genetics of bacteria and phages; gene cloning and manipulation.

### **Human Physiology**

Homeostatic control mechanisms; nerve cell physiology; central nervous system; peripheral nervous system; muscle physiology; cardiovascular physiology; blood and hematopoiesis; respiration and gas exchange; the kidneys; fluid and electrolyte balance; digestion and absorption of food; metabolism and energy balance; endocrine system; endocrine control of metabolism.

### **Molecular Biology of the Cell I**

Cells and Genomes; Cell Chemistry and Bioenergetics; DNA, Chromosomes, and Genomes; DNA Replication, Repair, and Recombination; Molecular Mechanisms of Transcription and Translation; Control of Gene Expression.

## **6<sup>th</sup> SEMESTER**

### **Biochemistry II**

The catabolism of phosphate bond energy, glycolysis, tricarboxylic acid cycle, pentose phosphate pathway, oxidative phosphorylation, oxidation of fatty acids, oxidative degeneration of amino acids, photosynthesis, biosynthesis of carbohydrates, lipids, amino acids and nucleotides.

## **Molecular Evolution**

Darwinian perspective of evolution, phylogeny, sources of genetic diversity, natural selection, genetic drift, gene flow, population genetics, species concept, history of life on earth, tree of life, animal, plant and microbial diversity, ecology.

## **Molecular Biology of the Cell II**

Membrane Structure; Membrane Transport of Small Molecules and the Electrical Properties of Membranes; Intracellular Compartments and Protein Sorting; Intracellular Membrane Traffic; Energy Conversion: Mitochondria and Chloroplasts; Cell Signaling; Cytoskeleton Structure and Function; The Cell Cycle; Molecular Mechanisms of Cell Death; Cell Junctions and the Extracellular Matrix.

## **7<sup>th</sup> SEMESTER**

### **Scientific Research Methods**

Responsible conduct of research (RCR): Collaborative Science, Conflicts of interests and commitment; data acquisition, management, sharing and ownership, ethical regulations in research involving human and animal subjects, mentoring; Peer review Publication practices and responsible authorship; research misconduct.

### **Biostatistics and Bioinformatics**

Measurements; Data analysis and organization of biological samples; Biological and Statistical variables; Samples and populations in biology; Descriptive statistics: central tendency, dispersion, standard error, confidence limits; Graphical display of data; Concepts of probability; Probability distributions; Hypothesis testing and inference: exact binomial tests, Chi-square tests, goodness of fit tests, Fisher's test, Student's t-test, ANOVA, MANOVA, Kruskal-Wallis test, Rank tests; Regression; Correlation; Contingency tables; Power analysis. Analyzing DNA, RNA and protein sequences; Access to Information; Pair-wise alignment; BLAST analysis; Multiple sequence alignment; Microarrays and Next-Generation Sequencing data analysis; Bioinformatic Approaches to RNA: Microarray and NGS; Proteomics data analysis; Bioinformatic analysis for human genome and human diseases.

### **Current Techniques in Molecular Biology**

Light and electron microscopy, spectroscopic techniques in biology, circular dichroism, the principles of chromatography, protein purification using chromatographic techniques, electrophoretic methods, identification of proteins and nucleic acids by electrophoresis, radioactive labelling methods, membrane filtration and dialysis techniques, centrifugation methods, polymerase chain reaction, DNA sequencing.

### **8<sup>th</sup> SEMESTER**

#### **Graduation Project**

A project is designed on a specific topic in an area of molecular biology and biotechnology for individual students to carry out laboratory studies under the supervision of a faculty member. A written final report and a presentation is required.

#### **Business Law and Occupational Health Safety**

Introduction to law; definition, main features, development and sources of labor law; concepts of employee, employer, employer's representative, workplace; foundation of labor relation, labor contract; types of labor contract; duties arising from labor contract; employee's duties of doing work; obedience; loyalty; employer's duties of paying wages, protecting employees and behaving equally; termination of labor contract; work stability; severance pay; workplace occupational health and safety; safe work practices in offices, industry and construction as well as how to identify and prevent or correct problems associated with occupational safety and health in these locations as well as in the home; implementation of safe healthy practices at work and at home.

### **DEPARTMENTAL ELECTIVE COURSES**

#### **Microorganism Genetics**

This course focuses on the genetics of prokaryotic microorganisms and their viruses. Some major topics covered are: regulation of gene expression, analysis of bacterial and phage genomes, plasmids, transposable elements, and mutation studies.



### **Plant Molecular Biology**

Structures of nuclear and cytoplasmic genomes; gene transfer techniques; gene expression and regulation in flowering plant development; transgenic plants and their use in biotechnology.

### **Modelling of Biological Systems**

Basic concepts of quantum mechanics; application of quantum mechanics to molecular systems (semi empirical, ab initio, DFT methods); molecular mechanics methods, molecular dynamics simulations, Monte Carlo simulation, conformational analysis, calculation of the geometries and energies of stable molecules and transition structures.

### **Enzymology**

Biology and chemistry of enzymes, laboratory and industrial techniques of enzyme purification, kinetics of enzymatic reactions: rapid equilibrium and steady-state kinetics, reversible and irreversible inactivation kinetics, enzymatic catalysis mechanisms, mechanisms to regulate enzyme activity, allosteric enzymes, industrial use of enzymes and enzyme immobilization methods, enzyme stabilization methods.

### **Developmental Biology**

Patterns of development; life cycles of model organisms and experimental techniques; morphogenesis; germ cells and fertilization; cell differentiation and stem cells; organogenesis; development of the nervous system; growth and post-embryonic development; regeneration; evolution.

### **Immunogenetics**

The genetic basis of self/non-self discrimination underlies all immune responses and can influence disease susceptibility at the level of both individual and populations. This course cover: the terms of immunogenetics and immunogenomics, genetic control of immune responses, genetics of infection (host and pathogen interactions), genetics of antigen presentation, immunogenetics of vaccination, tumors and reproduction.

### **Plant Tissue Culture**

Basic and advanced knowledge of plant cell cultures, including preparation of optimal conditions and culture media, sterility management and laboratory equipment. Basic and advanced knowledge about use of plant biotechnology in breeding and micropropagation techniques.

### **Cancer Biology**

Nature of cancer; oncogenes and tumor suppressor genes; signaling pathways in cancer; dysregulation of cell cycle and apoptosis; steps in tumorigenesis; treatment of cancer.

### **Introduction to Stem Cells**

The course will provide students with knowledge of wide-ranging topics related to stem cell and regenerative biology, including: a brief history of the field, research on animal models of regeneration, tissue engineering, and the political and ethical issues surrounding the stem cell debate.

### **Neurobiology**

Cellular and structural components of the nervous system; electrical signaling in nerve cells; action potential propagation; synaptic transmission; structure and function of ion channels; sensory systems; development of the nervous system; neuronal plasticity; learning and memory; consciousness and behavior; emotions; nervous system disorders.

### **Genetic Engineering and Biotechnology**

Cutting and joining DNA; Cloning vectors: Plasmid vectors, bacteriophage and cosmid vectors, phagemids; making a gene library; recombinant selection and screening; expression in E.coli of cloned DNA molecules; DNA sequence determination; polymerase chain reaction; site-directed mutagenesis; Gene transfer into plant and animal cells; Cell production methods in biotechnological processes; basis of fermentation technology; fundamentals of enzyme engineering; purification and recovery techniques of biomolecules; classification, operation and control of bioreactors; mixed cultures; utilization of genetically modified microorganisms; material production by plant cell cultures; material production by animal cell cultures.

### **Animal Tissue Culture**

In this course, students receive hands-on laboratory experience including sterile technique, media preparation, cell counting, maintenance and storage of cell lines, and scale-up.

### **Genetics of Aging**

This course is focused on the current research literature about the genetic mechanisms of aging in animals and human beings. Topics include: mitochondria mutations, insulin-like signaling, sirtuins, aging in flies and worms, stem cells, human progeria, and centenarian studies.

### **Molecular Biology of Diseases**

The focus of this course is primarily on the molecular biology of common human diseases.

## **TECHNICAL ELECTIVE COURSES**

### **Anatomy**

This course provides systematic, topographical and functional theoretical and practical knowledge of human anatomy to acquire knowledge, skills and attitudes.

### **Science and Ethics**

Scientific concepts, history of science, the birth of modern science, science and society, ethics of science.

### **Pharmacogenetics**

Science of pharmacogenomics and its application in clinical practice; genetic basis for individual differences in metabolizing enzymes, transporters, and other biochemicals impacting drug disposition and action that underpin the practice of precision (personalized) medicine.

### **Basic Principles of Metabolism**

Synthesis, breakdown and metabolism disorders in biomolecules in human metabolism; etiology of metabolic disorders like diabetes mellitus, obesity, cancer and cardiovascular disorders and the signaling pathway defects causing metabolic disorders.

### **Pathology**

Basic Concepts in pathology, cellular injury and adaptation, acute and chronic inflammation, cellular response to injury and wound healing, hemodynamic disorders, immune system diseases, neoplasia, genetic and pediatric diseases, environmental and nutritional diseases, pathology of infectious diseases, coronary artery disease, hypertension, diabetes and thyroid diseases, female genital system and breast diseases.

### **Introduction to Programming - Python**

Introduction to Scientific and Engineering Computing; Introduction to Program Computing Environment, Variables, Operations and Simple Plot, Algorithms and Logic Operators, Flow Control, Errors and Source of Errors, Functions, Linear Algebra Applications, Solving Equations Applications, Polynomials Examples, Curve Fitting Applications, Interpolation Applications, Numerical Integration

Applications, Symbolic Mathematics, ODE Solutions with built-in functions; Introduction to Python Programming Language.

## **NON-DEPARTMENTAL ELECTIVE COURSES**

### **Introduction to Psychology**

This course focuses on the key concepts of psychology. This course includes psychology as a behaviour science, psychology and human, determinants of psychology of human, human behaviour and social environment; child, young, woman, adult, elderly, and retired psychology, subfields of psychology, what is applied psychology, psychological interview techniques, theories of personality, human behaviour, important psychologists around the world and Turkey, stress, conflict and management, psychiatric social work, psychopathology, mental health and illnesses, what is social psychology.

### **Introduction to Sociology**

In this course, students are introduced with the discipline of sociology in relation to the formation of modernity. It examines some of the fundamental topics of sociology such as social transformation and inequality, poverty, ethnicity, gender, class, globalization, states, nationalism, citizenship and identities. It offers a particular focus on social transformation and problems in Turkey. The Turkish case was taken into consideration on the issues of neoliberal economy, urbanization, nationalism, political identities, citizenship and ethnicity.

### **Creative Writing**

This course gives avid readers the skills necessary to turn a love of the written word into a practical experience. It introduces the key characteristics of creative writing, and students are supported with stage-by-stage guidance as they assimilate and put into practice a range of critical and creative methods. In addition to tutor feedback on the course assignments, participants will be encouraged to discuss one another's writing in the course forums, and will be given guidance on offering constructive and useful criticism.

### **Written and Oral Expression**

The course aims to train students of language in understanding and processing of texts in Turkish, and the acquisition or improvement of linguistic skills: speech, writing and comprehension.

### **Critical Thinking**

This course covers some of the most central and important skills of critical thinking, and focus on applying those strategies to understanding current issues, belief systems, and ethical positions.

### **Entrepreneurship**

The following topics are included in the scope of this course: framework and definition of entrepreneurship/ Small businesses and entrepreneurship/ Creativity and innovation/creating or recognition and evaluation of the opportunity/ Preparing a business plan/ funding the venture/ raising money as seed and growth capital/ venture capital/ valuation of ventures. Succession planning/ selling a venture; mergers and acquisitions for ventures.

### **Foreign Language**