ISTINYE UNIVERSITY FACULTY OF ENGINEERING AND NATURAL SCIENCES

DEPARTMENT OF BIOMEDICAL ENGINEERING

COURSE DESCRIPTIONS

1. Semester

Calculus I (2+2), 5
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.

Computational Thinking (3+2), 6
Introduction to the central idea of computational thinking as it applies to a wide variety of human endeavors, including natural and physical sciences; computational mathematics with Sage, Matlab, and Mathematica; introduction to programming with Python.

Physics II (4+1), 6
Vectors. Motion in one and two dimensions. Newton's laws and its applications. Work and energy. Conservation of mechanical energy. Momentum and motion of systems. Static equilibrium of rigid bodies. Rotation and angular momentum. Newton's law universal gravitation.

Computing Literacy (2+2), 4
Email and IM usage and etiquette; Computer security basics; Mobile and Cloud computing basics; Google apps and services: Docs, Sheets, Slides, Drive, Calendar, Keep, Scholar; Apple apps and services.

Introduction to Biomedical Engineering (3+0), 5
A general introduction to biomedical engineering, in context with historical developments in science and technology. Topics include biomedical imaging and various imaging techniques, bioinstrumentation, biopotentials, biosensors, biomaterials, biomechanics, tissue engineering and clinical engineering.

Turkish Language I (2+0), 2
To teach the importance of language in human and social life; showing the classification of languages and teaching of Turkish among the world languages; to teach the characteristics of Turkısh in terms of phonology, morphology, syntax; to analyze spelling and writing rules of Turkish.

Occupational Health and Safety I (2+0), 2

2. Semester

Linear Algebra with Applications (2+2), 5
Systems of linear equations, matrix algebra, determinants, vector spaces and subspaces, basis and dimension, linear transformations, eigenvalues and eigenvectors, diagonalization, and orthogonality; singular-value decomposition.

Calculus II (2+2), 5

Computer Aided Design (2+2), 5
Introduction to computer aided technical drawing. Basic drawing functions and multi-view projection. Sectioning and conventions. General concepts in 3D modelling. Creating parts in 3D design and solid modeling. Transfering 3D parts to drafting detailing. Assembly modelling and assembling parts. Surface modelling.

Physics II (4+1), 6

Biochemistry (2+2), 5
Fundamentals of biochemistry. Water and importance of water in biological systems. Amino acids, peptides and proteins. Detailed structure of proteins. Functions of proteins. Enzymes, carbonhydrates, fats, biological membranes.

Turkish Language II (2+0), 2
To teach spelling, writing and punctuation rules, to teach basic elements of writing essays, to introduce Turkısh and World literary canons; to teach writing creative texts of literature especially story, poem and essay ; to teach writing scientific paper and texts; To analyse expression and punctuation disorders, to contribute lectures.

Occupational Health and Safety 2 (2+0), 2

3. Semester

Differential Equations (2+2), 6
First and second order differential equations; separation of variables; linear differential equations; systems of first order equations; nonlinear differential equations and stability

Electrical Circuits (3+2), 7
The course introduces the fundamentals of the circuit engineering. Topics covered include: basic circuit elements; circuit analysis techniques; independent and dependent sources; RL, RC, RLC circuit analysis; digital abstraction and basics of amplifiers; dynamics of first- and second-order networks; design in the time and frequency domains

Biomaterials (3+1), 5
Structure-property relationships of metals, ceramics, polymers and composites. Characterization methods for biomaterials, including physical and chemical characterization, mechanical testing, surface characterization, diffraction and imaging methods. Interaction between human tissue and biomaterials, behavior of materials in physiological environment. Regulations for implantable materials.

Biological Sciences for Engineering (2+2), 6
To ensure that students learn about fundamental cell biology and get practical experience with experimental techniques. Introduction to biology from the perspective of biomedical engineering, nanoparticles and polymer principles, cellular elements, cell membrane structure, cell metabolism and experimental modeling approaches, the cell cycle and apoptosis mechanisms, meiosis mitosis and life cycles, the molecular basis of genetics, from gene to protein, gene expression regulation, protein and gene drug delivery, genomics, and proteomics, metabolics etc.

General English I (2+0), 2
The English of the terms and concepts encountered in various branches of engineering are examined in depth, and for the proper use of these terms, Turkish-English bilingual translations are explained. English language training for students starts from simple forms and intended to develop over time.

Ataturk's Principles and History of Revolution I (2+0), 2
The Collapse of the Ottoman Empire, Tanzimat and Reform Edict, I. and II. Constitutional Era, Tripoli and Balkan Wars, Worl War I, Mudros Armistice, War of Independence; Amasya Circular, National Congresses, Establishment of Turkish Grand National Assembly, Declaration of Republic

Manifest of Istinye I (0+1), 1

4. Semester

Human Anatomy and Physiology (4+0), 6
Introduction to the terminology for communicating anatomical information. Structure and function of tissues from cellular level to organism level will be studied. Physiology of skeletal, nervous, endocrine, cardiovascular, respiratory, digestive, reproductive and immune systems will be studied along with relevant physiological control mechanisms.

Biomedical Electronics (3+2), 7
The aim of this course is to introduce students the advanced electronics as applied to biomedical instruments. Amplifier classes, high and low frequency responses of amplifiers, operational and instrumentation amplifiers, active filters with operational amplifiers and it's frequency responses, designs which can be used at the output of EEG, EMG, ECG. Oscillators and voltage regulators. Logic circuits and digital circuit design applied in the instruments such as EEG, EMG, ECG, patient stimulator and pacemakers in the medical field applications.

Probability and Statistics (3+2), 6
The field of biostatistics has developed in the past three decades. Disciplines in health sciences play a central role in this development. The focus of these studies is to develop novel study designs and statistical methodology and apply them in bio/medical problems. Compared to the traditional statistical discipline, a unique feature of biostatistical research is its close connection with real world applications.

Signals and Systems (3+2), 7
An introduction to continuous and discrete time signals and systems. Study of the Fourier transform, Fourier series, z-transforms, and the fast Fourier transform. Sampling theorems for continuous to discrete-time conversion. Difference equations for digital signal processing systems, digital system

realizations with block diagrams, analysis of transient and steady state responses, and connections to other areas in science and engineering

General English II (2+0), 2
The English terms and concepts encountered are examined in depth and Turkish-English bilingual translations are used in order to use the concepts correctly. To be able to master professional English language, the students are informed about grammatical structures of sentences, spelling and pronunciation.

Ataturk's Principles and History of Revolution II (2+0), 2
Revolutions in Turkish politics, political parties and multi-party system attempts, revolutions in law, reorganization of public life, reforms in economics, Turkish foreign policy 1923-1938, Turkish domestic and international politics in post-Atatürk era.

Manifest of Istinye II (0+1), 1

5. Semester

Biomedical Instrumentation (3+2), 7
Biomedical engineers need to understand the wide range of topics including basic mathematical modeling; anatomy and physiology; electrical engineering, signal processing and instrumentation; biomechanics; biomaterials science and tissue engineering; and medical and engineering ethics.

- Basic concepts of medical instrumentation
- Basic sensors and principles
- Amplifies and signal processing
- Biological signals
- Biopotential electrodes
- Biopotential amplifies
- Blood pressure
- Measurement of the respiratory system

Biomechanics I (3+2), 6
Introduction to concepts of stress and strain. Biomechanics of structures comprising the musculoskeletal system including ligaments, tendons, muscles and cartilage, with a focus on fundamental principles of mechanics applied to the study of these biological tissues. Finite element modeling and its applications in biomechanics. Kinetics and kinematics of human motion. Posture and gait analysis.

Summer Internship I (0+1), 1
Description of Numerical Methods and application of them particularly in engineering. Error analyses in numerical methods, analitical solutions, numerical methods for the solution of systems (lineer and non linear), approximation methods, interpolation, linear regression, numerical integration.

Principles of Economics (3+0), 5

Course includes basic evaluation of the cost and benefits of an engineering project. Basic topics on the course is: Time, money, cash flow, relationships; Engineering economy principles Depreciation schedule, replacement analysis, after-tax analysis; Economic based project management

6. Semester

Biomedical Transport Phenomena (3+2), 7

This course presents and uses the principles of momentum, mass, and thermal energy transport in the context of biomedical and engineering issues. Analysis of momentum, mass, and thermal energy transfer issues in biological systems at the macroscopic and microscopic levels.

Medical Imaging (3+2), 7

Physics background information, data acquisition principles and reconstruction methods for imaging modalities including x-ray imaging, ultrasound imaging, gamma camera, CT, PET, SPECT and MR imaging. Image quality, spatial resolution, radiation dose and patient safety issues will also be discussed.

Biotechnology and Biopharmaceutics (3+1), 5

Using the tenets of biology and the applied tools of engineering, researchers develop an understanding of living systems, opening new opportunities and solutions in these complex systems. This course is designed to give students with a thorough knowledge of the most recent applications, discoveries, and challenges in biotechnology and biopharmaceutics. The course will cover subjects such as molecular genetics, genome sequencing, epigenetics, stem cells and tissue engineering applications, biofuels, and plant biotechnology and agricultural production, among others.

Engineering Ethics (2+0), 2

Students will learn about relevant moral theories, categories of ethical decision-making, professional codes of ethics, the common morality (individual and group human subjects protections), animal protections, intellectual (software) property rights

7. Semester

Capstone Project I (3+2), 6

A capstone project is designed to push you to think critically and apply what students learned through his program. They will solve the real engineering problems using engineering or scientific approach. New methods, products.

Biodesign I (1+2), 3

Two semester course includes medical system design and project management and improving skills on innovative design and aimed to boost entrepreneurship. Course includes basic skills about developing a medical device. Fundamentals of design from the conception of an idea to a marketable end product within the framework of a start-up company Building a business plan, a project management schedule, product design, incorporation of standards, quality directives, and calculating risk factors. There will be a demonstration at the end of the project.

Summer Internship II (0+1), 1

Manifest of Istinye III (0+1), 1

8. Semester

Capstone Project II (3+2), 7

A capstone project is designed to push you to think critically and apply what students learned through his program. They will solve the real engineering problems using engineering or scientific approach. New methods, products.

Biodesign II (0+2), 2

Two semester course includes medical system design and project management and improving skills on innovative design and aimed to boost entrepreneurship. Course includes basic skills about developing a medical device. Fundamentals of design from the conception of an idea to a marketable end product within the framework of a start-up company Building a business plan, a project management schedule, product design, incorporation of standards, quality directives, and calculating risk factors. There will be a demonstration at the end of the project.

Manifest of Istinye IV (0+1), 1

DEPARTMENT ELECTIVE COURSE DESCRIPTIONS

Biomedical Systems Modeling, 5

Introduction to mathematical modeling in biological and biomedical sciences. Agent based modelling. Topics include enzyme kinetics, population genetics, infectious diseases, systems physiology and physiological control systems, pharmacokinetic and pharmacodynamics models.

PCR Based Molecular Diagnostics, 5

This course gives a thorough review of the underlying principles of clinical molecular diagnostics and investigates the application of molecular methods in disease diagnosis. Topics to be covered include: nucleic acid structure and function, genetics, DNA chemistry, introduction to nucleic acid isolation, identification and amplification techniques such as PCR, RT-PCR and Q-PCR used in disease diagnosis and evaluation of controls to validate results obtained and PCR-based diagnostic kit development.

Biomedical Signal Processing, 5

Explains the fundamentals of digital signal processing with particular emphasis on problems in biomedical research and clinical medicine. Course includes: Data acquisition, Image filtering, Basic coding, Feature extraction and modeling

Nanomedicine, 5

This course is designed to learn the studies conducted in the field of Nanomedicine and to follow the research areas and developments. This course incudes definitions and applications of nanomaterials, nanoparticle design and the therapeutic strategies of nanoparticles, bionanotechnology and nanomatrices..

Stem Cells and Cancer, 5

The aim of the course is to give basic information about stem cells and cancer, and their applications. This course includes biological principles and types of stem cells, in vitro cell culture techniques, therapeutic approaches of stem cells, production a usage of stem cells in clinics. Moreover, biological principles of cancer and researches about cancer will be mentioned.

Tissue Engineering, 5
The aim of the course is to give detailed information about basic concepts in tissue engineering and to enable students to perform tissue engineering applications and learn cell and tissue culture techniques.This course includes biological principles of tissue engineering; scaffold design scaffold production and characterization, cell isolation and characterization, 3D bioink design, tissue engineering laboratory applications and ab to the market point of view.

Introduction to Machine Learning, 5
This course introduces principles and applications of machine learning for modeling and prediction. It includes broad introduction to machine learning and statistical pattern recognition. Topics include: (i) Supervised learning methods. (ii) Unsupervised learning. (iii) Best practices in machine learning. The course will engulf numerous case studies and applications of machine learning in bio/medicine discipline.

Genetics, 5
The course will cover subjects such as molecular genetics the principles of genetics and molecular biology. Provide a comprehensive professional perspective on the basic dogma of molecular biology. The biochemistry of the gene and the nature of gene activity in prokaryotic and eukaryotic cells will be used to address advances in molecular genetics.

Bioinformatics, 5
This course include bioinformatics databases, sequence and structure alignment, protein structure prediction, protein folding, protein-protein interaction, Monte Carlo simulation, and molecular dynamics.

Research Techniques, 5
This course consists of language of research, reporting and presentation, research ethics, literature review process, hypothesis and research problem formulation, quantitative and qualitative methods for research, data management and data driven decision making.

3D Printing in Medicine, 5
Applications and future of 3D Printing in Medical Environment. 3D Printing Technology, Material Technology Bioprinting, Implant, Prosthetics and body parts , Advantages and Limitations of 3D printing.

Advanced Python, 5
This course is designed to fully immerse you in the Python language, so it is great for both beginners and professionals. Learn Python programming, advanced Python concepts by codding examples, essential modules, and creating a final project. The course includes script, web scraping, database, web framework, GUI programming, data visualization, and machine learning.

Artificial Intelligence in Medicine, 5
This course introduces the basics of knowledge representation, problem solving, and learning methods in the sense of artificial intelligence. Students should be able to develop intelligent systems by assembling solutions to concrete computational problems; understand the role of knowledge representation, problem solving, and learning in medical intelligent-system.

Microprocessors, 5
The goal of this course is to solidify and build upon a student's knowledge of embedded systems in medical devices by presenting hands-on experience with microcontrollers and circuits. Students will also examine a few sensors that are used in commercial and medical products and learn how to interface them in an embedded system. During the course, different aspects of applied embedded systems are introduced and the concepts are clarified by real world examples of medical devices. Architecture of ARM based Microcontrollers, Introduction to embedded operating systems, Fundamentals of Embedded C programming

Quality Management in Healthcare, 5
This course aims to provide students knowledge about quality concept, and effect of the quality management on healthcare market. Quality Management Systems, Key Features of Clinical Quality, Quality Standards and Application Examples, Case Study.

Patient Safety and Risk Management, 5
This is an explanatory course about patient risk, risk presentation and risk management on a clinical environment.

Numerical Simulations in Biomedical Engineering, 5
This course is an introduction to explain the fundamentals of numerical analysis. The primary objective of the course is to develop the basic understanding of numerical algorithms and skills to implement algorithms for solving mathematical problems on the computer. Course includes several homeworks and a term project.

Introduction to Biomedical Optics, 5
Principles of optics and lasers in medicine. Optical properties of biological tissue and light tissue interactions. Radiometry, photometry and light dosimetry. Applications in biomedical optics including oxymetry, optical biosensors, lasers, near infrared spectroscopy.

Polymer Engineering, 5
Understanding the polymer chemistry, relation between monomer/polymer structures, and understanding the polymer processing. Course includes Importance of molecular structure, molecular weight, crystallinity, molecular orientation. Elastic properties of polymers, elasticity. Viscoelastic behavior of polymers Selection of polymer properties in biomedical engineering Estimate failure behaviors of polymers and analysis.

Drug Delivery, 5
This course is designed to teach students the foundations of novel drug delivery technologies. Introduction to materials and biomaterials as carriers of novel and modern Drug Delivery Systems. This course aims to address to design of New Drug Delivery Systems: Micro-particle and Nanoparticle delivery systems, Composition of Liposomes and Exosomes, Transdermal Drug Delivery Systems. Peptide Protein Gene and Drug Delivery Systems and Micro-needle and Microchip Technology.

Implant Design, 5
Engineering principles in implant design. Biocompatibility criteria and surface properties of biomaterials. Mechanical and material properties of implants. Host-implant interaction. Application examples including vascular grafts, stents, pacemakers, orthopedic implants. Regulatory aspects for implant design and validation.

Introduction to Neural Engineering, 5
Neuroanatomy and physiology of the nervous system. Methods for measurement of neural activity. Neurostimulation and neuromodulation for restoring neural function. Application examples in disorders of the nervous system.

Molecular Imaging, 5
Basic principles of molecular imaging modalities including magnetic resonance, ultrasound, nuclear imaging, fluorescence, bioluminescence. Design and working principles of molecular imaging probes for biomarker detection, quantification of molecular events in live cells, cell tracking and cellular kinetics.

Human Computer Interaction, 5
Interactions between computers and humans should be as intuitive as conversations between two humans. This course introduces the basics of design concepts with regarding user experience, human psychology, and design processes. This course provides a comprehensive introduction into HCI, so students can designs windowing systems that provide outstanding user experiences.

Bioelectricity and Biomagnetism, 5
Course includes basic electromagnetic theory principle such as Maxwell's equation, vector analysis, static electric fields. Course gives an explanatory overview over examples of bioelectricity and biomagnetism in various species as well as applications on medical field, and medical device working theory principles.

Health and Medical Informatics, 5
An overview of medical informatics. Stages in system analysis and design. Course presents the fundamental principles, concepts, and technological elements that make up the building blocks of Health Informatics. It introduces fundamental characteristics of data, information, and knowledge.