

**NECMETTİN ERBAKAN UNIVERSITY**  
**FACULTY OF ENGINEERING AND ARCHITECTURE**  
**DEPARTMENT OF COMPUTER ENGINEERING**  
**2020-2021 TEACHING PLAN UNDERGRADUATE COURSE CONTENTS**

**1<sup>ST</sup> SEMESTER**

**BIL101 - MATHEMATICS-1**

**Credit(4+0) ECTS(5)**

Definition of limit. Number sequences and their limits. Limit of a function. Limit Laws. One-sided limits and limits at infinity. Continuity and properties of continuous functions. Derivative, geometric meaning of derivative and properties of derivative. Derivatives of basic elementary functions. High-degree derivative and differentiation. Basic derivative theorems. Analyzing changes of functions and plotting their graphs. Mean value theorem for integrations. Concavity and curve sketching. Anti-derivative and indefinite integral, substitution rule. Calculating area between curves. Newton-Leibnitz formula. Volumes by slicing and rotation about an axis, volumes by cylindrical shells. Integration by parts. Inverse functions. Logarithm and rational functions. Hyperbolic functions. Integration methods. Integration of rational functions. Improper integral.

**BIL103 - PHYSICS-1**

**Credit(2+1) ECTS(3)**

Unit systems. Scalar quantities and vectors. One dimensional motion. Two dimensional motion. Newton's laws of motion. Circular motion. Work and energy. Potential energy and conservation of energy. Impulse, momentum and motion of systems. Rotation of rigid objects. Kinematics of rotation, dynamics of rotation. Angular momentum. Statical equilibrium and elasticity. Harmonic motion. Newton's law of universal gravitation.

**BIL105 - ENGLISH-1**

**Credit(3+0) ECTS(3)**

Who/what/how/which/why/when/where questions. This/that, these/those. Have got/has got. There is/there are. Simple present tense. "Be going to" future tense. Can/must/have to modals. Present tense. Comparison of present tense and simple present tense.

**BIL107 - PRINCIPLES OF ATATURK AND REVOLUTION HISTORY-1**

**Credit(2+0) ECTS(2)**

The establishment and fall of the Ottoman state from the foundation of the Ottoman state to the armistice of Mondros. The issue of orient. Reform movements after Tanzimat. Intellectual currents that are directed to save the Ottoman state. The activities of minorities in Ottoman history, especially the emergence of the Armenian issue and its reflections on this day. Secret treaties and Wilson principles. Turkish War of Independence. Mustafa Kemal's life is his military and political activities. Misak-ı Milli (National Pact) and opening of the TBMM. Establishment of a regular army from the Turkish Independence Movement to the Treaty of Lausanne and east west and south fronts. Mudanya armistice. Abolition of the Sultanate. Treaty of Lausanne and its consequences.

**BIL109 - TURKISH LANGUAGE-1**

**Credit(2+0) ECTS(2)**

What is language? The place and importance of language in national life as a social institution. Language culture relation. The place of Turkish language among the world languages. The development of the Turkish language and its historical circuits. Turkish language today and its spreading areas. The sound structure of Turkish. Spelling rules and punctuation marks. General information about composition. Plan and application to be used in writing composition. Petition and CV writing. Application of spelling and punctuation rules.

**BIL111 – INFORMATION TECHNOLOGIES**

**Credit(2+0) ECTS(3)**

Definition of computer engineering and application areas. Basic computer hardware. Problem solving by using computers. Basic databases. Information safety and network management. Basic components of operating system. Representation and structure of algorithms. Problem analysis. Algorithm design.

**BIL113 - ALGORITHMS AND PROGRAMMING-1**

**Credit(3+2) ECTS(7)**

Evolution and definition of computer. Number systems (binary, decimal, hexadecimal etc.). Character sets (ascii, unicode). Problem solving and algorithm logic. Algorithm. Representations of algorithm (pseudo-code, flow charts). Problem solving approaches (algorithmic and heuristic). Variables definitions. Coding standards. Data types. Operators. Input-output functions. Type conversion. Overall structure of C programming languages. Condition-selection statements (if-else, switch-case). Loops(for, while, do-while). Arrays. Functions. Recursive and built-in functions. Pointers. Variables and memory address. Pointers arithmetic. Pointers and array. Pointers and functions. Function pointers. Dynamic memory management

(malloc,realloc,calloc). Struct. File processes.

### **BIL115 – ELECTRIC CIRCUITS**

**Credit(3+2) ECTS(5)**

Basic circuit elements. Load. Current. Voltage. Ohm's law. Kirchoff laws. Ideal and non-ideal sources. Environment and node analysis. Linearity and superposition theorem. Thevenin and Norton theorems. DA circuit solutions with maximum power transfer methods. The main issues of my AA. Phasor representation of sinusoidal functions. Phasor relations of R, L, C elements. Source transformation. AA circuit solutions with Thevenin and Norton theorems. Instant and average power concepts in AA. Effective values of periodic functions. Complex power in AA circuits. Power factor and improvement in AA circuits.

### **AKT1 – ACADEMIC TURKISH -1**

**Credit(2+0) ECTS(2)**

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

### **BIL102 – MATHEMATICS-2**

**Credit(4+0) ECTS(5)**

Series. Partial sum. Convergence. Divergence.  $n^{\text{th}}$  term test for divergence. Alternating series. Absolute and conditional convergence. Power series. Taylor and McLaurin series. Limits and continuity in higher dimensions. Partial derivative. Chain rule. Polar coordinates. Graphing in polar curves. First order differential equations.

### **BIL104 – PHYSICS-2**

**Credit(2+1) ECTS(3)**

Electrical charge of things. Electric fields. Gauss's law. Electric potential. Capacitance and dielectrics. Current and resistance. Magnetic fields. Sources of magnetic fields. Electromagnetic induction and Faraday's law. Alternating current circuits. Maxwell equations. Electromagnetic waves. Optics. Reflection and refraction. Lenses. Interference.

### **BIL106 – ENGLISH-2**

**Credit(3+0) ECTS(3)**

Would like. A/an, some/any, much/many. Past tense. Irregular verbs. "Will" future tense. Conditional sentences with "when/if". Present perfect. Just/already/yet.

### **BIL108 - PRINCIPLES OF ATATURK AND REVOLUTION HISTORY-2**

**Credit(2+0) ECTS(2)**

Kuva-yı Milliye (National forces). The plans of sharing of Turkey by Allied Countries. I. İnönü war. II. İnönü war. Sakarya war. The Big attack. Mudanya treaty. Lozan peace agreement. Strategy of the Turkish Revolution. Revolutions in the political sphere. The proclamation of the republic. Abolition of the caliphate. The Progressive Republican Party and Takrir-i Sükun period. Revolutions in the field of law. Revolutions in education and culture. Revolutions in the economic field. Constitutional movements. Political parties after the National Struggle. Transition to the multiparty period. Reactions to the regime. Revolution in the field of law. Revolution in the field of education. Revolutions in the social sphere. Atatürk's principles and reforms. Atatürk's foreign policy.

### **BIL110 - TURKISH LANGUAGE-2**

**Credit(2+0) ECTS(2)**

Narrative forms in composition. Story. Depiction. Essay. Article. Noun inflections in Turkish. Verb conjugation in Turkish. Words-nouns, adjectives, adverbs in terms of meaning and duty. Pronouns, verbs, prepositions. Elements of the sentence. Sentence analysis and its application. Expression disorder. Reading and analyzing works related to the world of literature and thought. Rhetorical practices. Rules to be followed in the preparation of scientific articles. Expert report. Spelling and punctuation.

### **BIL112 - ALGORITHMS AND PROGRAMMING-2**

**Credit(3+2) ECTS(9)**

Learning a new programming language. Programming language perspectives and categories. Variables, data types, operators, input/output functions, program control structures, interactive shell, condition-selection and loops, modules, strings, modifiable and unchangeable objects, collections (lists, tuples, sets, dictionaries), functions, scope and domain names, nested functions, file operations, testing and debugging, error trapping and exception handling in a high level language.

### **BIL114 – ELECTRONICS CIRCUITS**

**Credit(3+2) ECTS(6)**

Semiconductor materials of type P and N. PN junction. Structure and principle of operation of the semiconductor diode. Equivalent circuits. Forward and reverse direction characteristics. Zener diode. LED diode. Schottky diode. Varikap diode. Tunnel diode. Half-wave-full-wave bridge rectifiers. Staples. Trimmers.

Voltage doublers and zener diode voltage regulation applications. PNP and NPN combination. BJT working principle, upgrade operation and connection types, input and output characteristics according to connection types. JFET and MOSFET structure, working principle, current-voltage characteristics and models. Bias types of diodes, BJT, FET and MOSFET. Stability of biasing circuits. Comparison of biasing circuits. Determination of the working point. Class A, B, AB, C and D amplifiers. Noise, gain and power calculations. The structure and operation of the ideal operational amplifier. Application circuits (inverting, inverting amplifiers, adder, differential, derivative and integrator, linear operational amplifier circuits, etc.).

**AKT-2 – ACADEMIC TURKISH - 2**

**Credit(2+0) ECTS(2)**

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

**BIL201 – DATA STRUCTURES**

**Credit(3+0) ECTS(6)**

Data concept and data types. Lists. Linked lists. One-way linked lists. Bidirectional linked lists. Circular linked lists. Stacks and linked list of stacks. Infix, prefix and postfix. Queues and linked list in queues. Trees and binary search trees. Search algorithms. Sorting algorithms. Graphs.

**BIL203 - OBJECT ORIENTED PROGRAMMING**

**Credit(3+2) ECTS(6)**

Introduction to programming and problem solving using the object-oriented paradigm. Primitive data types. Reference data types. Operators. Control statements. Loops. String operations. Classes. Objects. Fields. Methods. Constructor methods. Arrays. Packages. Access specifiers. Composition. Inheritance. Abstract classes. Interfaces. Method override. Keywords: this, super, final, static. Inner classes. Polymorphism. Exception management. File/folder operations and input/output streams. Collections (list, map etc.). Generic. Multi-thread. Design patterns.

**BIL205 – LOGIC CIRCUITS AND DESIGN**

**Credit(3+1) ECTS(6)**

Analog numeric concepts. Number systems. Logic mathematics and process rules. Combinational logic circuits and design. Multipliers and comparators. Decoders. Multiplexers. Digital IC MSI functional structure of ICs. sequential circuit elements. The design of synchronous and asynchronous sequential circuits, Flip-flops; RS, D, T, J-K flip flops. Memory structures.

**BIL207 – LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS**

**Credit(3+0) ECTS(4)**

Matrices, matrix types, matrix equality. Adding, subtracting, multiplying matrices. Special matrices. Inverse of a matrix. Definition and properties of determinant. Vectors. Vector spaces. Eigenvalues and eigenvectors. Differential equations. First order differential equations and engineering applications. Second or higher order differential equations and engineering applications. Laplace transform.

**BIL209 – OCCUPATIONAL ENGLISH**

**Credit(2+0) ECTS(4)**

Starting from the basic concepts of computer and information technology, giving information about hardware, software and internet in English. Teaching the technical terms of the basic information on the subjects covered by "Computer Engineering" and reading and understanding the technical texts.

**BIL211 – STATISTICS AND THEOREM OF PROBABILITIES**

**Credit(3+0) ECTS(4)**

Definition, types and using areas of statistics. Variables, graphs and frequency distributions. Gathering and organizing data. Averages. Probability theorem. Conditional probability. Dependent and independent events. Bayes rule. Random variable. Probability density function. Distribution function. Expected value. Variant and standard deviation. Continuous random variable. Discrete and continuous distributions. Hypothesis tests.

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

**BIL202 – VISUAL PROGRAMMING**

**Credit(3+2) ECTS(5)**

Description of the variable type used in Qt visual programming tool, introduction of design and code environment of Qt and use of the Qt libraries. The creation of dynamic objects by using Qt objects. Creating a database connection with Qt. Data into the database by using the Qt, use of the some SQL statements such as inserting, deleting updating. Introduction and use of components that are used to printing the output of a program written with Qt. Control of objects by mouse and keyboard devices.

**BIL204 – SOFTWARE ENGINEERING****Credit(3+0) ECTS(4)**

Software project management: criteria, estimations and planning. Software development methodologies. Agile development method. Software requirement analysis techniques. Software design techniques. UML diagrams, interface and database design techniques. Software implementation techniques. Unit tests. Software version control systems. Software quality assurance. Software test and maintenance. Comparison of case technologies.

**BIL206 – ALGORITHMS****Credit(3+0) ECTS(5)**

Computational complexity. Divide and conquer algorithms. Priority queues. Depth-first search and breadth-first search. Balanced search trees(2-3 trees, B-trees, Red-black trees). Dynamic programming. Linear programming. Advanced algorithms. Compression algorithms. Encryption algorithms. Shortest path finding algorithms and minimum spanning tree algorithms.

**BIL208 – MICROPROCESSORS****Credit(2+2) ECTS(5)**

Overview of the Microprocessor. Features and components of the microprocessor. Overview of the microcontroller. 8-bit microcontroller with the general characteristics of the Pic16f877A microcontroller. Software required for the Pic16f877A microcontroller. Pic16f877A programming with the Micro C, instruction set. Parallel and series I/O units. Subroutine, interrupt and stack concept. Digital-analog and analog-digital converters. Pic16f877A applications with Proteus software.

**BIL210 – DISCRETE MATHEMATICS****Credit(3+0) ECTS(3)**

Logic, sets and functions. Algorithms and complexity of algorithms. Counting techniques. Relations. Graphs theory. Trees and their applications. Recursive concepts. Finite state machines with/without output.

**BIL212 – NUMERICAL ANALYSIS****Credit(2+0) ECTS(2)**

Data structures, structural programming. Numerical solutions of multi-dimensional optimization problems. Properties of convergence. Gradient and Newton methods. Solutions of linear and non-linear equations. Solution of root of a polynomial. Numeric differentiation. Numeric integral. Curve fitting. Solution of differential equations.

**BIL214 – OCCUPATIONAL INTERNSHIP- 1****Credit(0+0) ECTS(6)**

In order to reinforce the theoretical knowledge about the profession of the person who will be a computer engineer by practice, the practices and experiences she has made in appropriate institutions, institutions or establishments in accordance with the principles determined by the Department internship Commission. Internship areas are: Software, Hardware, Computer Science, Artificial Intelligence, Control and Control Systems, Information Technologies, Informatics, Computing.

**5<sup>th</sup> SEMESTER****BIL301 – COMPUTER ARCHITECTURE AND ORGANIZATION****Credit(3+0) ECTS(5)**

Computer organization and architecture. The development of computers. Computer components. Processor, bus, and control. Cache. Instruction set features. Instruction sets addressing modes. Microprocessor organization. Data migration methods, interrupts and direct memory Access. RISC and CISC architectures and pipelining. Pipelining to improve performance and bus representation. RISC architecture and pipelining. The command level parallel operation. The control unit. Multicore CPUs.

**BIL303 – OPERATING SYSTEMS****Credit(3+0) ECTS(5)**

Introduction to operating systems. History of operating systems. Processes and process management mechanisms. Parallel processes. Mutual exclusion. Basic process scheduling algorithms and their comparison. Interprocess communication. CPU timing. Deadlock. Memory management : segmentation, paging, virtual memory. Security and protection in operating systems. File systems input/output unit. UNIX and other sample operating systems.

**BIL305 – DATABASE SYSTEMS****Credit(3+2) ECTS(5)**

Database concepts. Relational database design and creation of ER diagrams. Normalization concept and its types. Showing SQL commands on Oracle database. Query operations on multiple tables. Showing the concepts of view and index.

**BIL307 – MOBILE PROGRAMMING****Credit(3+1) ECTS(5)**

Introduction to mobile information systems. Mobile operating systems and software development environments. Mobile communication networks and their structures. Short distance communication technologies. Application development techniques for mobile systems. Publishing and distributing mobile application.

## **TECHNICAL ELECTIVE 1-2**

### **BIL315 - MANAGEMENT OF SOFTWARE PROJECTS (TE. 1-2) Credit(3+0) ECTS(5)**

IT projects success factors. Project manager duties, project suggestions. Area management. Project backlog, schedule and cost plan. Risk management. Project running (monitoring and control). Project closure. Source selection. Cost benefit analysis. Project management software tools.

### **BIL319 - INTRODUCTION TO SIGNALS AND SYSTEMS (TE.1-2) Credit(3+0) ECTS(5)**

Sign and system types. Basic system features. Convolution in systems that do not change with linear time. Properties of systems that do not change with linear time. Difference equations. Analysis of periodic signs with fourier series. Continuous time fourier transform. Discrete time fourier transform. Time and frequency properties of signals and systems. Filtering. Sampling. Modulation. Laplace transform. Z transform.

### **BIL323 - CONCEPTS OF PROGRAMMING LANGUAGES (TE.1-2) Credit(3+0) ECTS(5)**

Reasons for studying the concepts of programming languages. Classification of programming languages. Language evaluation criteria. Implementation methods. History of programming languages. Syntax and semantics. Context-Free Grammar (CFG). Backus-Naur Form (BNF). Parse trees. Ambiguity. Operator precedence. Lexical and syntax analysis. Names, bindings and scopes. Data types. Sub-programs. Exceptions handling.

### **BIL325 - INTRODUCTION TO DATA PREPROCESSING (TE.1-2) Credit(3+0) ECTS(5)**

Feature selection, data incompatible data elimination, normalization, data discrimination, data balancing concepts before data are processed. Making applications with data from global databases on various algorithms related to these concepts.

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

### **BIL302 – COMPUTER NETWORKS Credit(3+0) ECTS(5)**

Basis and architecture of computer networks. Computer network topologies and types. OSI Model and network protocols. Network connection devices, active and passive devices. LAN communication technologies(802.X family and Ethernet, token ring, FDDI). WAN communication technologies(x25, DSL, ISDN, FR, etc.). Network operating systems. Application layer, presentation layer, session layer, transport layer, network layer, data link layer, Physical layer.

### **BIL304 – EMBEDDED SYSTEMS Credit(3+1) ECTS(4)**

Overview of Embedded Systems, embedded systems components and tools. Software and hardware features of embedded systems. Atmel based 8-bit processors. The Arduino programming. Programming tools and software development. Applications with Arduino.

### **BIL306 – WEB PROGRAMMING Credit(3+1) ECTS(4)**

Introduction to client programming: HTTP, web servers, HTML, CSS2, dynamic HTML, forms, JavaScript, VBScript, XML/XSL, DTD, schema, XML separators, XHTML, Java, Applets. Introduction to server programming: Web servers, CGI scripts (PERL), Java, HTTP server, PHP, ASP, JSP, XML separators, database link, writing web service and php web service connections.

### **BIL308 – COMPUTER ENGINEERING APPLICATION PROJECT Credit(2+0) ECTS(3)**

Performing a computer engineering project by applying theory and practices. Project can be performed individually or as a group, under supervision of a faculty member.

### **BIL328 – OCCUPATIONAL INTERNSHIP-2 Credit(0+0) ECTS(4)**

In order to reinforce the theoretical knowledge about the profession of the person who will be a computer engineer by practice, the practices and experiences she has made in appropriate institutions, institutions or establishments in accordance with the principles determined by the Department internship Commission. Internship areas are: Software, Hardware, Computer Science, Artificial Intelligence, Control and Control Systems, Information Technologies, Informatics, Computing.

### TECHNICAL ELECTIVE 3-4

#### **BIL316 – SOFTWARE QUALITY ASSURANCE AND TESTS (TE. 3-4) Credit(3+0) ECTS(5)**

Software quality management. Software configuration management. Software test strategies. Unit test. Integration test. System test. Acceptance test. Software maintenance. Software rebuild and software quality application.

#### **BIL320 – INTRODUCTION TO BIOMEDICAL ENGINEERING (TE. 3-4) Credit(3+0) ECTS(5)**

Definition, scope and history of biomedical engineering. History of medicine. Human anatomy and physiology. Biomechanics. Rehabilitation engineering. Biomaterials. Tissue engineering. Bioinstrumentation. Biomedical sensors. Biomedical signal processing. Bioinformatics. Medical imaging. Biomedical ethics.

#### **BIL322 – DATABASE PROGRAMMING (TE. 3-4) Credit(3+0) ECTS(5)**

Teaching PL/Sql language used on Oracle database. Cursor definitions, defining error controls. Teaching of procedure, function, packed, trigger, job spelling.

#### **BIL330 - ADVANCED MOBILE PROGRAMMING (TE. 3-4) Credit(3+0) ECTS(5)**

Introduction to Android and basic programming techniques. Menus. SMS. Positioning-based services. Sensors. Data base. Thread. AsyncTask. Handler. Positioning and map.

#### **BIL332 - INTRODUCTION TO ARTIFICIAL INTELLIGENCE (TE. 3-4) Credit(3+0) ECTS(5)**

What is Artificial Intelligence? Classification, regression and clustering concepts. Complexity matrix and classification algorithms performance criteria. A star. Decision trees. Neural networks. Naive bayes. K closest neighbors. Deep learning. Genetic algorithm. Particle swarm optimization.

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

#### **BIL401 – COMPUTER GRAPHICS Credit(2+1) ECTS(3)**

Presentation of point. Transformations of points. Transformations of lines. 2D transformations. Mirroring. Scaling. Line drawing algorithms. 3D transformations. Axis based rotations. Projection. Basic computer graphics principles. Bezier curves and B-Spline curves. Model transformations and scaling. 2D and 3D models. Camera movements. OpenGL examples.

#### **BIL403 – APPLICATIONS OF COMPUTER ENGINEERING-1 Credit(2+0) ECTS(5)**

To be able to find problems according to the needs of the region, country or the world in the field of computer engineering and develop software and hardware applications that produce solutions to them using up-to-date technologies.

#### **BIL423 – ENTREPRENEURSHIP CULTURE Credit(1+0) ECTS(1)**

Lesson; it covers the entrepreneurial process in establishing a new business, from the thought phase to the business phase. It also focuses on the process of transforming the personal and demographic characteristics of entrepreneurs and their business ideas into new jobs. Students will also learn about the process of starting and developing new business enterprises in small and medium-sized businesses. Students will benefit from interactive regional, national and international entrepreneurs' experiences, including case studies and hands-on experience.

#### **BIL425 – OCCUPATIONAL HEALTH AND SAFETY-1 Credit(1+0) ECTS(1)**

Learning the definition and history of occupational safety. Understanding accident formation and types. Understanding occupational diseases and ways of protection. Understanding ergonomics (effects of worker and workplace conditions on worker health). Understanding the necessity of introducing and using protectors (machine and personal protectors) in occupational safety. Learning the rules of First Aid. Identifying and understanding safety precautions in fires and explosions. Understanding of labor laws and regulations.

### TECHNICAL ELECTIVE 5-6-7

#### **BIL415 - HUMAN COMPUTER INTERACTION (TE. 5-6-7) Credit(3+0) ECTS(6)**

Within the scope of this course, students know the basic sheet metal feet of the interdisciplinary field, as well

as the limits of man and machine. Accordingly, they are skilled in what kind of rules should be followed in computer systems to be developed by considering these limits and which models and examples should be used. Finally, evaluation methods and methods of measuring the usability and ease of use of the designed systems are evaluated as applied.

**BIL417 - EXPERT SYSTEMS (TE. 5-6-7)**

**Credit(3+0) ECTS(6)**

Knowledge about artificial intelligence. General knowledge about the expert system which is sub-branch of artificial intelligence. Advantages and disadvantages of expert systems. Areas where expert systems are used. Design of rule-based systems. Designing example expert systems with prolog language.

**BIL419 - DATA MINING (TE. 5-6-7)**

**Credit(3+0) ECTS(6)**

Introduction to data mining concepts. Teaching data preprocessing steps. Classification, association rules, teaching cluster concepts. Teaching bayes, decision trees, support vector machines, artificial neural networks, Knn algorithm, apriori, k-means algorithms. In this course, various analyzes are made on data using Weka data mining software and various software with real life data sets.

**BIL431 - INFORMATION SECURITY (TE. 5-6-7)**

**Credit(3+0) ECTS(6)**

Introduction to ethical piracy. Footprint and discovery. Network scans. Vulnerability analysis. System piracy. Malware threats. Sniffing. Social engineering. Denial of service. Session play. IDs. Avoid firewalls and honeypots. Hacking web servers. Hacking web applications. Sql injection. Hacking wireless networks. Hacking mobile platforms. IOT hacking. Cloud computing. Cryptography.

**BIL435 - FUZZY LOGIC (TE. 5-6-7)**

**Credit(3+0) ECTS(6)**

Fuzzy logic concept. Fuzzy sets and membership functions. Fuzzy systems and parameters. Grading and granulation concept. Detection of information particles. The discovery of fuzzy rules. Interpretability of fuzzy systems. Fuzzy system design using learning algorithms. Fuzzy system design for classifying problems. Fuzzy system design for pattern recognition. Fuzzy control systems.

**NON-TECHNICAL ELECTIVE 1**

**BIL427 - COMMUNICATION AND PRESENTATION TECHNIQUES  
(NTE. 1)**

**Credit(2+0) ECTS(2)**

General information about communication and presentation techniques. Effective presentation ways in visual and verbal communication. Effective presentation preparation techniques. Presentation content enrichment. Organizing meetings. Effective presentation student applications.

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

**BIL402 - FORMAL LANGUAGES AND AUTOMATA**

**Credit(3+0) ECTS(4)**

Languages and their representation. Finite automata and regular grammars. Context free grammars. Abstract machines and acceptance of language. Deterministic and non-deterministic finite state machines. Pushdown automata. Turing machines and introduction to calculating theory.

**BIL404 – APPLICATIONS OF COMPUTER ENGINEERING-2**

**Credit(2+0) ECTS(5)**

To be able to find problems according to the needs of the region, country or the world in the field of computer engineering and develop software and hardware applications that produce solutions to them using up-to-date technologies.

**BIL422 – OCCUPATIONAL HEALTH AND SAFETY-2**

**Credit(1+0) ECTS(1)**

Occupational safety rules. Work environment oversight. Occupational hygiene. JHS in laws. Protection policies. Maintenance and repair of hand tools. JHS in motor vehicles. Risk management and evaluation. Psychosociological risk factors.

**TECHNICAL ELECTIVE 8-9-10**

**BIL412 – WEB TECHNOLOGIES (TE. 8-9-10)**

**Credit(3+0) ECTS(6)**

State-of-art web technologies. Web frameworks. Programming web pages with interactive content. The design of web pages that need to dynamically access the database on a server. Making web pages accessible to dynamic data (search results, images, videos, maps, etc.). Java, php, .net and python web technologies. ORM

and hibernate. Ajax. MVC and MVT architectures.

**BIL416 – INTRODUCTION TO IMAGE PROCESSING (TE. 8-9-10)**

**Credit(3+0) ECTS(6)**

Digital image properties. Image enhancement in pixel and frequency space. Image sharpening and compression. Image processing techniques. Image detection and recognition. Medical image processing and recognition. Neighborhood, contiguity, connectivity, regions, boundaries, distance criteria. Image navigation. Simple image processing algorithms. Simple filters and applications. Color models. Image file formats.

**BIL418 - OPTIMIZATION ALGORITHMS (TE. 8-9-10)**

**Credit(3+0) ECTS(6)**

Introduction to optimization. Single variable optimization. Multi variable optimization. Modeling of optimization problems. Multiobjective optimization. Unconstrained optimization. Constrained optimization. Nature-inspired optimization algorithms. Genetic algorithm. Swarm intelligence-based optimization algorithms. Discrete and continuous optimization problems.

**BIL428 - INTRODUCTION TO EVOLUTIONARY COMPUTING (TE. 8-9-10)**

**Credit(3+0) ECTS(6)**

Problems, origins of evolutionary computation and what is the evolutionary algorithm? The components of evolutionary algorithms. Representation, mutation and recombination. Fitness, selection and population management. Genetic algorithms. Differential evolution algorithm. Scatter search algorithm. Parameter control. Working with the evolutionary algorithms. Hybridization. Performance analysis.

**NON-TECHNICAL ELECTIVE 2**

**BIL424 - SCIENTIFIC RESOURCE TECHNIQUES (NTE. 2)**

**Credit(2+0) ECTS(2)**

Science and basic concepts (fact, knowledge, absolute, true, false, universal knowledge, etc.). Basic information about the history of science. Structure of scientific research. Scientific methods and different views on these methods. Problem, research model. Universe and sample. Data collection and data collection methods (quantitative and qualitative data collection techniques). Data recording, analysis, interpretation and reporting.