Fırat University

Faculty of Engineering Department of Mechatronics Engineering Course Descriptions

1st Year 1st Semester

FİZ 105 PHYSICS LABORATORY -1- (0 0 2 1)

Introduction; Basic Laboratory Principles, Fundamental Quantities, Unit Systems, Physical Measurements and Errors, Introduction to Laboratory Equipment, Free Fall Experiment, Simple Pendulum, Coefficient of Friction, Centripetal Force, Uniform Linear and Accelerated Motion, Newton's Second Law of Motion, Conservation of Energy, Elastic Collision, Inelastic Collision.

FİZ 111 PHYSICS -1- (4 0 0 4)

Physics and Measurement, Addition and Subtraction of Vectors, Vector Multiplication, Definitions of Scalar and Vector Product, Motion in One Dimension, Motion in Two Dimensions, Laws of Motion, Circular Motion and Applications of Newton's Laws of Motion, Work and Kinetic Energy, Potential Energy and Conservation of Energy, Linear Momentum and Collisions, Rotation of Rigid Bodies Around a Fixed Axis, Rolling Motion and Angular Momentum, Static Equilibrium.

KİM 105 CHEMISTRY -1- (4 0 0 4)

Properties of matter, SI unit system, uncertainty and significant figures, the mole concept. Molecular and ionic compounds, molecular weight, composition, oxidation states, names, and formulas. Chemical reactions and equations, stoichiometry, solution reactions, determination of limiting reactants. Nature of aqueous solutions, precipitation reactions, acid-base reactions, oxidation-reduction: balancing redox reactions, oxidizing and reducing agents, stoichiometry in aqueous solution reactions. General properties of gases: pressure, simple gas laws, combined gas laws: the ideal gas equation and general gas law, applications of the ideal gas law, gases in chemical reactions, gas mixtures, kinetic theory of gases, real (non-ideal) gases. Terminology in thermochemistry, heat, heat of reaction, and calorimetry, work, the first law of thermodynamics, heat of reaction: Hess's law, internal energy and enthalpy, indirect calculation of enthalpy, standard enthalpies of formation, fuels as energy sources. Composition of the atmosphere, the atmosphere as a source of chemical substances, nitrogen and its important compounds, environmental pollution involving nitrogen oxides, oxygen, the ozone layer, and its role, noble gases, carbon oxides, environmental problems caused by carbon dioxide; global warming and the greenhouse effect, hydrogen, the hydrogen economy. Intermolecular forces and some properties of liquids, evaporation of liquids: vapor pressure, some properties of solids, phase diagrams, van der Waals forces, hydrogen bonding, chemical bonds in terms of intermolecular forces, crystal structures, energy changes in the formation of ionic crystals. Arrhenius theory of acids, Brønsted-Lowry theory of acids and bases, ionization of water and the pH scale, strong acids and bases, weak acids and bases, polyprotic acids, ions as acids or bases, molecular structure and acid-base behavior, Lewis acids and bases. Nuclear chemistry, radioactivity, radioactive isotopes, nuclear reactions and artificial radioactivity, rate of radioactive decay, energy in nuclear reactions, nuclear fission and fusion, applications of radioisotopes.

KİM 109 CHEMISTRY LABORATORY (0 0 2 1)

This course aims to provide students with practical skills related to basic laboratory techniques used in chemistry. Therefore, the rules for working safely in the laboratory and the procedures students need to follow in case of potential accidents will be taught first. The materials available in the laboratory and their uses will be explained. Measurements and weighing processes, types of solutions and methods for preparing these solutions, purification techniques such as crystallization and distillation, determination of the melting and freezing points of pure substances, the reduction reaction of $KMnO_4$ in an acidic medium using titration, determination of the heat capacity of a metal with a simple calorimetric method, determination of the enthalpy of formation of magnesium oxide, determination of molecular weight using the freezing point depression method, determination of the water of hydration in substances containing crystal water, and determination of acetic acid in vinegar through titrimetric analysis will be carried out by students.

MAT 161 MATHEMATICS -1- (4 0 0 4)

Prerequisites: Specially defined functions, trigonometry, inverse trigonometric functions, complex numbers, and logarithms. Limit, right-hand and left-hand limits, trigonometric limits, continuity, uniform continuity, derivatives, general differentiation rules, derivatives of elementary functions, logarithmic and exponential functions, higher-order derivatives, the geometric meaning of derivatives, physical applications, local and absolute extrema of a function, Rolle's Theorem, Mean Value Theorem, indeterminate forms, L'Hospital's Rule, curve sketching, indefinite integrals, and methods of integration will be covered.

MKM 103 ALGORITHM AND PROGRAMMING -1- (2 0 2 3)

Overview of Computers and Programming, Creating Algorithms, Flowcharts, C Programming Language, Selection Structures (if, else if, else), Loop Structures (while, for), Modular Programming and Functions, Arrays, Strings, Comparative Examples with Other Programming Languages, Applications on Different Operating Systems (UNIX, DOS).

MKM 105 INTRODUCTION TO MECHATRONICS ENGINEERING (1 0 0 1)

Definition and Principles of Engineering, Engineering Profession and Ethical Rules, Emergence of Mechatronics and Mechatronics Engineering, The Role and Necessity of Mechatronics Engineering in Engineering Disciplines, The Role and Importance of Mechatronics Engineering in Future Technology, Mechatronic Systems and Elements, Laboratory and Factory Visits.

YDİ 107 ENGLISH -1- (2 0 0 2)

Level Determination via Placement Test, Pronunciation (Simple Daily Conversations), Dictation Exercises, Simple Sentence Structures, Word Types and Their Features, Essential Grammar Rules, Properly Conjugated Verbs, Oral and Written Exercises on Simple

BMÜ 122 ALGORITHM AND PROGRAMMING -2

Introduction to Object-Oriented Programming, Abstract Data Types, Classes and Objects, Arrays, Pointers and Methods for Passing Arguments Using Pointers, Algorithm Complexity, Stacks and Queues, Dynamic Memory Management, Linked Lists, Recursion and Tree Structures, Search and Sorting Algorithms, Hash Tables, Comparative Examples with Other Programming Languages.

FİZ 106 PHYSICS LABORATORY 2 (0 0 2 1)

Introduction; Basic Laboratory Principles, Introduction to Laboratory Equipment, Reading Resistance Values, Series-Connected Resistor Circuits, Parallel-Connected Resistor Circuits, Ohm's Law, Kirchhoff's Law and Wheatstone Bridge, Biot-Savart Law, Magnetic Force, Faraday's Law of Induction.

FİZ 112 PHYSICS 2 (3 0 0 3)

Electric Charge, Coulomb's Law, Electric Field, Gauss's Law, Electric Potential, Capacitance and Properties of Dielectrics, Current, Resistance, and Electromotive Force, Direct Current Circuits, Magnetic Field, Magnetic Properties Affecting Current-Carrying Conductors, Magnetic Field and Properties of a Current, Electromotive Force of Induction, Alternating Currents, and Electromagnetic Waves.

MAT 104 LINEAR ALGEBRA (2 0 0 2)

Introduction to Matrix Algebra, Special Types of Matrices, Matrix Addition and Multiplication Operations and Their Properties, Determinants, Laplace Expansion, Rank of a Matrix, Adjoint Matrix, Inverse of a Matrix, Linear Equation Systems and Solution Methods, Vector Algebra, Linear Dependence and Independence.

MAT 162 MATHEMATICS -2- (4 0 0 4)

Definite integrals, applications of definite integrals (area and volume calculations), applications of definite integrals (arc length and surface area of revolutions), sequences, series, positive series and convergence tests, alternating series, Taylor and Maclaurin series, multivariable functions, limits and continuity for functions of two variables, partial derivatives, chain rule, total differential, derivatives of implicit functions, directional derivatives, maximum and minimum values, region transformations, geometric interpretation of partial

derivatives, differentiation under the integral sign, double integrals, region transformations, applications of double integrals (area and volume calculations), applications of double integrals (mass, center of gravity, moment of inertia).

MKM 120 COMPUTER-AIDED TECHNICAL DRAWING (2 0 2 3)

Introduction to modern CAD programs, drawing of lines, arcs, ellipses, and polygons using a CAD drawing program, dimensioning, hatching, layer definitions, scaling, mirroring, copying, moving, deleting, isometric drawings, drawings of machine elements, disassembly and assembly drawings, tolerances and surface roughness symbols, drawing and meanings of mechatronic symbols, electrical power circuit diagrams, and current flow diagrams.

MKM 122 ELECTRICAL CIRCUITS (3 0 2 4)

Basic concepts in electrical circuits, circuit analysis and circuit theorems, linearity and superposition, series/parallel combinations of R-L-C circuits, operational amplifiers (OpAmps), sinusoidal steady-state, impedance. Experiments: Reading resistance values, simulations using Orcad PSpice and EWB programs, Kirchhoff's current and voltage laws, current and voltage division, proportionality and superposition theorems, Thévenin equivalent circuit and maximum power theorem, usage of oscilloscopes and signal generators, transient response of RC circuits, resonance in RLC circuits.

YDİ 108 ENGLISH -2- (2 0 0 2)

Vocabulary development, irregular verbs, commonly used terms, idiomatic expressions, oral communication through listening and speaking, basic composition writing, grammar studies, application of known rules, dictionary usage, and translation exercises from a foreign language to the native ge.

2nd Year 1st Semester

AİT 201 ATATÜRK'S PRINCIPLES AND HISTORY OF THE TURKISH REVOLUTION -1- (2 0 0 0)

Purpose of studying Atatürk's Principles and the History of the Turkish Revolution, the concept of revolution, the collapse of the Ottoman Empire, and the reasons leading to the Turkish Revolution. The partition of the Ottoman Empire, the Tripoli War, the Balkan Wars, World War I, the Armistice of Mudros, the state of the country under occupation, and Mustafa Kemal Pasha's reaction. Mustafa Kemal Pasha's departure to Samsun and the first steps toward the National Struggle. Organization through congresses: Amasya, Erzurum, and Sivas Congresses; the National Forces (Kuvayı Milliye) and the National Pact (Misak-ı Milli). The opening of the Grand National Assembly of Turkey and its assumption of leadership in the War of Independence. The Treaty of Sèvres, political events up to the Sakarya Victory, and military developments leading to the Sakarya War and the Great Offensive.

MAT 271 DIFFERENTIAL EQUATIONS (4 0 0 4)

First-order ordinary differential equations and their engineering applications, linear differential equations and their engineering applications, Green's functions, introduction to linear algebra, simultaneous linear differential equations, finite differences, mechanical systems and electrical circuits, Fourier series and integrals, and Laplace transforms.

MKM 223 ELECTRONIC CIRCUITS -1- (3 0 0 3)

Semiconductor structures, diode characteristics, diode models, diode circuits, basics of circuit analysis, circuit models for bipolar junction and field-effect transistors, nonlinear elements, small-signal analysis, piecewise-linear analysis, analysis and design of single-stage transistor amplifiers, biasing and gain concepts, introduction to frequency and time-domain representations, lumped and distributed circuit concepts, frequency-dependent circuit characteristics, introduction to feedback circuits and feedback amplifiers, stability, phase margin and compensation concepts, multistage amplifier circuits, power amplifier circuits, oscillators, operational amplifiers, and their applications.

MKM 211 ENGINEERING MECHANICS (3 0 0 3)

Principles of mechanics, dimensional analysis, vectors, forces, moments, planar and spatial problems, equilibrium state, distributed forces, centers of gravity, geometric centers of planar surfaces, volume centers, mass centers, moments of inertia, section moduli, mass moments of inertia. Principles of dynamics, Newton's laws, unit systems, kinematics of particles, rectilinear motion, uniformly accelerated rectilinear motion, curvilinear motion, derivatives of vector functions, planar curvilinear motion, relative motion, angular motion of a line, coordinate transformations, kinetics of particles, equations of motion, work and energy, impulse and momentum, angular momentum, conservation of momentum, and inertia properties.

MKM 213 MATERIAL SCIENCE (2 0 2 3)

Classification of materials, atomic structure and interatomic bonds, crystal structures, defects in solids, diffusion, mechanical properties of metals, dislocations, strength, phase diagrams, phase transformations, and changes in mechanical properties. Alloys, the structure and properties of ceramics, polymer structures, their applications, and processing. Composites, corrosion, electrical and thermal properties, magnetic and optical properties of materials, and example applications for material selection.

MKM 225 DYNAMICS (3 0 0 3)

Definition and Classification of Mechanics, Purpose, Principles of Dynamics – Newton's Laws, Dimensional Analysis, Unit Systems, Kinematics of Particles, Linear Motion of Particles – Uniform Linear Motion – Uniformly Accelerated Linear Motion, Description of Particle Motion, Curvilinear Motion of Particles – Derivatives of Vector Functions, Curvilinear Motion in a Plane – Relative Motion – Angular Motion of a Line, Curvilinear Motion in Space – Coordinate Transformations – Relative Motion in Space, Kinetics of Particles (Force – Mass – Acceleration) – Equations of Motion, Work and Energy, Impulse and Momentum, Angular Momentum, Conservation of Momentum, and Inertia Properties.

TRD 209 TURKISH LANGUAGE -1- (2 0 0 2)

What is Language? The Role and Importance of Language as a Social Institution in National Life, The Relationship Between Language and Culture, The Place of the Turkish Language Among World Languages, The Current Status and Expansion Areas of the Turkish Language, Sounds in Turkish and Their Classification, Phonetic Features and Rules Related to Turkish, Syllable Structure, Spelling Rules and Their Application, Punctuation Marks and Their Application.

SOCIAL ELECTIVE COURSES (2 0 0 2)

EGT 271 DEVELOPMENT AND LEARNING

Face-to-face Interaction with Students, Discussions, Course Delivery, Student Responsibilities, and Assessment Explanation. Basic Concepts of Development, Developmental Processes, Continuity and Discontinuity in Development, Factors Influencing Development, Principles, Stages, and Developmental Tasks. Physical Development During Prenatal and Infancy Periods, Physical Development in Early Childhood and Adolescence, Cognitive Development, Personality Development, Moral Development, Psychology of Learning; Basic Concepts and Factors Affecting Learning, Classical and Operant Conditioning Theories, Social-Cognitive Theory, Information Processing Theory, Weiner's Attribution Theory, and Gagne's Conditions of Learning Theory.

MKM 217 TOTAL QUALITY MANAGEMENT

Historical Chronological Events Directly or Indirectly Influencing Total Quality Management (TQM), Elements of TQM: Customer Orientation, Cooperation with Suppliers, Principles of Learning Organizations, Institutional Attitude Towards Learning, Continuous Learning Process, Benchmarking, Social Responsibility, TQM in Education, Contemporary Teaching – Effective Learning, Project-Based Learning, Collaborative Learning Model, Advanced Learning Strategies and Thinking Skills, Learning to Learn, Learning to Think, Lifelong Learning, Quality Boards, Quality Improvement Teams, Teamwork, Strategic Plans, Self-Evaluation, and Development of Data Collection Methods and Tools.

RTV 203 POLITICAL SCIENCE

Developing students' ability to analyze political phenomena and events conceptually, and familiarizing them with the terminology of political science. Helping students develop an understanding of the main actors and topics in politics. Providing knowledge about core political topics, particularly the state, power, political regimes, and ideologies.

RTV 223 ORAL EXPRESSION

Dialogue, Techniques for Effective Speaking, Preparing Speeches for Special Occasions, Organizing Speech Content, Factors Affecting Speech, Body Language in Speaking, Techniques for Reading Poetry, Debates, Open Forums, Panels, Symposiums, Conferences, Television Productions, Diction and Its Importance, Key Points in Proper Turkish Pronunciation, Correct Spelling, Proper Emphasis, Correct Intonation, and Text-Based Practices.

SOS 249 PHILOSOPHY OF MORALITY AND ETHICS

Value and Fact, Structure of Values, What Constitutes a Value? The Indefinability of Value, The Valuable as That Which Gives Pleasure, Value as Desire or Preference, Moral Values, Morality and Moral Philosophy, The Relationship Between Moral Philosophy and Social Sciences, Approaches to Moral Philosophy, Moral Situations, Conditions for Moral Behavior, The Problem of Freedom, Moral Objectives, Classification of Moral Theories, Socrates and the Emergence of Moral Philosophy, Cynicism and the Morality of Indifference, Cyrenaics and Hedonism, Plato, Aristotle, and the Ethics of Happiness, Epicurus and the Avoidance of Pain, Stoicism and Self-Control, The Ethical Traditions of Monotheistic Religions, Kant and the Ethics of Duty.

SOS 251 INDUSTRIAL SOCIOLOGY

Basic Concepts Related to Industrial Sociology, The Impact of Industry and Industrialization on Social Life, Theories of Work Organization in Industrial Organizations, Theories Related to Labor Movements and Trade Unions, Industrial Production Systems, Perspectives on Contemporary Industrial Organizations, Social Structures and Operations of Modern Industrial Organizations, Ownership of Factories, Roles of Managers, Supervisors, and Workers, The Status and Roles in Industrial Organizations, The Role and Importance of Informal Groups in Industrial Organizations, An Overview of Turkey's Industrialization, Labor Movements in Turkey, Trade Unions for Workers and Employers, and The Relationship Between Industrialization and Social Change.

SOS 255 SOCIOLOGY OF MANAGEMENT

The Management Process, Universal and Environmental Elements of Management, Theoretical Approaches to Management, Processes, Structures, Functions, and Problems of Formal and Natural Organizations, Defining and Explaining the Concepts of Organization and Organizing, Bureaucracy as One of the Many Forms of Formal Organizations, Bureaucratic Behavior, Major Bureaucratic Theories, Key Features of Bureaucracy in Ottoman and Turkish Republican Public Administration, Centralization and Decentralization in Public Administration.

SYE 227 FIRST AID

This course aims to equip healthcare technicians with the ability to intervene in life-threatening situations encountered in first aid contexts. Course content includes the definition of first aid and the ABC rule, objectives of first aid, basic life support, removal of foreign objects from the airway, types of bleeding and methods to stop bleeding, application of a tourniquet, first aid in cases of consciousness disorders, shock, and fainting, types of injuries and regional injuries, spinal injuries, first aid for fractures, dislocations, and sprains, types of burns and their first aid, types of poisoning and their first aid, first aid for heatstroke and frostbite, and methods of transporting patients and injured individuals.

2nd Year 2nd Semester

AİT 202 ATATÜRK'S PRINCIPLES AND HISTORY OF THE TURKISH REVOLUTION -2- (2 0 0 0)

The Strategy of the Turkish Revolution, Reforms in the Political Sphere, Proclamation of the Republic, Abolition of the Caliphate, the Progressive Republican Party and the Period of Suppression of Rebellions, Reforms in the Legal Sphere, Reforms in Education and Culture, Economic Reforms, Attempts to Transition to Multi-Party Politics and Certain Domestic Political Events, Social and Cultural Reforms, Turkish Foreign Policy During the

Atatürk Period, Turkish Foreign Policy from 1923 to 1932, Turkish Foreign Policy from 1932 to 1938, Atatürk's Principles: Republicanism, Nationalism, Populism, Statism, Secularism, and Reformism.

İST 234 PROBABILITY AND STATISTICS (3 0 0 3)

Counting Techniques; Multiplication Rule, Permutation, Combination, Concept of Probability, Sigma Algebra, Axioms of Probability, Conditional Probability, Bayes' Theorem, Random Variable, Distribution Function, Probability Function, Chebyshev's Inequality, Discrete and Continuous Distributions, Uniform Distribution, Bernoulli Distribution, Poisson Distribution, Geometric Distribution, Hypergeometric Distribution, Normal Distribution, Exponential Distribution, Gamma Distribution, Beta Distribution, Generating Functions, Decision Theory, Estimation Concept, Hypothesis Testing, Nonparametric Tests, Correlation and Regression, Engineering Applications.

MKIM 224 ELECTRONIC CIRCUITS LABORATORY (0 0 2 2)

The experiments conducted in this course include Current-Voltage Characteristics of Diodes, Clipper Circuits, Zener Diode, Transistor Biasing Circuits, JFET Characteristics, MOSFET Characteristics, Transistor Amplifiers, FET Amplifiers, MOSFET Frequency Response, Basic Op-Amp Circuits, Op-Amp Current-Voltage Converters, and Op-Amp Applications.

MKM 214 NUMERICAL ANALYSIS (1 2 0 2)

Error Analysis, Solution of Linear Equations and Systems of Equations, Solution of Nonlinear Equations and Systems of Equations, Interpolation, Numerical Derivation, Numerical Integration, Numerical Solutions of Ordinary Differential Equations, Numerical Solutions of Partial Differential Equations, Curve Fitting.

MKM 218 MANUFACTURING PROCESSES (2 0 2 3)

Overview of Modern Manufacturing Technologies; Introduction to Inspection and Control Methods in Manufacturing Processes, Materials and Manufacturing Properties, Description and Industrial Applications of Various Traditional and Advanced Manufacturing Systems, EDM, ECM, Laser Processing, Machining, Turning, Milling, Drilling, Broaching, Grinding, etc. Laboratory Applications and Factory Visits, Casting, Metal Forming, Forging, Extrusion, Rolling, Joining, and Welding.

MKM 220 THERMODYNAMICS AND HEAT TRANSFER (3 0 0 3)

Basic Concepts, Properties of Pure Substances, Equations of State, The First Law of Thermodynamics, Enthalpy and Internal Energy, The Second Law of Thermodynamics, Exergy and Available Energy, Modes of Heat Transfer, Heat Transfer by Conduction, Thermal Resistances, Heat Transfer in Fins, Lumped System Analysis in Transient Heat Conduction, Calculation of Transient Heat Conduction Using Tables, Introduction to Convection, Properties of Fluids, Flows in Closed and Open Geometries, Hydrodynamic and Thermal Boundary Layers, Performing Convection Calculations Using Tables, Natural Convection, Heat Transfer by Radiation.

MKM 222 PROFESSIONAL ENGLISH (3 0 0 3)

Grammar Review, Shapes, Physical Descriptions, Matter, Molecules in Motion, Acids, Bases and Salts, Wave Motion, Engineering Materials, Metals, Torricelli's Experiment, Generators and Faraday, Force, Friction.

TRD 210 TURKISH LANGUAGE -2- (2 0 0 2)

General Information About Composition, Application of Oral and Written Composition Types, Elements of a Sentence, Sentence Analysis and Application, Studies on Expression and Sentence Errors, Rules for Preparing Scientific Writings, Selected Texts from Turkish and World Literature and the History of Thought.

MKM 226 STRENGTH OF MATERIALS (3 0 0 3)

Fundamentals of Strength of Materials, Internal and External Forces, Section Effects, Normal Force, Shear Force and Bending Moment Diagrams, Problem Solving Using the Cutting Method and Area Method, Stress Analysis and Formulations for Uniaxial Stress, Biaxial Stress Analysis and Graphical Problem Solving Methods, Triaxial Stress Analysis with Examples, Mechanical Properties of Solid Bodies, Strain and Stress-Strain Relationships, Strain Energy, Axial Normal Force State, Torsion, Moments of Inertia, Bending, Shear State, Combined Stress States, Shear Bending Applications, Elastic Curve, Applications of Elastic Curve.

MKM 303 THEORY OF MACHINES (3 0 0 3)

Introduction to Mechanisms, Basic Concepts and Degrees of Freedom, Position, Velocity, and Acceleration Analysis of Mechanisms, Cam Mechanisms, Static and Dynamic Analysis of Mechanisms, Influence Coefficients, Principle of Virtual Work, Lagrange Equations, Balancing, Introduction to Mechanical Vibrations.

MKM 311 MACHINE ELEMENTS (3 2 0 4)

Machine Elements and Design in Engineering, Strength in Machine Design, Material Selection in Machine Manufacturing, ISO Tolerances and Fits, Shafts and Axles, Joints and Their Components, Springs, Clutches, Tribology, Bearings, Gears; Power and Motion Transmission Mechanisms.

MKM 323 FLUID MECHANICS (2 0 0 2)

Properties of Fluids, Conservation of Mass, Energy Equation for Incompressible Flows, Energy Equation for Compressible Flows, Frictional Flow in Pipes, Fluid Flow Measurement Methods, Two-Dimensional Flows, Potential Flow and Euler Equations, Real Flows and Navier-Stokes Equations, Boundary Layer Theory.

MKM 343 SYSTEM DYNAMICS AND MODELING (3 0 0 3)

Modeling of Dynamic Systems, Time Domain Analysis, Fourier and Laplace Transforms, Transfer Functions, Block and Signal Flow Diagrams, Discrete-Time Systems and Z-Transforms, Linearization, Reduction of Higher-Order Systems, Frequency Domain Analysis.

MKM 345 ELECTROMECHANICAL SYSTEMS (4 0 0 4)

Magnetic Circuits, Principles of Electromechanical Energy Conversion, Transformers, Faraday's Law and Rotating Machines, Structure, Properties, and Operating Principles of Synchronous Machines (Motors and Generators), Operation and Performance of DC Machines, Small Power AC Motors, Brushless DC Motors, Stepper Motors, Servo Motors, Switched Reluctance Motors.

MKM 329 DIGITAL ELECTRONICS (2 0 2 3)

Number Systems and Codes, Implementation of Logic Functions with Contactless Elements, Boolean Algebra, Quine-McCluskey Method, Karnaugh Map Method, Combinational Circuits, Arithmetic Circuits, Small-Medium-Large Scale Integrated Circuits, Mux/Demux Encoder/Decoder Structures and Applications, Structure of Sequential Circuit Elements, Asynchronous and Synchronous Sequential Circuits and Their Design, Digital-to-Analog and Analog-to-Digital Converters, Digital Memory Circuits, FPGA, PLA, and PLC Circuits, Introduction to Microprocessors. Experiments: Theoretical Information About Experiments, Applications Using FPGA, TTL and CMOS Circuits, Combinational Circuits, Sequential Circuits, ALU Circuits, Latches, Flip-Flops, Registers, Counters, PLD Applications, and Memory Applications.

MKM 331 PROFESSIONAL PRACTICE -1- (0 2 0 0)

The objective of this course is to reinforce and enhance the theoretical and practical knowledge that Mechatronics Engineering students have gained during their first and second-year courses through their third-year summer internship. Students are expected to address and report the following topics during their internship: Information about the organization, including its history, organizational structure, fields of work, qualifications and number of employees, examples of previous projects related to mechatronics engineering, and future plans. Identification, observation, and documentation of topics related to mechatronics engineering within the organization, examination and observation of at least five projects completed or ongoing within the organization, with written and photographic documentation in the report. Observation and analysis of production technologies related to mechatronics engineering within the organization, including the production processes, machinery, and tools used for each production technology. Documentation of at least five mechatronics-related sample products, preferably including technical drawings and photographs created by the students. Cost analysis for at least two of the sampled projects or products.

TECHNICAL ELECTIVE COURSES (2 0 0 2)

MKM 333 AIR CONDITIONING SYSTEMS

Central Air Conditioning Systems, Heat Load Calculations for Air Handling Units, Selection of Cooling and Heating Units, Humidification, Selection of Filters and Cooling Tower Units, Installation of Air Handling Units, Cooling Tower Installation, Commissioning of Air Handling Units, and Commissioning of Cooling Towers.

MKM 335 OPTIMIZATION TECHNIQUES

Introduction to Classical Optimization, Objective Function and Variables, Optimization of Single and Multi-Variable Functions Without Constraints, Constrained Optimization Techniques, Lagrange Multipliers Method, Linear and Nonlinear Programming, Dynamic Programming, Optimization with Genetic Algorithms, and Non-Mathematical Search Methods.

MKM 337 SMART MATERIALS

Composites, Carbon-Carbon Fiber Composites, Ceramic Composites, Materials Used in Electronic Circuit Components, Composites, Dielectric Materials, Conductive Polymers, Thin and Thick Films, Silicon and Synthetic Diamond, Introduction to Biomedical Materials, Amorphous Materials, Artificially Produced Crystalline Materials, and Intermetallic Compounds.

MKM 339 INTRODUCTION TO MICROELECTROMECHANICAL SYSTEMS (MEMS)

Fundamentals of MEMS Production Technology, Sensor Design and Integration, Advantages and Disadvantages, Applications in Automotive, Defense, Microfluidics, Biotechnology, and Medical Fields, Manufacturing and Assembly, and a Design Project Application.

3rd Year 2nd Semester

MKM 338 AUTOMATIC CONTROL (3 0 0 3)

Mathematical Modeling, Linearization, Properties of Feedback Systems, Transient and Steady-State Response Analysis, Stability, Routh-Hurwitz Stability Test, Root Locus Analysis, Frequency Response Analysis, Bode Diagram, Polar and Nyquist Diagram, Frequency Response of Closed-Loop Systems, Analysis of Multi-Input Multi-Output Systems, Transfer Matrix, Controllability and Observability, Lyapunov Stability Analysis, Performance Analysis of Control Systems.

MKM 320 SENSORS AND MEASUREMENT METHODS (1 0 2 2)

Sensors and Fundamental Concepts, Transducers, Sensing and the Need for Sensing, Signals and Sampling, Distance Sensors (IR Sensors, Ultrasonic Sensors, Capacitive Sensors), Position Sensors (Gyroscopes, Accelerometers, Tilt Sensors), Magnetic Sensors (Hall-Effect Sensors), Fundamental Measurement Concepts, Performance Characteristics of Measurement Elements, Electrical and Electronic Measurement Devices, Computer-Aided Measurement Systems, Measurement Methods for Electrical Quantities, Data Collection and Processing, Methods for Measuring Dimensions, Area, Pressure, Flow, Temperature, Heat, Force, Torque, Deformation, Displacement, Velocity, Acceleration, and Sound.

MKM 336 COMPUTER-AIDED DESIGN AND MANUFACTURING (1 0 2 2)

Computer-Aided Design, Computer-Aided Manufacturing, and Introduction to Computer Integrated Manufacturing, Solid Modeling, Curve and Surface Modeling, CAD Databases and Standards, Group Technology and Process Planning, Data Transmission Systems in Manufacturing, Computerized Control and Numerical Machines, Integrated Computer-Aided Manufacturing.

MKM 322 MICROPROCESSORS (2 0 2 3)

Microprocessor Architecture, Software for a Specific Microprocessor (to be selected), Input-Output Interface Design, Interrupt-Driven Input-Output, Direct Memory Access, Microprocessor-Based Communication.

MKM 324 DIGITAL SIGNAL PROCESSING (3 0 0 3)

Digital Signal Processing Methods, Discrete-Time Signals and Systems, Solution Methods for Difference Equations, Analysis of Signals and Systems in the Frequency Domain, Discrete-Time Fourier Transform, Discrete Fourier Transform, Fast Fourier Transform, Z-Transform, Inverse Z-Transform, Region of Convergence and Its Properties, Transfer Function, Pole/Zero Analysis, Frequency Response Calculation, Implementation Algorithms for Digital Systems, Digital Filters, Design Steps for FIR and IIR Filters.

MKM 326 INDUSTRIAL PROGRAMMING (1 2 0 2)

Programming PLCs Using Ladder Diagrams and Function Blocks, Programming Touch Panels, Performing PLC Input-Output Operations, Writing Programs Using Ladder Diagrams, Writing PLC Programs Using Sequential Function Blocks, Connecting and Programming Touch Panels with PLCs. Experiments: Applications with Siemens SIMATIC S7-1200 PLCs, Bidirectional Operation of Short-Circuit Asynchronous Motors, Star-Delta Starting of an Asynchronous Motor, Position and Speed Applications on an XY Table, Applications with Servo, Stepper, and DC Motors.

MKM 328 ARTIFICIAL LEARNING METHODS (2 0 0 2)

Neural Cell Models, Learning Processes, Single-Layer Perceptron, Linear Least Squares Algorithm, Adaptive Linear Elements, Learning Curves, Multi-Layer Perceptrons, Learning Algorithms, Supervised Learning, Backpropagation Learning Algorithm, Unsupervised Learning, Self-Organizing Algorithms, Kohonen Map Organization Algorithm, Dynamic Neural Networks, Hopfield Networks, Introduction to Cellular Neural Networks, Neural Network Applications. Terminology and Fundamental Definitions of Fuzzy Logic, Theoretical Set Operations, Membership Function Formulation and Parameterization, Fuzzy Complement, Intersection and Union, Norms, Extension Principle, Fuzzy Relations and Linguistic Variables, Fuzzy If-Then Rules, Fuzzy Causality, Fuzzy Models, Mamdani and Sugeno, Input Space Partitioning, Fuzzy Modeling, Fuzzy Control.

MKM 340 ELECTRICAL MACHINES LABORATORY (0 0 2 1)

Starting and Speed Control of DC Shunt Motors, Starting and Speed Control of Three-Phase Asynchronous Motors, Stepper Motor Control, DC Motor Control Using a DC Chopper Circuit, Three-Phase Asynchronous Motor Control with PLC, Starting and Speed Control of Single-Phase Asynchronous Motors.

<ins>TECHNICAL ELECTIVE COURSES (2 0 0 2)</ins>

MKM 310 MECHANICAL VIBRATIONS

Periodic Motion, Free Vibrations, Harmonic Motion, Torsional Vibrations, Simple Pendulum, Energy Methods and Rayleigh Principle, Single-Degree-of-Freedom Systems, Rayleigh Energy Method, Vibration Modes and Mass Effects, Forced Vibrations, Undamped Forced Harmonic Vibrations, Transmitted Forces and Vibration Isolation, Measuring Instruments, Damped Vibrations, Viscous Damping, Logarithmic Decrement, Coulomb Damping, Hysteresis, Damped Forced Vibrations, Two-Degree-of-Freedom Systems, Torsional Vibrations.

MKM 312 FACTORY ORGANIZATION

Definition of Organization, Optimization, Costs and Their Concepts, Break-Even Analysis, Site Selection, Facility Renewal, Workplace Arrangement, Demand Forecasting, Linear Programming, Production Planning and Control Techniques (CPM, PERT), Inventory Control, Ergonomics, Technical Management, Quality Control, and Total Quality Management.

MKM 318 BIOMEDICAL MEASUREMENTS

Principles of Biomedical Sensors, Amplifiers and Signal Processing, Amplification and Detection of Bio-Potentials and Their Origins, Blood Flow and Pressure Measurement, Medical Imaging, and Patient Safety in Medical Devices.

MMÜ 332 FINITE ELEMENT ANALYSIS

Introduction to Numerical Analysis Techniques, Types of Finite Elements, Definition of Stiffness and One-Dimensional Elements, Element Matrices and Construction of the Global Stiffness Matrix, Evaluation of Boundary Conditions, Frames and Formation of Transformation Matrices, Fundamentals of Linear Elasticity,

Analysis of Two-Dimensional Problems, Triangular Finite Elements, Mesh Generation, Isoparametric Finite Elements, Stress, Temperature, and Other Analyses with Applications.

MKM 437 DIGITAL CONTROL (2 0 0 2)

Basic Components in Digital Control Systems, Use of Z and Inverse-Z Transforms for Digital Control Systems, Solving Systems Modeled with Difference Equations Using Z-Transform, Digital Control Systems in MATLAB, Application of the Convolution Integral Method to the Right and Left Half Z-Plane, Reconstructing Original System Signals from Sampled Signals, Pulse Transfer Function of Digital Control Systems, Transient Response of Pulse Transfer Functions, Implementation of Digital Control Systems, Conversion Between Laplace (S-Plane) and Z-Plane, Defining System Performance Criteria in the Z-Plane, Stability in Digital Control Systems, Effect of Sampling on Transient Response Analysis in Digital Control Systems, Performance Criteria for Basic System Dynamics, Frequency Response of Digital Control Systems, Controller Design in W-Plane, Single Input-Single Output Optimal Digital Control Systems, Time-Optimal Controller Design Using Analytical Methods.

MKM 439 POWER ELECTRONICS AND DRIVES (3 0 2 4)

Semiconductor Switches, Snubber Circuit Design, AC-AC Chopper Circuits, Uncontrolled and Controlled Single and Three-Phase Rectifiers, Inductive and Capacitive Filtering Circuits, Flyback, Forward, and Boost-Type Converter Circuits and Their Analysis, Examination of PWM Techniques, Analysis of Inverter Circuits, Switch-Mode Power Supplies (SMPS), and Four-Quadrant Operation. Experiments on Single and Three-Phase Controlled and Uncontrolled Rectifiers, DC-DC Choppers, AC-AC Choppers, and Inverter Circuits are conducted within the course.

MKM 427 MECHATRONIC DESIGN (0 2 0 1)

Steps in Mechanical System Design, Modeling and Simulation of Physical Systems, Selection of Sensors and Transducers, Selection of Actuators, Selection of Hardware Components for Mechatronics, Selection of Controllers Suitable for Design, Advanced Applications in Mechatronics, Reverse Engineering, and Discussion of Student Projects.

MKM 429 ROBOT VISION (2 0 0 2)

Image Formation and Image Detection, Binary Images, Geometric Properties, Topological Properties, Regions, and Image Segmentation, Image Processing, Continuous and Discrete Images, Edges and Edge Detection, Brightness and Color Reflection Map, Photometric Stereo Reflection Map, Shape from Shading, Motion Fields and Optical Flow, Photogrammetry and Stereo, Image Classification, Polyhedral Objects, Extended Gaussian Images, Passive Navigation and Structure from Motion, Object Assembly.

MKM 431 LABOR LAW (2 0 0 2)

Introduction to Labor Law, Key Legislation in Labor Law, Basic Concepts of Labor Law, Scope of Application of the Labor Law, Types of Employment Contracts, Prohibited Work for Employment Contracts, Rights and Obligations of Workers and Employers Arising from Employment Contracts, Termination of Employment Contracts, Working Hours, Leave and Wages, Concept of Social Security, Union Law, Collective Labor Agreement Law, Strikes, Lockouts, and Disputes Over Rights and Interests.

MKM 433 PROFESSIONAL PRACTICE 2 (0 2 0 0)

The objective of this course is for Mechatronics Engineering students in their fourth-year summer internship to recognize and examine the practical applications of advanced engineering knowledge acquired during their studies and to participate in design, project planning, research and development, product development, production, and method improvement activities. The topics that students are required to work on and report in the relevant organization are as follows: Information about the organization, including its history, organizational structure, fields of work, qualifications and number of employees, examples of previous work related to Mechatronics Engineering, and future plans. Design, project planning, research and development, product development, production, and method improvement activities related to Mechatronics Engineering in the organization. Detailed examination and presentation of at least two examples of design, project planning, research and development, product development, production, or method improvement activities conducted by the

organization. Detailed explanation of the student's contributions to at least one relevant project during the internship, including technical calculations and drawings. Each project should include: Subject and definition Qualifications and number of personnel directly involved Sources of information used Processes and stages Methods and approaches employed (analytical, numerical, experimental, computer-aided design, and/or simulation) Laboratories, production, and/or testing units utilized Technical devices and equipment Computer hardware and software systems Sensors, actuators, and control subsystems, with detailed explanations, technical calculations, and technical drawings.

MKM 441 ENGINEERING ECONOMICS (2 0 0 2)

Basic Economic Concepts, Cost Concept, Interest and Interest Formulas, Time-Value of Money Formulas. Applications of Engineering Economics: Application of Time-Value of Money Formulas, Comparison of Alternative Solutions, Prediction of Cash Flows, Inflation, and Price Changes, Replacement Investments. Additional Topics in Engineering Economics: Decision-Making Under Risk, Decision Tree Applications, Influence Diagrams, Decision-Making Using Expected Value Method, Decision-Making Under Uncertainty, Strategic Evaluation Techniques.

TECHNICAL ELECTIVE COURSES (2 0 0 2)

BMÜ 467 COMPUTER NETWORKS

Seven-Layer ISO-OSI Model, Media Access Layer, ALOHA and Local Area Network Protocols, IEEE 802.2 and Ethernet, Data Link Layer, Error Detection and Correction, Data Link Protocols, Network Layer, Routing, Congestion Control, Transport Layer, Internet, and Internet Tools. MKM 417 VEHICLE DYNAMICS Simulation and Mathematical Modeling of Vehicle Dynamics, Tire Models, Road-Holding Dynamics, Rolling Dynamics, Motion Dynamics, Evaluation of Vehicle Structures and Parameters, and Assignments.

4th Year 2nd Semester

MKM 402 GRADUATION PROJECT (0 2 0 1)

The Graduation Project is carried out in accordance with the principles defined in the "Engineering Faculty Graduation Project Directive" and the "Departmental Graduation Project Implementation Guidelines," under the supervision of a project manager. Project studies include the review and development of work under managerial supervision, writing the project in compliance with thesis format and writing rules, and submission of the final Graduation Project.

TECHNICAL ELECTIVE COURSES-4 (3 0 2 4)

MKM 426 ROBOTIC SYSTEMS

Introduction to Robots, Kinematic Structures of Manipulators, General Structure of Robot Control Systems, Forward and Inverse Kinematic Solutions, Jacobian Relations, Homogeneous Transformations, Denavit-Hartenberg Principle, Manipulator Statics and Dynamics, Computed Torque Control, Programming of Robot Manipulators, and Industrial Applications.

MKM 428 OPTICAL SYSTEMS

Properties of Semiconductor Optical Elements, Band Structures, Optical Absorption, Nonlinear Optical Properties of Semiconductor Elements, Optoelectronics, Circuits, Lasers, Operating Principles, Structures, and Properties, Photodetector Structures and Principles, Solar Cells.

TECHNICAL ELECTIVE COURSES-5 (2 0 0 2)

MKM 430 SPECIAL ELECTRIC MACHINES

Classification and Applications of Special Electric Machines, Structure and Operation of Stepper Motors, Drive Circuits for Stepper Motors, Reluctance Motors, Linear Motors, Hysteresis Motors, Structure and Operation of Brushless DC Motors, Drive Circuits for Brushless DC Mtors.

MKM 432 FLEXIBLE MANUFACTURING SYSTEMS

Introduction to Manufacturing Systems and Automation in Manufacturing, Single-Station Manufacturing Systems, Group Technology and Cellular Manufacturing, SCADA Systems, Flexible Manufacturing Systems (FMS), Transfer Lines and Automated Manufacturing Systems, Automated Assembly Systems, Planning of Flexible Manufacturing Systems, FMS Performance Evaluation, and Decision Models in FMS Design.

MKM 434 MECHATRONICS IN AUTOMOTIVE ENGINEERING

Approaches to Automotive Design Systems, Suspension, Steering, Brakes, Power Transmission Systems, Basic Vehicle Dynamics, Performance and Road-Holding Characteristics, Assignments.

MKM 436 RENEWABLE ENERGY SYSTEMS

Introduction to Renewable Energy: Current Energy Use, Fossil Fuels and Climate Change, Renewable Energy Resources, Renewable Energy in a Sustainable Future. Energy Economy Project: Capital Investment, Other Costs, Internal Rate of Return, Payback Period, Present Value Calculation, Inflation, Discounted Cash Flow. Solar Energy: Availability and Nature of Solar Energy, Active Solar Heating, Passive Solar Heating, Thermal Solar Engines and Power Generation, Economy, Potential and Environmental Impact. Solar Photovoltaic: Introduction to Photovoltaics, Electrical Characteristics of Silicon PV Cells and Modules, PV Systems for Remote Energy Production, Grid-Connected PV Systems, Energy Costs from PV Systems. Tidal Energy: Introduction to Tidal Energy, Technical, Environmental and Economic Factors, Tidal Energy Potential, Tidal Stream Turbines. Wind Energy: Environmental Impact, Wind Turbines, Commercial Developments and Wind Energy Potential, Offshore Wind Energy, Economy. Wave Energy: Physical Principles of Wave Energy, Wave Energy Resources, Wave Energy Technology, Environmental Impact, Economy. Geothermal Energy: Geothermal Energy Resources, Energy Technologies for Geothermal Resource Operation, Environmental Impact, Economy. Hydropower: Brief History of Hydropower, Types of Hydropower Plants, Small-Scale Hydropower, Environmental Assessment, Economy. Energy Transmission and Storage: Heat Transmission, Power Transmission, Heat Storage, Storage of High-Quality Energy Forms.

MKM 438 HYDRAULIC AND PNEUMATIC SYSTEMS

Power Hydraulic Systems, Basic Features of Hydraulic and Pneumatic Systems, Components, Direction, Flow and Pressure Control Valves, Hydraulic Power Units, Pumps, Motors, Cylinders, Hydraulic Fluids, Filters and Sealing Components, Hydraulic and Pneumatic Circuit Design and Interpretation, Standard Symbols for Hydraulic Circuits, Example Circuit Diagrams.

MKM 440 BIOMECHANICAL SYSTEMS

Human-body-based biomechanical systems and solving related problems. Learning mechanical laws, center of gravity and balance, applying mechanical laws to biomechanical systems consisting of skeletal-muscle, joints and similar elements. Knowing the material and mechanical properties of the components forming biomechanical systems, acquiring knowledge about the strength of solid bodies, applying strength calculations to biomechanical systems.

MKM 442 ENTREPRENEURSHIP AND INNOVATION

This course includes the following topics: Concept of Entrepreneurship and Its Development, Entrepreneurship Culture, Ethics in Entrepreneurship, Business Models in Entrepreneurship, Innovation Management, Competitive Analysis in Entrepreneurship, Strategic Alliances in Entrepreneurship, Management Skills and Leadership, Marketing Management in Entrepreneurship, Financing Entrepreneurship, Corporate Entrepreneurship, Public Administration and Innovation in Entrepreneurship, Social Entrepreneurship vs. Commercial Entrepreneurship in Solving Social Problems, Relationship Between Entrepreneurship and Globalization, EU Applications.

MKM 444 OCCUPATIONAL HEALTH AND SAFETY

This course covers fundamental concepts and historical development of occupational health and safety, the duties, authorities and responsibilities of workplace physicians and safety specialists, concepts of risk, hazard, primary, secondary and tertiary protection, physical, chemical, biological and psychosocial risks, occupational health and safety regulations and workplace applications.

MKM 402 GRADUATION PROJECT

Graduation Project studies are conducted in accordance with the principles specified in the "Engineering Faculty Graduation Project Directive" and the "Departmental Graduation Project Guidelines" in consultation with the project manager. Project studies are reviewed and developed under supervision, written in thesis format in accordance with writing rules, and submitted as the Graduation Project.

MKM 446 APPLIED ENGINEERING

Education is provided within the framework of the Applied Engineering course implementation regulations. The purpose is to reinforce the knowledge and skills gained during the education period, offer opportunities for application, and allow students to follow technological developments in the industry closely while building self-confidence.