

Firat University Faculty of Engineering Department of Mechatronics

Engineering Course Contents

1st Grade 1st Semester

PHYS 1105 PHYSICS LABORATORY -1- (0 0 2 1)

Introduction; Basic Laboratory Principles, Fundamental Quantities, Unit Systems, Physical Measurements and Errors, Introduction to Laboratory Instruments, 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.

PHYS 1111 PHYSICS -1- (4 0 0 4)

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

KIM 1105 CHEMISTRY -1- (4 0 0 4)

Properties of matter, the SI unit system, uncertainty and significant figures, the mole concept. Molecular and ionic compounds, molecular weight, composition, oxidation state, names, and formulas. Chemical reactions and chemical equations, stoichiometry, solution reactions, determining the limiting reactant. The nature of aqueous solutions, precipitation reactions, acid-base reactions, oxidation-reduction: balancing oxidation-reduction reactions, oxidants and reductants, stoichiometry in aqueous solution reactions. General properties of gasses: pressure, simple gas laws, combined gas laws: ideal gas equation and general gas equation, applications of the ideal gas equation, gasses in chemical reactions, gas mixtures, kinetic theory of gasses, real (non-ideal) gasses. Terminology used in thermochemistry, heat, heat of reaction and calorimeter, work, the first law of thermodynamics, heat of reaction: Hess's law: internal energy and enthalpy, indirect calculation of enthalpy, standard enthalpy of formation, fuels as energy sources. Atmospheric structure, the atmosphere as a source of chemical substances, nitrogen and important compounds, environmental pollution containing nitrogen oxides, oxygen, the ozone layer and its role, noble gasses, carbon oxides, the environmental problem 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 change in the formation of ionic crystals. Arrhenius theory of acids, Brønsted-Lowry theory of acids and bases, ionization of water and pH scale, strong acids and bases, weak acids and bases, polyprotic acids, ions as acids and bases, molecular structure and acid-base behavior, Lewis acids and bases. Nuclear chemistry, radioactivity, radioactive isotopes, nuclear reactions and artificial radioactivity, the rate of radioactive decay, the energy of nuclear reactions, nuclear fission and fusion, radioisotope applications.

KIM 1109 CHEMISTRY LABORATORY (0 0 2 1)

This course aims to provide students with practical experience in basic laboratory techniques used in chemistry. Therefore, first of all, students will be given the rules for working safely in the laboratory and what they should do in case of potential accidents. The materials available in the laboratory and their uses will be described. Students will be asked to perform experiments on measurement and weighing processes, types of solutions and methods for preparing them, purification techniques for mixtures including crystallization and distillation, determination of the melting and freezing points of pure substances, study of the reduction reaction of KMnO_4 in an acidic environment using titration, determination of the heat capacity of a metal using a simple calorimetric method, determination of the enthalpy of formation of magnesium oxide, determination of the molecular weight of a pure substance using the freezing point depression method, determination of the water of hydration in a substance containing water of crystallization, and determination of acetic acid in vinegar using titrimetric methods.

MAT 1161 MATHEMATICS -1- (4 0 0 4)

Number Systems, Properties of Real Numbers, Inequalities, Absolute Value, Intervals, Extended Real Numbers, Induction, Complex Numbers, Relation and Function, Some Basic Properties of Trigonometry, Periodic Functions, Limit and Continuity for Functions of One Variable, Some Properties of Continuous Functions, Derivative of a Function of One Variable, Properties of Differentiable Functions, Applications of the Derivative, Indeterminate Forms and L'Hospital's Rule, Integral, Indefinite Integral, Some Integration Techniques, Definite Integral and Some Important Theorems, Area of a Region, Volume of a Solid.

MKM 1105 INTRODUCTION TO MECHATRONICS ENGINEERING, ORIENTATION AND ETHICS (1 0 0 1)

Definition and Principles of Engineering, Engineering Profession and Ethical Rules, Mechatronics and the Emergence of Mechatronics Engineering, Place and Necessity of Mechatronics Engineering in Engineering Disciplines, Place and Importance of Mechatronics Engineering in Future Technology, Mechatronics Systems and Elements, Laboratory and Factory Visits. Job description, professional terminology, content and field application of Mechatronics Engineering education, international professional organizations, professional ethics, legal consequences of unethical behavior.

1st Grade 2nd Semester

PHYS 1106 PHYSICS LABORATORY 2 (2 0 0 1)

Introduction; Basic Laboratory Principles, Introduction to Laboratory Devices, 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.

PHYS 1112 PHYSICS-II (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 of a Current and Magnetic Properties, Induced Electromotive Force, Alternating Currents and Electromagnetic Waves.

MAT 1146 LINEAR ALGEBRA (2 0 0 2)

Matrix definition, addition and scalar multiplication operations between matrices, matrix multiplication operation, elementary operations, determinant definition and calculation, determinant calculation methods, calculation of the inverse of a matrix with respect to multiplication, rank of a matrix, linear equation system definition, existence-non-existence and uniqueness of solutions, Cramer systems, Gauss-Jordan methods, homogeneous equation systems, vector space definition and some basic properties, subspaces, linear combination and the concept of being generated by vectors, linearly dependent and independent vectors, the concept of basis, operations between vectors and their applications, scalar product and vector product, Gram-Schmidt orthonormalization concept, linear transformations between vector spaces, matrices corresponding to linear transformations, eigenvalues and eigenvectors concepts, Cayley-Hamilton Theorem and its applications.

MAT 1162 MATHEMATICS -2- (4 0 0 4)

Definite integral, Applications of definite integral (Area-volume calculation), Applications of definite integral (arc length calculation-Surface area of revolution), Sequences, Series, Positive series and convergence tests, Alternating series, Taylor, Maclaurin series, Multivariable functions, Limit continuity for functions of two variables, Partial derivatives, Chain rule, Total differential, Derivative of implicit functions, Taking derivatives in any direction, Maxima, minima, Region transformations, Geometric meaning of partial derivatives, Differentiating under the integral sign, Double integrals, Region transformations, Applications of double integrals (Area calculation-Volume calculation), Applications of double integrals (Mass calculation-Finding the center of gravity-Moment of inertia).

MKM 1122 ELECTRICAL CIRCUITS (3 0 2 4)

Basic concepts in electrical circuits. Circuit analysis and circuit theorems. Linearity and additivity. Series/parallel combinations of R, L, and C circuits. Sinusoidal steady state. Impedance. Magnetic fields and circuits. Electromechanical energy conversion.
2nd Grade 1st Semester

MAT 2171 DIFFERENTIAL EQUATIONS (4 0 0 4)

First-Order Ordinary Differential Equations and Engineering Applications, Linear Differential Equations and Engineering Applications, Green's Functions, Introduction to Linear Algebra, Simultaneous Linear Differential Equations, Finite Differences, Mechanical Systems and Electrical Circuits, Fourier Series and Integral, Laplace Transform.

MKM 2111 ENGINEERING MECHANICS (3 0 0 3)

Principles of Mechanics, Dimensional Analysis, Two and Three-Dimensional Forces, Moment, Planar and Spatial Problems, Equilibrium, Distributed Forces, Centers of Gravity, Geometric Center of Planar Surfaces, Volume Centers, Mass Centers, Truss Systems, Cable Forces, Frictional Systems.

MKM 2113 MATERIALS SCIENCE (2 0 0 2)

Classification of Materials, Atomic Structure and Interatomic Bonds, Crystal Structure, Defects in Solids, Diffusion, Mechanical Properties of Metals, Dislocations, Strength, Phase Diagrams, Phase Transformations and Changes in Mechanical Properties, Alloys, Structure and Properties of Ceramics, Polymer Structures, Applications and Processing, Composites, Corrosion, Electrical, Thermal, Electrical Properties of Materials, Magnetic and Optical Properties, Example Applications for Material Selection.

MKM 2115 INTRODUCTION TO ENTREPRENEURSHIP, INNOVATION, AND PROJECT MANAGEMENT (1 0 0 1)

This course covers the fundamentals of entrepreneurship, innovative thinking and opportunity assessment processes, business model development, market and competition analysis, financial planning, and resource management. Additionally, while covering the fundamental concepts of project management, project planning, and risk and crisis management strategies, practical exercises and case studies will also be presented to develop skills such as leadership, teamwork, and effective communication. In the later weeks of the course, topics such as innovation management, R&D processes, and strategic planning will also be covered, with the aim of students gaining practical experience thru real-life examples.

MKM 2119 MANUFACTURING PROCESSES (2 0 0 2)

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

MKM 2121 THERMODYNAMICS (2 0 0 2)

Pure substances and their properties. Perfect and real gasses. Energy, heat, work. Conservation of energy, application to closed and open systems, the 2nd Law of Thermodynamics

MKM 2123 ELECTRONIC CIRCUITS (3 0 0 3)

Structure of semiconductors, diode characteristics, diode models, diode circuits, circuit models of bipolar junction and field-effect transistors, Nonlinear elements, Small signal analysis, Analysis and design of single-layer transistor amplifiers, Concepts of biasing and gain, Introduction to frequency and time domain representations, Concepts of lumped and distributed circuits, Frequency-dependent circuit characteristics, Introduction to feedback circuits and feedback amplifiers, Multistage amplifier circuits, Power amplifier circuits, Oscillators, Operational amplifiers.

MKM 2125 PROFESSIONAL ENGLISH AND PRESENTATION TECHNIQUES (2 0 0 2)

The Professional English course aims to develop students' skills in reading, understanding, analyzing, and interpreting technical texts relevant to their field of expertise. Within the scope of the course, emphasis is placed on introducing sectoral terminology, acquiring professional vocabulary, and the correct usage of these words. Within the scope of the course, elements important for delivering a successful presentation will be discussed. The preparation of the general presentation plan, audience analysis, the correct and effective use of voice in the presentation, the effective use of body language, and measures to overcome presentation fear will be examined. Presentation techniques using PowerPoint will be taught.

MKM 2131 ENGINEERING MATHEMATICS (3 0 0 3)

This course focuses on the solution techniques of basic differential equations to enable students to solve mathematical problems they will encounter in engineering applications. While separable and linear equations are examined within the scope of first-order differential equations, the focus is on the homogeneous structure and particular solutions (undetermined coefficients, variation of parameters method) of second-order differential equations. Additionally, the fundamental definitions and solution methods for Green's functions and simultaneous differential equations are conveyed. It is an important component of the Laplace transform course, and its definition, basic properties, inverse Laplace transform, and the solution of differential equations using the Laplace method are covered in detail. An introduction to numerical methods is provided, covering the definition, calculation methods, convergence criteria, and applications of Fourier series. This is reinforced with practical examples using tools like Matlab or Mathematica, demonstrating the finite difference method and other numerical solution techniques.

2nd Grade 2nd Semester

EGT 2710 DEVELOPMENT AND LEARNING (2 0 0 2)

This course examines cognitive, affective, and social development theories (Piaget, Vygotsky, Bandura, etc.) within the context of mechatronics engineering, and investigates their effects on human-machine interaction and team communication processes. It teaches the preparation of on-the-job training programs and e-learning materials using instructional design (ADDIE, principles of andragogy) and HMI-focused content development methods. Thus, students gain the ability to design practical training modules and assessment tools that they can use both in industrial applications and in lifelong learning plans.

IST 2134 STATISTICS AND PROBABILITY (3 0 0 3)

Basic statistical concepts, measures of central tendency and dispersion, skewness and kurtosis coefficients, regression and correlation analysis, discrete and continuous probability distributions, hypothesis testing, chi-square analysis

MKM 2104 ALGORITHM AND PROGRAMMING (2 0 2 3)

Overview of computers and programming, algorithm creation, flowcharts, C programming language, selection structures (if, else if, else), loop structures (while, for), modular programming and functions, arrays, strings, Files, Graphics in C, text mode screen commands. Matlab programming language, Variable definition, Displaying, Arrays, Trigonometric functions, Graph operations, File operations, Selection structures (if, else if, else), Loop structures (while, for), Modular programming and functions, Numerical solution of differential equations, Polynomials, Simulink.

MKM 2125 PROFESSIONAL ENGLISH AND PRESENTATION TECHNIQUES (2 0 0 2)

The Professional English course aims to develop students' skills in reading, understanding, analyzing, and interpreting technical texts relevant to their field of expertise. Within the scope of the course, emphasis is placed on introducing sectoral terminology, acquiring professional vocabulary, and the correct usage of these words. Within the scope of the course, elements important for delivering a successful presentation will be discussed. The preparation of the general presentation plan, audience analysis, the correct and effective use of voice in the presentation, the effective use of body language, and measures to overcome presentation fear will be examined. Presentation techniques using PowerPoint will be taught.

MKM 2131 ENGINEERING MATHEMATICS (3 0 0 3)

This course focuses on the solution techniques of basic differential equations to enable students to solve mathematical problems they will encounter in engineering applications. While separable and linear equations are examined within the scope of first-order differential equations, the focus is on the homogeneous structure and particular solutions (undetermined coefficients, variation of parameters method) of second-order differential equations. Additionally, the fundamental definitions and solution methods for Green's functions and simultaneous differential equations are conveyed. It is an important component of the Laplace transform course, and its definition, basic properties, inverse Laplace transform, and the solution of differential equations using the Laplace method are covered in detail. An introduction to numerical methods is provided, covering the definition, calculation methods, convergence criteria, and applications of Fourier series. This is reinforced with practical examples using tools like Matlab or Mathematica, demonstrating the finite difference method and other numerical solution techniques.

2nd Grade 2nd Semester

EGT 2710 DEVELOPMENT AND LEARNING (2 0 0 2)

This course examines cognitive, affective, and social development theories (Piaget, Vygotsky, Bandura, etc.) within the context of mechatronics engineering, and investigates their effects on human-machine interaction and team communication processes. It teaches the preparation of on-the-job training programs and e-learning materials using instructional design (ADDIE, principles of andragogy) and HMI-focused content development methods. Thus, students gain the ability to design practical training modules and assessment tools that they can use both in industrial applications and in lifelong learning plans.

IST 2134 STATISTICS AND PROBABILITY (3 0 0 3)

Basic statistical concepts, measures of central tendency and dispersion, skewness and kurtosis coefficients, regression and correlation analysis, discrete and continuous probability distributions, hypothesis testing, chi-square analysis

MKM 2104 ALGORITHM AND PROGRAMMING (2 0 2 3)

Overview of computers and programming, algorithm creation, flowcharts, C programming language, selection structures (if, else if, else), loop structures (while, for), modular programming and functions, arrays, strings, Files, Graphics in C, text mode screen commands. Matlab programming language, Variable definition, Displaying, Arrays, Trigonometric functions, Graph operations, File operations, Selection structures (if, else if, else), Loop structures (while, for), Modular programming and functions, Numerical solution of differential equations, Polynomials, Simulink.

MKM 2170 TOTAL QUALITY MANAGEMENT (2 0 0 2)

This course covers TQM principles and history, followed by topics such as ISO 9001 quality management systems, the PDCA cycle, and continuous improvement tools (Kaizen, 5S, Six Sigma); it presents practical case studies enriched with process management, quality cost analysis, and customer-focused leadership approaches.

SOS 2510 INDUSTRIAL SOCIOLOGY (2 0 0 2)

Some basic concepts related to industrial sociology, the effects of industry and/or industrialization on social life, theories related to work organization in industrial organizations, theories related to the labor movement and trade unions, industrial production systems, perspectives on contemporary industrial organizations, the social structure and functioning of contemporary industrial organizations, factory ownership, manager-expert, foreman (master craftsman), worker status and roles, the place and importance of informal groups in industrial organizations, the main outlines of industrialization in Turkey, the main outlines of the labor movement in Turkey, trade unions, employer unions, industrialization and social change.

SYE 2270 FIRST AID (2 0 0 2)

Definition, Importance, Principles of First Aid, Bleeding, Shock and Types, Injuries, CPR (Cardiopulmonary Resuscitation), Foreign Body Aspiration, Fractures, Dislocations and Sprains, Burns, Exposure to Heat and Cold, Poisoning, First Aid in Medical Conditions.

3rd Grade 1st Semester

MKM 3103 MACHINE THEORY (2 0 0 2)

Definition and classification of mechanisms, Kinematic pairs and degrees of freedom, Analysis of planar mechanisms, Velocity and acceleration analyzes, Force and moment analysis, Gear mechanisms and motion transmission, Cam mechanisms, Oscillation and balance analyzes, Basic principles of vibrations

MKM 3113 OCCUPATIONAL HEALTH AND SAFETY (1 0 0 1)

Definition and importance of the concept of occupational health and safety, historical development; legal regulations in Turkey and the world (especially Occupational Health and Safety Law No. 6331); causes, effects, and approaches to preventing occupational accidents and diseases; systematic risk assessment methods and applications; classification and effective use of personal protective equipment; emergency planning and crisis management; fire safety and fire fighting equipment; ergonomics principles and ergonomic approach in workplace design; chemical, physical, and biological risk factors; creating safe working environments and developing a sustainable occupational health and safety culture.

MKM 3115 CONTROL CIRCUITS (4 0 0 4)

General Information about Control Circuits, Buttons, Switches, Relays, Contactors, Motor Protection Relays and Fuses, Control Circuit Elements, Control Circuit Symbols and Identification Marks, Control Circuit Diagram Applications, Three-Phase Asynchronous Motor Control Applications, Overview of Programmable Logic Controller (PLC), General Features of PLCs, External Circuit Connections of PLC, Programming of PLC, Motor Control Applications in PLC.

MKM 3119 BIOMEDICAL MEASUREMENT (2 0 0 2)

Introduction to physiological systems and bioelectric signals. The general structure of biomedical measurement systems. Types of sensors and transducers. Amplifiers and filters used in medical signal processing. Measurement of basic parameters such as ECG, EEG, EMG, body temperature, blood pressure, and respiration. Data acquisition systems, analog/digital conversion, signal conditioning, and noise suppression. Points to consider in system design. Patient safety, isolation, and grounding. Calibration, maintenance, and standards.

MKM 3121 STRENGTH OF MATERIALS (3 0 0 3)

Sectional effects, Normal force, Normal stress, Stress-strain relationship, Safety stress, Torsion, Shear stress, Simple bending and simple shear, Shear bending condition, Area moments and moments of inertia, Critical buckling calculations, Principal stresses and Mohr's circle.

MKM 3129 DIGITAL ELECTRONICS (1 0 1 1)

Analog-Digital Concept, Number Systems, Digital and Alphanumeric Encodings, Logic Mathematics, Combinational Circuits and Design Steps, Methods for Reducing Function Equations, Electronic Structures of Combinational Circuit Elements. Integrated Circuits and Combinational Circuit Design Experiments, Digital Circuit Design with Proteus and EWB Software Packages, and Digital Circuit Design with VHDL, Integrated Logic Circuits, MSI Circuits, Sequential Logic Circuits, Flip-Flops, Synchronous and Asynchronous Circuits, Digital Memories and Their Properties.

MKM 3131 PROFESSIONAL PRACTICE - 1 (0 2 0 1)

The aim of the third-year summer internship for Mechatronics Engineering Department students is to reinforce and develop the theoretical and practical knowledge they gained in their first and second-year courses. In this direction, the topics that students will work on at the organization where they will do their summer internships and that they will include in their reports are listed as follows: Information about the organization; the organization's history, organizational chart, areas of work, the qualifications and number of employees, examples of past studies related to mechatronics engineering, and future plans, the definition, observation, and documentation of mechatronics engineering-related work topics within the organization; the examination and observation of at least five studies completed and ongoing within the organization, to be documented in writing and photographs within the scope of the report, the observation and examination of production technologies related to mechatronics engineering within the organization; the observation and examination of production technologies related to mechatronics engineering within the organization. For this purpose, the characteristics of production processes, machines, and tools for each production technology, their areas of use within the organization, and the documentation of the characteristics of various mechatronics-related sample products, with at least 5 samples taken from production processes, machines, and tools, are included in the report, preferably with technical drawings and photographs made by the students. Cost calculations for at least two of the sampled works and products.

MKM 3133 AIR CONDITIONING SYSTEMS (2 0 0 2)

Heat transfer and thermodynamic principles; psychrometry; indoor air conditions and comfort criteria; HVAC system components: heaters, coolers, fans, filters, humidifiers; air duct and pipe systems; heating-cooling load calculations; air conditioning system types (split, VRF, central systems); ventilation systems; building energy management; automatic control systems; design, selection, and energy efficiency analysis of HVAC systems

MKM 3135 OPTIMIZATION TECHNIQUE (4 0 0 4)

Introduction to optimization, Basic definitions and concepts of optimization, Classification of optimization problems, Classification of optimization methods, Design space, constraint surfaces, objective function, Expression of the optimization problem, Overview of Mathematical Programming techniques, Classical optimization techniques, Introduction to Artificial Intelligence, Genetic algorithm, Differential evolution algorithm, Particle swarm optimization, Artificial bee colony, Different applications of artificial intelligence optimization algorithms.

MKM 3141 ELECTRONIC COMMUNICATION (2 0 0 2)

Introduction to communication systems, signal and system definitions, modulation and demodulation techniques (AM, FM, PM), digital communication concepts (PCM, ASK, FSK, PSK), noise, spectrum, bandwidth, channel capacity, information theory fundamentals, communication circuits and elements, analog and digital transmission systems, carriers, modulators, filters, and receiver systems. Introduction to Modern Communication Technologies: Wireless Communication, Satellite Communication, Communication Infrastructure in IoT Applications.

MKM 3143 SYSTEM DYNAMICS AND MODELING (2 0 0 2)

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 High-Order Systems, Frequency Domain Analysis

MKM 3145 ELECTROMECHANICAL SYSTEMS (4 0 0 4)

Development and Industrial Significance of Electrical Drive Systems, External Characteristics of Electric Motors, Examination of Electrical Drive Systems, Load Characteristics of Construction Machinery, Fundamentals of

Electromechanical Energy Conversion, Structure and Operation of Direct Current Motors, Starting and Speed Control of Direct Current Motors, Braking of Direct Current Motors, Structure and Operation of Asynchronous Motors, Single-Phase Asynchronous Motors, Starting and Speed Adjustment of Three-Phase Asynchronous Motors, Braking of Three-Phase Asynchronous Motors, Stepper Motors, Brushless Direct Current Motors.

RTV 2030 POLITICAL SCIENCE (2 0 0 2)

This course covers the definition and scope of political science and research methods used in political analysis through theoretical explanations and interactive activities; concepts of state, sovereignty, and authority; major political ideologies such as liberalism, conservatism, socialism, and nationalism; forms of government such as democracy, authoritarianism, and hybrid regimes; political parties, interest groups, and voting behavior; electoral systems and election management; public policy-making and management processes; political culture, participation, and citizenship; media, communication, and political discourse; basic concepts of international relations and major actors and institutions; and finally, the phenomena of globalization, governance, and regional integration.

RTV 2230 ORAL COMMUNICATION (2 0 0 2)

In this course, students will engage in theoretical and practical studies on the basic concepts of oral communication, effective listening, voice and emphasis techniques, body language, presentation structure and the use of visual aids, academic presentations, poster presentations, and discussion and debate methods.

SOS 2490 MORAL PHILOSOPHY AND ETHICS (2 0 0 2)

Introduction to the Concepts of Morality, Ethics, and Values, What is Philosophical Ethics? Overview of Ethical Theories, Ethics in Antiquity, Moral Thought in the Middle Ages, New Age and Modern Ethics, Deontology, Utilitarianism and Virtue Ethics Theories, Ethics Today, Moral Decision-Making Processes, Ethics in Engineering, Business Ethics and Professional Ethics, Technology, Artificial Intelligence and Ethical Boundaries, Environmental Ethics and Future Generations, Current Ethical Issues
SOS 2550 SOCIOLOGY OF MANAGEMENT (2 0 0 2)
Introduction to the Sociology of Management: Basic Concepts, Society, Culture and Organization Relationship, Weber and Bureaucracy Theory, Concepts of Authority and Legitimacy, Fordism, Post-Fordism and Flexible Production, Leadership and Power, Division of Labor, Class and Hierarchy, Work Culture and Corporate Identity, Gender, Labor and Management, New Social Movements and Forms of Organization, Globalization and Management Practices, Digitalization, Network Societies and New Organizational Models, Management Culture, Sociological Approaches

3rd Grade 2nd Semester

MKM 3110 MECHANICAL VIBRATIONS (2 0 0 2)

Basic Concepts of Vibration, Basic Elements of a Vibration System, Classification of Vibrations, Vibration Analysis Procedure, Single Degree of Freedom Vibration Systems, Damped Free Vibration, Forced Vibrations, Vibration of Two Degree of Freedom Systems, Vibration of Multi Degree of Freedom Systems, Vibration Isolation, Natural Frequencies and Mode Shapes, Dynamic Vibration Dampers, Industrial Application Examples.

MKM 3112 FACTORY ORGANIZATION (2 0 0 2)

Factory Organization: Relevant Definitions and General Concepts, Production and Production Systems, Factory Activities, Problems Related to Factory Layout and Organization, Site Selection, Placement Methods, Product and Process Methods, Machine and Technology Selection, Work Study, Feasibility Study and Quality Control, Material Handling Systems, Occupational Safety, Quality Management, Models and Tools for Factory Organization, Factory Services and Systems.

MKM 3116 INDUSTRIAL DESIGN (2 1 0 2)

Definition of design, function, structure, economy, esthetics, and management concepts. Sources of design: Nature, local design and crafts, technology. Design objectives: use, production, sales, infrastructure, recycling. Design communication and design language. Meaning in design. New goals in design theories. Design methods, design systems, design planning, corporate identity. Design psychology. Semiotics. Future-oriented topics in design. The role of information technology. Applications on function, local design, design objectives, design language, etc.

MKM 3118 MACHINE ELEMENTS (2 0 0 2)

The Meaning of Machines and Machine Elements, Design in Mechanical Engineering, Stages and Relationships of the Design Process, Analysis of Stresses and Strains, Factors Affecting Material and Selection, Fasteners, Shafts and Axles, Pin and Bolt Connections, Shaft-Hub Connections, Springs.

Machine Elements and Engineering Design, Concepts, Tribology, Bearings, Gears; Power and Motion Transmission

MKM 3120 SENSORS AND MEASUREMENT METHODS (1 1 0 1)

Classification and basic principles of sensors, Electrical, magnetic, optical, and mechanical sensors, Temperature, pressure, speed, acceleration, and position sensors, Analog and digital sensors, Signal conditioning and processing, Data acquisition systems, Calibration techniques and error analysis, Measurement methods used in industry

MKM 3122 MICROPROCESSORS (2 0 1 2)

Introduction and number systems, Overview of PIC, Assembly programming language, Bit testing for decision-making, Loop structures, Subroutines, Arithmetic operations, Sample applications in the Proteus environment.

MKM 3124 DIGITAL SIGNAL PROCESSING (2 0 0 2)

Signals, Systems, and Signal Processing, Classification of Signals, Analog-to-Digital and Digital-to-Analog Conversion, Discrete-Time Signals, Analysis of Discrete-Time Linear Time-Invariant Systems, Discrete-Time Systems Defined by Difference Equations, Frequency Analysis of Discrete-Time Signals, Frequency Domain Analysis of LTI Systems, Sampling and Reconstruction of Signals, Discrete Fourier Transform, Digital Filters, Digital Filter Design, Digital Signal Processing Applications in Matlab.

MKM 3126 INDUSTRIAL PROGRAMMING (2 1 0 2)

Introduction to PLC and Basic Logic Commands, Timers in PLC, Counters in PLC, Comparison Commands, Copy Commands, Digital (Logic) Operations, Mathematical Commands, Conversion of Data Types, Shift and Rotate Commands, ADC Operations in PLC, PWM Function, Subprogram, Using Data Blocks, Real-Time Clock (RTC) Applications.

MKM 3132 FINITE ELEMENT ANALYSIS (2 0 0 2)

Finite element types, Definition of stiffness and one-dimensional elements, Element matrices and complete stiffness matrix, Evaluation of boundary conditions, Spring element, Bar element, Analysis of two-dimensional problems, Direct formulation method.

MKM 3136 COMPUTER-AIDED DESIGN AND MANUFACTURING (2 0 0 2)

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

MKM 3138 AUTOMATIC CONTROL (3 0 0 3)

The control course aims for students to learn the basic concepts related to automatic control systems and to be able to analyze and design these systems. The resources used in the course are supported by the textbook, online content, and MATLAB software. Basic topics such as Laplace transforms, standard input functions, time constants, and dynamic behavior analyzes are covered within the scope of the course. The transient and steady-state behavior of control systems, stability in linear feedback systems, the Routh-Hurwitz criterion, root locus plots, and frequency response methods are explained with examples. Additionally, frequency domain analyzes such as Bode plots, phase margin, and gain crossover frequency are performed. PID controller design, industrial control elements, controllability and observability issues are reinforced with MATLAB applications. The course concludes with a general review of LQR controllers and other design methods, along with example applications. Students are evaluated thru midterm and final exams to put their theoretical knowledge into practice.

MKM 3140 ELECTRICAL MACHINES LABORATORY (0 0 2 1)

Introduction to the Materials and Experiment Sets Used in the Laboratory, Experiment 1-Starting and Speed Control of a DC Shunt Motor, Experiment 2-Starting and Speed Control of a Three-Phase Induction Motor, Experiment 3-Stepper Motor Control, Experiment 4-DC Motor Control with a DC Chopper Circuit, Experiment 5-Three-Phase Induction Motor Control with PLC, Experiment 6-Starting and Speed Control of a Single-Phase Induction Motor.

MKM 3142 SMART MATERIALS (2 0 0 2)

Information on the History of Smart Materials, Introduction to Smart Materials, Comparison of Classical and Smart Materials and Smart Material Types, Piezoelectric Materials and Applications, Polymeric Gels, pH-Sensitive Materials, Heat-Sensitive Materials, Shape Memory Alloys and Polymers, Optical Fibers, Light-Emitting Materials,

Color-Changing Materials, Self-Healing Polymers and Comparison with Biological Systems, Use of Smart Materials in Engineering.

4th Grade 1st Semester

MKM 4103 COMPUTER CONTROL WITH MATLAB (2 0 0 2)

Introduction to MATLAB, general usage, programming. Function creation, differential equations, and their solutions.

Introduction to Simulink, model creation, and solving. Symbolic variables and operations, symbolic equations and solutions. Signal processing approaches, Fourier transform, filters. Modeling, transfer function, state-space representation, system's time and frequency domain responses, root locus. Controller design approaches, derivative, proportional, integral (PID) controllers, analysis of closed-loop systems, implementation of the controlled system in Simulink. Kalman filter applications. State feedback, pole placement, linear quadratic regulators, observer design, interconnection of different systems. Discrete-time (digital) systems, discrete-time control design, various discretization methods and their comparison. Arranging the codes for publication (publish feature). Various examples and applications.

MKM 4105 AUTONOMOUS SYSTEMS (2 0 0 2)

Definition and Analysis of Autonomous Systems, Autonomic Nervous System and Hypothalamus, Intelligent and Autonomous Systems, Energy Harvesting for Autonomous Systems, Autonomous (Driverless) Vehicles and Subsystems that Make Up an Autonomous Vehicle, Precise Positioning System and Global Trajectory Planning System, Environmental Perception and Understanding System. Decision Support System. Local Orbit Planning System, Decision Implementation and Support System. A Simple Application Example, Fundamentals of the BGP (Border Gateway Protocol) Protocol, Introduction to Autonomous Robots, Industry 4.0 and Autonomous Robots, Autonomous Unmanned Aerial Vehicles, Autonomous security drones, Autonomous Flight System, unmanned systems, aviation, cockpit systems, systems engineering, software engineering and management, Embedded System Solutions for Autonomous Systems, Embedded System Solutions for Drones

MKM 4107 PROCESS CONTROL (2 0 0 2)

In this course, in addition to the theoretical knowledge that forms the basis of process control, the concept of modeling and the importance and use of model equations in process control applications are covered.

MKM 4127 ELECTIVE GRADUATION DESIGN PROJECT (0 2 0 1)

Learning to conduct literature studies, Conducting literature studies, Designing the project, Basic principles and components of mechatronic systems, Sensors and actuators, Microcontrollers and programming, Mechanical and electronic integration, System modeling and simulation, Feedback control systems, Industrial mechatronic systems and applications

MKM4129 ROBOT VISION (2 0 0 2)

This course is an introduction to robot vision, covering visual perception and interpretation processes in robotic systems. At the beginning of the lesson, the relationship between robot vision and other scientific and engineering fields is explained. Along with fundamental concepts such as image formation, reflections, brightness, the effect of lenses, and image perception, binary images and their geometric and topological properties are discussed. Histogram-based binary algorithms are detailed as region recognition and segmentation methods, while differential operations for edge detection, Laplacian, Gaussian, and Canny edge detection techniques are taught. The image formation process is examined from photometric stereo, radiometry, and reflectance perspectives. Depth perception and calibration processes are introduced, covering topics such as stereo imaging, matching, and 3D modeling. Advanced topics such as motion perception, optical flow, and structure from motion are covered within the framework of dynamic vision, with examples illustrating how robots perceive and interpret their surroundings.

MKM 4133 PROFESSIONAL PRACTICE – 2 (0 2 0 1)

This course aims to reinforce and develop the theoretical and practical knowledge gained by Mechatronics Engineering Department students during their third-year summer internship, which they acquired in their previous first and second-year courses. In this direction, the topics that students will work on at the organization where they will do their summer internships and that they will include in their reports are listed as follows: Information about the organization; History of the organization, organizational chart, areas of work, qualifications and number of employees, examples of past studies related to mechatronics engineering and future plans, Definition, observation and documentation of mechatronics engineering-related work topics in the organization; Examination and observation of at least five completed and ongoing studies within the organization, documented in writing and photographs within the scope of the report, Mechatronics in the organization

Observation and examination of production technologies related to engineering; observation and examination of production technologies related to mechatronics engineering within the organization; for this purpose, documentation of the characteristics of various mechatronic products, including at least 5 samples from each production process, machine, and tool, for this purpose, preferably including technical drawings and photographs of the products made by students in the report; and cost calculations for at least two of the sampled jobs and products.

MKM4135 MECHATRONICS IN AUTOMOTIVE ENGINEERING (2 0 0 2)

Vehicle structure, Vehicle components, Technological innovations, Vehicle mechatronic systems

MKM 4137 NUMERICAL CONTROL (2 0 0 2)

This course introduces numerical control systems and presents the basic concepts of discrete-time systems. The hardware infrastructure of digital systems is explained, covering topics such as AD/DA converters and signal reconstruction, as well as sampling and holding circuits. The definition of the Z-transform and the process of transitioning from continuous-time systems to discrete-time systems are discussed, along with block diagrams and pulse transfer functions. The stability, time response, root locus curves, and frequency response analyzes of discrete-time systems are detailed. While focusing on state space analysis and ensuring stability in this area, the design of numerical controllers and the structure of numerical PID controllers are examined. The canonical realizations and real-time applications of controllers are supported by computer-aided examples.

MKM 4139 POWER ELECTRONICS AND DRIVES (3 2 0 4)

Semiconductor switches, Snubber circuit design, AC-AC chopper circuits, Uncontrolled and controlled single and three-phase rectifiers, inductive and capacitive smoothing circuits, Flyback, Forward, and Boost type Converter circuits and Analysis, Examination of PWM techniques, Examination of Inverter circuits, Switch Mode Power Supplies (SMPS) and Four-Quadrant Operation. Performing experiments on single-phase and three-phase controlled and uncontrolled rectifiers, DC-DC choppers, AC-AC choppers, and inverter circuits in class.

MKM 4310 LABOR LAW (2002) Basic concepts, employment contract, formation, obligations of the parties, termination, and regulation of work

4th Grade 2nd Semester

MKM 4100 AVIONICS SYSTEMS (2 0 0 2)

Introduction and history of avionics systems Aircraft systems architecture Communication systems (VHF/UHF, ACARS, SATCOM) Navigation systems (GPS, INS, VOR, ILS) Autopilot systems and flight control systems Aircraft electrical power systems (AC/DC) Avionics interfaces, data busses (ARINC 429, MIL-STD-1553) Cockpit design, display systems (EFIS, MFD) System integration and fault detection Aviation standards (DO-178, DO-254) and cybersecurity

MKM 4102 GRADUATION PROJECT (0 2 0 1)

To be carried out in consultation with the Project Manager, with the project work examined and developed under the supervision of the manager, the project work to be written in a thesis format in accordance with the writing rules, and the graduation project to be submitted.

MKM 4110 MOBILE ROBOT DESIGN (2 0 0 2)

Introduction to mobile robots, robot kinematics and dynamics, motion mechanisms, sensors and perception systems, robot control, navigation and path planning techniques, robot design criteria.

MKM 4118 VEHICLE DYNAMICS (2 0 0 2)

Forces acting on the vehicle, principles of vehicle motion, motion resistances, road holding, skidding, axle and suspension geometry. MKM 4126 ROBOTIC SYSTEMS (3 0 0 3) In this course, the theoretical foundations of Robotic Systems, including kinematics and dynamics, will be covered. Mechanical designs will be created in a computer environment. For this, the SolidWorks software package will be utilized. Algorithms will be developed using the MATLAB package program for analysis and control applications. The results obtained will be interpreted, discussed, and open to suggestions.

MKM 4128 OPTICAL SYSTEMS (2 0 0 2)

The nature of light and basic optical concepts Geometric and wave optics Lenses, mirrors, optical setups Optical filters, polarizers, spectrometers Laser principles and types Structure and applications of fiber optic systems Imaging

systems and camera technologies Optical sensors and application areas Lidar systems and distance measurement
Industrial and biomedical optical applications Optical system design and integration

MKM 4130 Data Mining with Python and Applications in Mechatronic Systems (2 0 0 2)

Introduction to Python programming; fundamental concepts of data mining; data processing methods; machine learning algorithms; classification and regression analyses; clustering methods; big data analytics; application examples in mechatronic systems.

MKM 4132 Flexible Manufacturing Systems (2 0 0 2)

Introduction to Flexible Manufacturing Systems (FMS); classification of production systems; computer-aided manufacturing (CAM), CNC and DNC systems; integration of industrial robots into production systems; flexible cells and cell control systems; automated material handling, storage, and loading systems; production planning and scheduling; simulation and digital twin applications; advantages, limitations, and industrial applications of flexible systems; relationship to Industry 4.0.

MKM 4136 Renewable Energy Systems (2 0 0 2)

The concept of energy and the global energy outlook; comparison of fossil and renewable energy; solar energy systems (PV, thermal); wind energy and turbine technologies; biomass and biogas systems; geothermal and hydroelectric energy systems; energy storage technologies; smart grids and microgrid systems; integration with mechatronic control systems; carbon footprint, energy efficiency, and sustainability.

MKM 4138 Hydraulic and Pneumatic Systems (2 0 0 2)

Basic physical properties of fluids; hydraulic fluids, pump types, and hydraulic system components; pneumatic system components and air preparation systems; directional, pressure, and flow control valves; hydraulic and pneumatic circuit drawing and analysis methods; ISO symbols and circuit diagrams; electro-pneumatic systems; industrial application examples; laboratory applications and simulation studies.

MKM 4140 Industrial Measurement Systems (2 0 0 2)

Introduction to measurement and control systems; sensor and transducer principles; dimensional and geometric measurements; temperature, pressure, and flow measurements; optical and electronic measurement systems; measurement uncertainty and calibration methods.

MKM 4141 Biomechatronic Systems (2 0 0 2)

Definition and scope of biomechatronics; biomechanical systems and basic information on human anatomy; prosthetic limbs and exoskeleton systems; biosensors and bio-signal processing; motor control systems, EMG/EEG signals; rehabilitation robots and prosthesis control systems; neuro-mechanical interfaces; human-machine interaction and safety; ethics and engineering responsibility; applied project and case analysis.

MKM 4146 Applied Engineering (5 14 0 12)

Principles of applied engineering; project management and design; analysis and solution of engineering problems; engineering ethics; teamwork and communication skills.

MKM 4180 Electric Vehicles (2 0 0 2)

Introduction to electric vehicles, history and development; EV architecture and core components; electric motors (DC, AC, BLDC, PMSM); battery technologies (Li-ion, LFP, NMC, etc.); battery management systems (BMS); drive systems and inverter structure; regenerative braking and energy recovery; charging systems: AC/DC and fast-charging infrastructure; hybrid and plug-in hybrid systems; control systems and communication protocols (CAN) in electric vehicles; performance analysis and simulation; future technologies and sustainable transportation.

MKM 4190 Medical Mechatronics (2 0 0 2)

Introduction to medical engineering; classification of healthcare technologies; biomedical signals and sensors; diagnostic systems and biomedical imaging techniques; therapy systems; hospital automation systems; medical robots and human-machine interaction; software-hardware integration in medical devices; ethics and legal regulations; case analyses for clinical applications.

MKM 4410 Engineering Economics (2 0 0 2)

Basic economic concepts; engineering-economy decision making; time value of money and various interest calculations; cash flows; cost–volume–profit relationships and break-even analyses; project evaluation methods: payback period, present value, future value, net present value, net future value, internal rate of return (IRR), benefit/cost ratio, net benefit/cost ratio, annual equivalent value, annual equivalent cost methods; uncertainty analysis and sensitivity analysis; comparison of alternatives and investment decision making; legal implications of engineering solutions.