|  |
| --- |
| **DEPARTMENT OF MECHANICAL ENGINEERING****Content of Master's Degree in Mechanical Engineering with Thesis** |
| **COURSE CODE** | **COURSE NAME AND CONTENTS** | **T** | **A** | **C** | **ECTS** |
|  |
| **LUEE701** | **Scientific Research Techniques and Scientific Ethics** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To be able to know how a process in a scientific research proceeds and how a scientific report must be prepared. Fundamental concepts and information about the science, the structure of scientific research, scientific methods and different ideas on these methods, data acquisition methods (quantitative and qualitative), registration, analysis, interpretation and reporting of datas. |
|  |
| **MKM7002** | **Biomimetics in Engineering and Design** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To inform students about the activities of living and non-living creatures on earth to continue their lives, to comprehend their biological and physiological characteristics and to produce solutions to some problems with an engineering approach, to encourage them to acquire the necessary knowledge and experience to establish a bridge between different disciplines and engineering. and to help them use this knowledge and skills to find solutions to the problems they face when they start their business life. Introduction, basic definitions, historical development of biomimicry, Natural mechanisms and applications of biomimetics in aerodynamics, fin design, Bio-inspired design examples, biologically inspired mechanisms and machines, Bioinspired vehicle design, Biomimetic applications in materials, composites, Electronics, applications in optics, Biomimetic applications in energy biomimetic applications, Bio-inspired photonic materials, Biologically inspired smart materials, sensors, robots, Biomimetic applications in structures, Biomimetic applications in manufacturing, Biomimetic surfaces, Smart materials, biomaterials, biocompatible materials, Artificial organs, Giving students support by giving homework. |
|  |
| **MKM7004** | **Addivite Manufacturing and Applications** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | It is aimed to give information about additive manufacturing methods, usage areas, advantages and disadvantages, software and equipment, engineering materials used in these technologies, part design criteria, principles of material and method selection. Additive manufacturing (AM) methods; Design/production process in additive manufacturing, Orientation, Slicing strategies, Tool path creation; Method and material selection; Photopolymerization (FP) technique, design criteria and finishing processes in AM based on FP technique; Stereolithography; Extrusion-based additive manufacturing, Parameters, Materials, FDM and 3D printers; Powder bed laser melting systems, Materials and powder bed melting mechanisms, Sintering, SLS, SLM, DMSL and EBM methods; Wire arc additive manufacturing; Powder fed laser melting systems, Laser coating, Directed energy deposition, Laser metal deposition; Material jetting, Polyjet, Inkjet, Parameters; Binder jetting; Hybrid additive manufacturing methods, Additive manufacturing applications |
|  |
| **MKM7006** | **Optimization and Prediction Techniques** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To teach the principles of design of experiment and optimization processes for multi-factor problems encountered in mechanical engineering. To teach the use of methods used to predict the output of problems. Experimental Design in Mechanical Engineering, Taguchi Method, Orthogonal Array Selection, Signal/Noise Ratio, Effective Parameter Determination, Determination of Optimum Process Conditions. Analysis of Variance Method, F-Test. Prediction Methods in Experimental Design, Multiple Regression Method, Optimization in Mechanical Engineering Problems, Response Surface Methodology (RSM), Response Surface Design (Composite, Box-Behnken etc.) and Process Optimization with RSM, Artificial Neural Network (ANN) Method, Network Types, Backpropagation Learning and Prediction. |
|  |
| **MKM7008** | **Advanced Failure Analysis II** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Defects (cracks) containing structures Investigation of fracture behavior, fracture mechanics design criteria will be made on how to teach. Griffith crack theory, stress analysis of cracks, design philosophy, energy and stress the relationship between methods of approach. Cracks found at the end of the plastic zone size. Gerinimine plane plane without stretching transition. Plane-strain fracture toughness tests, fracture toughness of engineering materials, the crack tip toughness of the determination with the method of raster. J-integral method and elastic-plastic behavior and fracture toughness of the disclosure of the determination. Other refractive methods. Impact fracture toughness of power-relations. Fracture toughness of the micro-structure relationships. Of environmental conditions to break the effect. Fracture mechanics test methods applied. Material life and the crack length calculation methods. Stress-controlled fatigue, strain controlled fatigue, fatigue life of notched elements of the calculation, corrosion fatigue, stress corrosion. |
|  |
| **MKM701** | **Engineering Mathematics** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To have knowledge about the importance of mathematics in engineering, mathematical modeling of engineering problems and analytical and numerical solutions of mathematical problems. Mathematical relationship with physical laws, functions, graphs, derivatives, integrals, linear algebra, applications of ordinary and partial differential equations in engineering problems, comparison of analytical and numerical solutions, use of excel and matlab programs in solving mathematical problems, statistics, curve fitting to data, optimization, eigenvalue and eigenvector, laplace and Engineering applications of Fourier topics |
|  |
| **MKM703** | **Design and Manufacturing Systems** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Teach the stages of systematic design. Teach manufacturing systems. Teaching design reporting. Concept of design, Systematic design steps, Manufacturing systems, Scheduling in manufacturing |
|  |
| **MKM705** | **Computer-Aided Manufacturing Applications** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The aim of this course is to provide advanced knowledge to students on modeling complex systems and conducting engineering analyses of systems using computer-aided design software. The course covers concepts such as industrial design, computer-aided design, computer-aided technical drawing, 2D/3D part modeling, systematic design of complex systems, fundamentals and logic of geometric modeling, CAD/CAM/CAE systems, the importance of parametric design, drawing 2D part fabrication drawings from 3D solid models, 3D assembly-disassembly modeling, simulation of complex systems, mesh model of systems, design optimization, and engineering analyses of systems (static, tolerance, etc.). |
|  |
| **MKM709** | **Study of Vibrations with Analytical Methods** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To teach students concepts and theorems related to vibrations. Definitions and Concepts Regarding Vibrations. Virtual Work Principle. Hamiltonian Method. Lagrangian Method. Longitudinal Vibrations. String Vibrations. Transverse Vibrations. Nonlinear Vibrations. Dimensionalization. Rayleigh Method. Rayleigh-Ritz Method. |
|  |
| **MKM711** | **Energy Methods in Industry** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To provide students with information on the management of energy produced and consumed in the industry. Introduction, General Energy Outlook of the World and Turkey, Alternative Energy Sources, Principles of Energy Management Programs, Initiating an Energy Management Program in the Industry, Energy Saving Study Methods for Industrial Facilities, Monitoring Industrial Facilities for Energy Management, Stages of Setting Targets for Possible Energy Saving Potentials, Determination of Energy Consumption Standards in Industrial Facilities, Energy Production, Transportation, and Efficiency Improvement Methods in Industrial Processes, Cogeneration Applications in Industrial Facilities, Evaluation of Waste Energies in Industrial Facilities, Criteria for Evaluating Investments in Energy-Saving Projects, Determining the Environmental Impacts of Energies Used in Industrial Facilities. |
|  |
| **MKM712** | **Computer-Aided Manufacturing Applications** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The course within the scope of manufacturing engineering teaches the latest developments in computer-aided manufacturing and applications, focusing on understanding the design of a product for the manufacturing of a machine tool with automation. Participants gain knowledge on machine tools, cutting tools, generating machine code for computer-aided manufacturing, and workpiece clamping. It instructs on Computer-Aided Process Planning and its components. Participants also learn about the latest industrial developments in reverse engineering, rapid prototyping techniques, components, applications, and industrial robotics.The topics covered include Numerical Control (NC), NC Machines, Machine Axes. Computer-Aided Design (CAD) in Design and Manufacturing Elements, Element Recognition, Computer Numerical Control (CNC) Programming, Manufacturing Process Sequences for CNC (milling, drilling, tapping, turning, etc.). Workpiece clamping methods, material selection, and tool selection in manufacturing. Toolpath generation. Latest processors. Computer-Aided Process Planning (CAPP) and its components. Reverse Engineering. Scanners, Point Cloud Generation. Rapid Prototyping (RP) techniques, RP processes, and materials. Part positioning for RP. Industrial robotics. Industrial Computer-Aided Manufacturing (ICAM) applications. |
|  |
| **MKM713** | **Advanced Thermodynamics** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Strengthen the concepts of classical thermodynamics (first law, second law, availability analysis). 2- Provide advanced thermodynamic knowledge and a scientific approach. 3- Facilitate the application of thermodynamic information to advanced energy systems. Fundamental laws of thermodynamics. Equations of state. Property relations. Generation of tables. Availability analysis. Second law efficiency. Mixtures. Chemical thermodynamics. |
|  |
| **MKM716** | **Advanced Fluid Dynamics** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To impart theoretical knowledge and practical application skills for solving various heat transfer and fluid flow problems encountered in engineering using a computational fluid dynamics package. General conservation equations and boundary conditions. Application of the finite volume method to fluid mechanics and heat transfer equations. Diffusion, convection, time-dependent, and source terms of equations. Numerical approaches, algebraic equations, numerical cell structure. Implementation of boundary conditions. Introduction to turbulent flow, transition from laminar to turbulent flow, turbulent Navier-Stokes equations, characteristics of turbulent flow, turbulence models, and associated equations, k-ε turbulence model, boundary conditions. Principles of Computational Fluid Dynamics (CFD), PHOENICS CFD code, how PHOENICS works, programs constituting PHOENICS, boundary conditions, source terms. Solution of various engineering problems using PHOENICS: two and three-dimensional heat conduction, forced heat transfer in channels, flows in variable cross-section and obstructed channels, natural and mixed convection problems, time-dependent flow and heat transfer, impinging fluid jets, cooling of electronic components, etc. Two/three-dimensional, laminar/turbulent, time-dependent/time-independent, Cartesian/cylindrical coordinate flow and heat transfer problems. |
|  |
| **MKM724** | **Experimental Methods for Engineers** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The aim of this course is to equip students with the skill to perform engineering measurements with minimal error. Introduction to industrial measurement and calibration. Equipment used in industrial measurement. Fundamentals of electrical measurement, displacement and area measurements, methods of pressure, flow, and temperature measurement. Measurements of force, torque, and vibration. Measurement of air pollution. Analysis of experimental data. Principles of collecting and reporting experimental data. |
|  |
| **MKM736** | **Hydraulic and Pneumatic System Design** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To teach students the design, control, and synthesis of hydraulic and pneumatic circuits. Hydraulic and pneumatic control systems and components. Position and pressure sensing. Circuit layout planning, representation, and presentation. Problem-solving in control. Conceptual design methods for sequential circuits. Sequential logic circuit design. Combinational circuit design. Mixed control circuit design. Pneumatic control for hydraulic sequential power systems. Control and synthesis of hydraulic systems. PLC applications. |
|  |
| **MKM741** | **Material Selection in Machine Design** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The aim of this course is to provide information about material selection in machine design. Fundamentals of material selection, Material selection from a mechanical properties perspective, Material selection from a physical properties perspective, Material selection and design, Materials used in machine design and their characteristics. |
|  |
| **MKM742** | **CNC Control Systems and Industrial Applications** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To manually prepare part programs for CNC control systems commonly used in the industry, such as [Fanuc, Siemens (SiNumeric), Mazak (Mazatrol), Heidenhain], on lathe and milling machines. Commonly used CNC control systems in the industry. Differences between control systems. Programming techniques on the machine control panel. Control systems programmable with ISO standard codes. Control systems programmed through dialogue and other methods. Manual programming for CNC lathes and milling machines using systems that use the ISO coding system. Programming techniques in the dialogue system. Techniques and applications for writing CNC programs for Fanuc, Mitsubishi, Siemens (SiNumeric), Mazak (Mazatrol), and Heidenhain control systems. |
|  |
| **MKM744** | **Air Pollution and Control Technology** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Formation of air pollution and related definitions. Fuels, combustion, emissions, and the mechanism of emission formation. Environmental impact of air pollution. The technical aspect of air pollution control. Air pollution control technologies and applications. Methods for internal and external emission reduction. Emission calculations and pollution measurements. Introducing students to air pollution control applications and systems. Transferring engineering approaches and practices in the design and operation of relevant systems. |
|  |
| **MKM745** | **Energy Management I** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The importance of energy management and the role of energy-efficient systems. The significance of energy management and the role of energy-efficient systems; Control of energy, Energy analysis techniques (life-cycle cost analyses); Efficient lighting systems; Power quality, demand management, and harmonics; Optimization of heating, cooling, and ventilation systems; Utilization of combustion and industrial waste; Control systems; The importance of maintenance operations. |
|  |
| **MKM747** | **Operations Research in Energy Systems** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The application of mathematical programming methods to energy systems, Introduction to Operations Research. Mathematical programming and modeling. Linear programming. Solution techniques for linear programming: Simplex, Dual Simplex, Graphical Method. Sensitivity analysis and duality. Integer programming. Solution techniques for integer programming: Branch and Bound method, cutting-plane and transportation algorithms. Nonlinear programming problems. Kuhn-Tucker conditions in constrained optimization problems. Dynamic programming and solution techniques. Application of mathematical programming methods to energy systems. |
|  |
| **MKM748** | **Engineering Applications in Matlab** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Using the Matlab program to perform mathematical operations, obtaining numerical and symbolic results, and creating intermediate programs that obtain these results graphically. Learning basic Matlab commands. Matrix operations in Matlab, trigonometric, exponential, and logarithmic functions. Creating and running programs in Matlab. Plotting graphs. Interpolation, regression, and intermediate value calculations. Systems of equations, numerical and symbolic solutions. Numerical derivatives and integrals. |
|  |
| **MKM749** | **Mathematical Operations in Matlab** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Using the Matlab program to perform mathematical operations, obtaining numerical and symbolic results, and creating intermediate programs that obtain these results graphically. Learning basic Matlab commands. Matrix operations in Matlab, trigonometric, exponential, and logarithmic functions. Creating and running programs in Matlab. Plotting graphs. Interpolation, regression, and intermediate value calculations. Systems of equations, numerical and symbolic solutions. Numerical derivatives and integrals. |
|  |
| **MKM754** | **Advanced HVAC Systems** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Learning about air conditioning and cooling systems, system components, and applications. General information about air conditioning and cooling systems, heating and cooling load calculation. Determining the components of air conditioning and cooling systems and system characteristics, as well as project implementation. |
|  |
| **MKM762** | **Combustion in Internal Combustion Engines** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The aim of this course is to provide detailed information on combustion in internal combustion engines to Master's and Ph.D. students, assisting them in their advanced studies. Topics include fuels and combustion, properties of fuels, general occupational health and safety measures, combustion and knock in spark-ignition and compression-ignition engines, parameters affecting combustion, combustion chambers, exhaust pollutants, ignition delay in compression-ignition engines with compression, and parameters affecting combustion. |
|  |
| **MKM765** | **Measurement Techniques in Vehicle Engines** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The objectives of this course are to: 1. Provide students with in-depth knowledge of the measurement of performance and emissions of vehicle engines. 2. Develop skills in testing engines. Topics covered include research and experimental principles of vehicle engines, engine characteristics, engine test systems, dynamometer selection, computer-aided engine testing equipment, engine testing procedures, cylinder pressure measurement and recording devices, measurement devices for torque, force, speed, and temperature, fuel and air flow measurement, determination of effective, friction, and indicated power, emissions measurement, measurement errors, uncertainty analysis, and interpretation of experimental results. |
|  |
| **MKM766** | **Active and Passive Control of Mechanical Vibrations** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Basic Vibration Knowledge, Control System Design, Active and Passive Control Systems, Controllers, Mechanical Vibrations, Imbalance in Rotation, Control Systems, Active and Passive Control, Controllers. |
|  |
| **MKM767** | **Finite Element Method with Matlab** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Learning the finite element method with Matlab. Introduction to Matlab, approximate solution techniques, programming finite elements, spring system approach, Laplace and Poisson equations, beam elements, isoparametric elements, truss structures, plates. |
|  |
| **MKM779** | **Advanced Simulation and Analysis** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Teaching the modeling of complex systems using simulation methods and exploring them through the model. Introduction to simulation and classification of simulation model types, stochastic, discrete simulation, Monte Carlo simulation and applications, variance reduction techniques, random numbers, control variables, indirect measurement, importance sampling. Output analysis, terminated models, non-terminated models, system comparison, response surfaces, optimization. System dynamics, agent-based simulation, agent-environment interaction, state charts, hybrid simulation models. |
|  |
| **MKM784** | **Production and Properties of Rail Steels** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Introduction to the production methods of rails used in railways. Introduction of microstructure and mechanical properties of rail steels. Introduction of standards for rail steels. Introduction of innovations in rail production. Selection and production of rail materials, types of steel used as rail material. Quality standards for rail steels. Microstructural, physical, and mechanical properties of rail steels. Production methods and characteristics of pearlitic-hardened and bainitic microstructured rails. Recent developments in rail steel. |
|  |
| **MKM786** | **Advanced Heat Treatment and Applications** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To introduce iron alloys, especially steels, along with all their properties and heat treatments. To review general heat treatments. To teach heat treatment design and planning based on the process and usage conditions. To introduce industrial heat treatments and heat treatment environments. |
|  |
| **MKM790** | **Metal Joining Methods** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To comprehend the historical development and types of welding, obtaining combustible and supporting gases in oxy-acetylene welding and their properties. Acetylene oxygen cylinders, torches, types of flames, flame selection according to material type, soft and hard soldering, cutting with oxy-gas flame, ability to select appropriate welding parameters and methods, preparing parts for welding, fusion welding methods, welding-related electrical knowledge, welding arc, welding power generators (arc welding, characteristics and main components of power sources), welding electrodes, welding joint types, selection of welding parameters, welding in tension and distortion, gas metal arc welding techniques, protective gases, TIG, MIG-MAG, FCAW methods, submerged arc welding method, welding defects, resistance welding. The main content of the course is the physical foundations of plastic deformation, the formability of metals and alloys, and the experimental solutions of metal forming processes. Other topics include stress-strain relationship in metals, hot and cold deformation, friction problems in metal forming, basic manufacturing methods (rolling, deep drawing, extrusion, forging), and force and processing calculations in these methods. |
|  |
| **MKM791** | **Process Modeling in Welding Processes** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The objectives of this course include teaching detailed manufacturing processes, modeling these processes in a computer environment based on a simulation program, and instructing on how various scenarios can be applied to a simulation model and how to evaluate the results. The course covers the concept of job analysis in production, cycle time, and flowchart concepts in production, describing the general factory layout in production, explaining the concepts of functional layout, cellular layout, and group technology in production, introducing the queuing theory in production, providing a general overview of simulation software used in production, explaining the modules used in simulation and the concept of scenario analysis, describing the sub-modules used in simulation software and malfunction scenarios, modeling the profile cutting station in the simulation environment, and scenario analysis. Simulating the nest cutting workstation in production and conducting scenario analysis. Modeling the pre-manufacturing workstation in the simulation environment. Simulating the Jig workstation. Modeling the panel line used in production in the simulation environment and conducting scenario analyses. |
|  |
| **MKM797** | **MSc Seminar** | **0** | **2** | **0** | **6** |
| **Purpose and Content** | To impart the skill of delivering presentations on a specific topic to students. |
|  |
| **MKM798D** | **Course Specialised Field** | **4** | **0** | **0** | **4** |
| **Purpose and Content** | Course Specialised Field is a theoretical course proposed by a faculty member to share their knowledge, experience, and expertise in their scientific field with graduate students under their supervision. This course aims to educate students on scientific ethics and instil a strong work discipline. |
|  |
| **MKM798T** | **Thesis Specialised Field** | **4** | **0** | **0** | **4** |
| **Purpose and Content** | Thesis Specialised Field is a theoretical course that the faculty member proposes to the graduate students he/she supervises in order to share the methods of conducting research in the current literature, following and evaluating the literature, and to establish and carry out the scientific foundations of the student's thesis / exhibition / project work. |
|  |
| **MKM799** | **MSc Thesis Research** | **0** | **1** | **0** | **26** |
| **Purpose and Content** | To develop the ability to conduct scientific research, access information, and evaluate and interpret data. |
|  |
| **MKM7007** | **Advanced Technologies in Hybrid and Electric Vehicles** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The aim of this course is to provide postgraduate-level knowledge about hybrid and electric vehicles, introduce the systems used, and provide theory-based information about their designs. The goal is to build expertise for the widely used future vehicle technology. The course covers the history of hybrid and electric vehicles and compares them with internal combustion engine vehicles. Topics include energy storage devices, batteries, and fuel cells. Energy conversion systems, different types of motors used, torque-speed characteristics, and control techniques. Basic variables in hybrid and electric vehicle design and the software used. Motion control and energy management systems in hybrid and electric vehicles. |
|  |
| **MKM7009** | **Mechanics of Composite Materials** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The goal is to teach the mechanics of fiber-reinforced polymer composite materials in a theoretical and detailed manner at both the micro and macro levels. The topics include fiber-reinforced composite materials, the linear elastic stress-strain properties of composite materials, determining engineering constants with micromechanics, plane stress approach, stress-strain relationships in the global coordinate system, classical lamination theory: Kirchhoff theory, classical lamination theory: laminate stiffness matrix, damage theories for fiber-reinforced materials: maximum stress criterion, damage theories for fiber-reinforced materials: Tsai-Wu criterion. |
|  |
| **MKM7013** | **Industrial Hydraulic and Pneumatic Applications** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Recognition of hydraulic systems, an indispensable part of industrial systems, selection of basic components such as valves and pumps used in systems, recognition of advanced valves and pumps, and selection of valve and pump components according to circuit diagrams of industrial hydraulic systems, ensuring pressure-flow calculations. Introduction to hydraulics, basic principles in hydraulics, standard symbols in hydraulics, hydraulic pipes and hoses, pumps, motors, hydraulic cylinders, sealing elements, valves, oil tanks, filters, hydraulic accumulators, hydraulic fluids, advanced valves and pumps, circuits and fault diagnosis in hydraulic systems, valve and pump selection according to the system, hydraulic calculations. |
|  |
| **MKM702** | **Dynamics of Mechanical Systems** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Obtaining the dynamic equations of mechanical systems and learning solution methods. Rigid body dynamics and gyroscopic effects. Generalized coordinates. Constraints, Lagrange's equation. Hamilton's principle. Motion equations of single and multiple degree of freedom systems. Solution of motion equations. |
|  |
| **MKM715** | **Advanced Heat and Mass Transfer** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Understanding the physical mechanisms of heat and mass transfer and the mathematical models of these mechanisms. Understanding and utilizing the analogy between heat and mass transfer. Learning and applying exact and approximate analytical solution techniques for solving heat and mass transfer problems. Applying basic heat and mass transfer knowledge to air conditioning processes. Fundamental concepts and laws related to heat and mass transfer. Analogy between heat and mass transfer (similarity). Heat and mass diffusion: Characteristics and mechanisms. One-dimensional concentration distributions in solids and laminar flow conditions. Continuity and energy equations for mixtures. Multi-dimensional and time-dependent systems. Momentum, heat, and mass transfer in turbulent flow. |
|  |
| **MKM733** | **Advanced Manufacturing Methods** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The aim of this course is to introduce advanced manufacturing methods and discuss developments in this field. Introduction to advanced manufacturing methods, Electron beam machining, Ion beam machining, Chemical machining, Electro-erosion machining, Ultrasonic machining, Laser beam machining, Water jet machining, Plasma arc manufacturing, Rapid Prototyping, and Special methods. |
|  |
| **MKM737** | **Sheet Metal Forming Mechanics** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To provide graduate students considering working in the field of sheet metal forming with the necessary fundamental mechanical concepts. Stress and strain, yield criteria, experimental strain analysis under large deformation, strain rate, bending and springback in bending, deep drawing, forming limit diagrams. |
|  |
| **MKM746** | **Heating Ventilation and Air Conditioning System Design** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Providing a general overview of Air Conditioning, Refrigeration, and Heating, learning design criteria, enabling the calculation of a building's heat loss, projecting the heat gain, and understanding the design criteria for cooling. Topics include hot water and steam heating, hot air heating and ventilation systems, heat loss calculations, radiator selection, annual fuel calculations, air conditioning central systems, locations where air conditioners are used, psychrometrics of moist air, heat gain calculations, dew point temperatures of devices, compressed cooling systems, ejector and air cooling calculations, refrigerants. |
|  |
| **MKM755** | **Performance and Fuel Economy in Internal Combustion Engines** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Teaching the performance, fuel economy, and influencing parameters in internal combustion engines. Topics include motor performance parameters, strategies for improving fuel economy, electric vehicles, parameters affecting fuel economy in engines and vehicles, fuel economy in spark-ignition engines with spark plugs and compression-ignition engines, emissions in compression-ignition engines, electronic controlled fuel injection, alternative fuels, and their use in engines, and studies on improving performance and fuel economy in internal combustion engines. |
|  |
| **MKM760** | **Energy Economics and Applications** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Analysis and modeling of energy policy, energy, and sustainable growth. Fundamental concepts of economics, foundations of macroeconomics and microeconomics, economic analysis of energy projects, financing energy projects, financial analysis of energy investments, energy investment planning, tariffication and pricing, energy cost analysis, energy trade, energy derivative markets, global energy potential, supply and demand, energy balance, global energy markets, regional outlooks for the next 30 years: dominant trends and forecasts, energy indicators, analysis and modeling of energy policy, energy and economic growth, regulations in energy markets, liberalization, and competition. |
|  |
| **MKM771** | **Product Processing Machinery and Design** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The aim of this course is to provide the construction principles of tools and machines used in product processing. Systems for cleaning and classifying agricultural products after harvesting, Screw and Pneumatic Conveyors, Bucket and Belt Conveyors, Seed Cleaning and Classification. |
|  |
| **MKM773** | **Vehicle Emissions and Control** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The purpose of this course is to provide in-depth knowledge to graduate students on vehicle emissions and to introduce emission control systems. Air pollution and its sources. The impact of vehicles on air pollution. Pollutants from internal combustion engines. CO, HC emissions, and their formations. NOx, soot emissions, and their formations. The effect of engine structure on emissions. The effect of engine maintenance and adjustments on emissions. Emission control systems. Activated carbon filter. Exhaust gas recirculation. Catalytic converters. Alternative clean fuels. Emissions from biodiesel, hydrogen, natural gas, and alcohol fuels. Emission standards. Emission control in direct-injection engines. |
|  |
| **MKM774** | **Problem-Solving Techniques and TRIZ Principles** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The aim of this course is to introduce appropriate tools for solving problems encountered in businesses, to reduce production costs using optimal tools and methods suitable for the problem, and to provide information on techniques that will improve product quality. Problem-solving strategies, effective problem solutions, gathering information about the problem, problem definition. |
|  |
| **MKM777** | **Smart Vehicle Technology** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | This course aims to provide an overview of the general concept of vehicles, the general history and development of automobiles, general automotive main systems, the importance of fuel efficiency, human safety, and recent developments in driver assistance systems. It includes the examination of a wide range of mechatronic applications in automotive systems, such as electronic ignition, airbag systems, immobilizers, ABS, drive, brake, steer, shift, etc. The course also explores the functions and benefits of these mechatronic applications within vehicles, including vehicle dynamic control (ABS, ASR, ESP, VDC) and active and semi-active suspension control. |
|  |
| **MKM782** | **Energy Efficiency, Fuels and Lubricants in Rail Systems** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | This course aims to achieve the following objectives: 1. Convey the importance of sustainable and environmentally friendly supply of fuel and lubricants for rail systems to students. 2. Familiarize students with the fundamental characteristics of fuels and oils, including selection, procurement, transportation, and storage. 3. Provide knowledge about fuel standards and corporate specifications. 4. Understand the importance of energy-efficient operations, maintenance, driving, and traffic management. Specific topics covered in the course include: 1. Efficient use of electric and fuel energy in rail systems, oils, greases, and additives. 2. Evaluation of energy consumption data for vehicles, including energy/fuel efficiency ratios, rotation, utilization, and turnstile calculations. 3. Types and specifications of fuels, including diesel fuel, LNG and CNG applications, and systems using hybrid energy. 4. Evaluation of the energy efficiency of using AC and DC electric traction. 5. Energy-efficient operation, including dynamic and regenerative braking, and the impact of traffic management systems on energy efficiency. 6. Case studies in railways and urban transportation. 7. Oils, greases, and additives, their purposes, effects, and methods of recovery-recycling and waste management in fuels, oils, and greases. 8. Environmental impacts and trends, issues, and solutions in rail operations. |
|  |
| **MKM789** | **Safety and Comfort Systems in Motor Vehicles** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Understanding the factors and interactions that contribute to safety and comfort requirements in motor vehicles, as well as recognizing these systems and developing perspectives for new designs. Elements influencing vehicle design, interactions between factors affecting vehicle design, analysis of different safety systems used in vehicles, and new recommendations. Analysis of various comfort systems used in vehicles and new proposals, along with the ability to comprehend the elements and interactions influencing safety and comfort requirements in motor vehicles and creating perspectives for recognizing these systems and developing new designs. Understanding the factors influencing vehicle design, the interactions between elements affecting vehicle design, and analyzing different safety and comfort systems used in vehicles to provide new recommendations. |
|  |
| **MKM792** | **Smart Transportation Vehicles and Cybersecurity** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Introducing the current state, historical background, fundamental terminology, and significant technologies in the field of cybersecurity against cyberattacks on smart transportation systems. Explaining the legal, ethical, political, and economic impacts of cyberattacks on smart transportation vehicles. Topics covered include smart transportation vehicles, attacks on smart transportation systems, cyber vulnerabilities in smart transportation vehicles, fundamental concepts related to cyberspace and cybersecurity, cybercrime, information technology law, computer law, and cyber law, forensic investigation and computers, information security and control, computer and network security, cyber warfare, and international standards in cybersecurity. |
|  |
| **MKM795** | **Continuous Transport Systems** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To ensure continuous flow during the production stage and the entry-exit of facilities in industrial plants, the selection, design, and construction of appropriate systems for the transportation of raw materials, semi-finished, and finished products inside and outside the facility are of great importance. Continuous material transportation plays a significant role in industrial economies. A modern industrial facility cannot be imagined without an efficiently organized transportation system. Adequate construction can be achieved through the engineer's experience, knowledge, intelligence, and ability. The purpose of this course is to provide the design principles of workflow and economic transportation methods in industrial facilities. Classification of loads to be transported and continuous transport machinery. Calculation principles of belt conveyors and the structures of their components. Calculation principles of elevators, oscillating, and vibrating transport machinery. Design of hydraulic and pneumatic transport machinery. |
|  |
| **MKM796** | **Semester Project** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Providing students with the opportunity to develop projects in hardware or software subfields or under a common umbrella. Preparing project proposals, implementing the project, overseeing the design stages, interpreting the results, and presenting them. |
|  |