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| **DEPARTMENT OF MECHANICAL ENGINEERING****Content of Master's Degree in Mechanical Engineering English with Thesis** |
| **COURSE CODE** | **COURSE NAME AND CONTENTS** | **T** | **A** | **C** | **ECTS** |
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| **GEI701** | **Scientific Research Techniques and Scientific Ethics** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Learning the definition of science and scientific research methods/techniques, understanding scientific methodology, learning research techniques and data collection methods, understanding ethical issues in scientific research. Learning types of scientific publications (thesis, paper, article, report, etc.), acquiring the ability to follow current scientific developments in the field, and learning ethical principles to be followed in scientific research and publication. Defining scientific knowledge along with highlighting its differences from other types of knowledge. Introducing the philosophy of science and knowledge philosophy (epistemology) to establish a conceptual foundation. |
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| **MCE712** | **Advanced Manufacturing Processes** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The aim of this course is to provide information about additive manufacturing methods, their usage areas, purposes, advantages compared to conventional manufacturing technologies, software used, equipment, and material variety used in methods. It also aims to provide information about part design criteria, support design, material selection criteria, and finishing processes in additive manufacturing. Introduction to Additive Manufacturing (AM) technologies / Reverse engineering in AM - (3D digitizing, data generation, data capture, point cloud, filtering) / Software in AM and STL files / Orientation and slicing strategies / Toolpath generation / Supports in AM and the minimum volume support usage model, cost model / Photopolymerization (FP) technique-based additive manufacturing methods, process parameters / Photopolymerization process (curing depth) model / FP laser scanning models (Weave, Aces, etc.) and self-pulling model / Design criteria and finishing processes in FP-based additive manufacturing / Powder Bed Fusion (PBF); materials used and PBF mechanisms depending on the material / Solid-state sintering - Partial melting - Full melting - Chemical bonding / SLS, SLM, EBM methods, parameters, energy model / Design criteria and finishing processes in PBF / Extrusion-based (EB) additive manufacturing; parameters, materials, Cartesian 3D printer, delta 3D printer, polar 3D printer, SCARA 3D printer / Design criteria and finishing processes in EB additive manufacturing / Polyjet, Inkjet methods / Direct energy deposition method, principles, and basic principles, hybrid additive manufacturing methods. |
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| **MCE717** | **Surface Engineerin** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | This course is designed to provide graduate students in the fields of Mechanical Engineering, Mechatronics Engineering, Manufacturing Engineering, and Metallurgy and Materials Engineering with advanced knowledge in engineering surfaces and their metrological evaluation, coating technologies, and tribology. The objectives of this course include: Providing information on the importance, characteristics, and properties of engineering surfaces. Introducing processes for the manufacturing of engineering surfaces. Offering advanced knowledge on suitable coating and surface modification processes to address wear and friction issues. Presenting information on biomedical surfaces, their compatibility within the body, and surface coating and modification methods enhancing cell growth (osseointegration). Characterizing engineering surfaces, including the measurement of coating thickness and wear using precision metrological systems. The course covers various topics such as the definition and importance of engineering surfaces, surface metrology, the characteristics of engineering surfaces, manufacturing processes for engineering surfaces, coating and surface modification applied to engineering surfaces, metrological evaluation of coatings, biomedical surfaces, tribology on engineering surfaces, and the future trends and studies in surface metrology. If you have any specific sentences or sections you'd like me to focus on or if you have any other requests, feel free to let me know. |
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| **MCE726** | **Experimental Methods for Engineers** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | This course aims to enhance students' abilities in designing experiments, conducting experiments, and analyzing and interpreting results, with a focus on conducting experiments and measurements on ship machinery. The course covers the following topics: Experiment definition and design Principles of measurement in engineering, statistical methods in measurement, measurement errors Uncertainty and error analysis in experiments, calibration, similarity Measurements of pressure, flow, velocity, level, deformation, force, temperature, speed, moment, current imaging, dynamometer principles Measurement of electrical quantities, material microstructure imaging methods Sampling, digital devices, data collection, and processing Parallel connection and synchronization of generators DC and AC experiments Cylinder wear experiments in engines Application of basic refrigeration machine Determination of motor performance values Strength tests of ship structural elements HVAC system application experiments Metallographic preparation and microscopic examination Pump experiments in series and parallel configurations Continuous and local head losses in pipes. |
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| **MCE729** | **Conduction Heat Transfer** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To provide a new perspective on heat conduction problems and prepare the necessary groundwork for advanced studies. The course covers the following topics:General heat conduction equation Boundary conditions Solution methods for time-dependent and time-independent heat conduction problems Modeling techniques for one, two, and three-dimensional heat conduction problems. |
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| **MCE745** | **Rolling Technology** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The aim of the course is to provide engineers with the competencies related to establishing, operating, and maintaining a rolling mill production facility. Topics covered include the rolling process and its variations, rolling mill systems and components, rolled products and defects, the process of preparing bedded rolls, and operational challenges in a rolling mill facility. |
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| **MCE747** | **Mechanical Vibrations Active and Passive Control** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Fundamental Vibration Knowledge, Control System Design, Active and Passive Control Systems, Controllers. Mechanical Vibrations, Unbalance in Rotation, Control Systems, Active and Passive Control, Controllers. |
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| **MCE748** | **Analytical Methods For Studies Of Vibration** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To teach students concepts and theorems related to vibrations. Definitions and Concepts Related to Vibrations. Virtual Work Principle. Hamilton's Method. Lagrange's Method. Longitudinal Vibrations. String Vibrations. Transverse Vibrations. Nonlinear Vibrations. Dimensionalization. Rayleigh Method. Rayleigh-Ritz Method. |
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| **MCE749** | **Optimization and Prediction Techniques** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To teach the fundamentals of experimental design (design of experiment) and optimization processes for multifactorial problems encountered in mechanical engineering. To teach the use of methods for predicting the output of problems. Experimental Design in Mechanical Engineering, Taguchi Method, Selection of Orthogonal Arrays, Signal-to-Noise Ratio, Determination of Effective Parameters, Determination of Optimum Process Conditions. Variance Analysis Method, F-Test. Prediction Methods in Experimental Design, Multiple Regression Method, Optimization in Mechanical Engineering Problems, Response Surface Method (RSM), Response Surface Design (Composite, Box-Behnken, etc.) and Process Optimization with RSM, Artificial Neural Network (ANN) Method, Network Types, Backpropagation Learning, and Prediction. |
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| **MCE751** | **Finite Element Analysis of Composite Materials** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To impart the ability to perform composite material analysis using the finite element method to students. Introduction, Finite Element Types Used in Composite Material Analysis (Implicit Analysis) Definition of Layered Structure in Shell and Solid Elements (Implicit Analysis) Modeling, analysis, and interpretation of results in 2D plates (Implicit Analysis) Thermal Stress Analysis in Composite Plates (Implicit Analysis) Modeling of Sandwich Structures (Implicit Analysis) Application of Fracture Mechanics (Implicit Analysis) Modeling and Analysis of Pressurized Composite Shells Modeling and Analysis of Simply Supported and Clamped Plates 3D modeling, analysis, and interpretation of results (Implicit Analysis) Stress Analysis in Pin/Bolt Hole Plate (2D and 3D) Explicit Element Types and Material Properties Creation, Solution, and Examination of the Drop Test Model Creation, Solution, and Examination of the Impact Test Model Examination of Behavior at Different Impact Velocities |
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| **MCE754** | **Applications of Industrial Hydraulics and Pneumatics** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | Recognition of hydraulic systems, which are indispensable for industrial systems; selection of basic components such as valves and pumps used in systems; understanding advanced valves and pumps; selection of components according to circuit diagrams of industrial hydraulic systems; and conducting 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 Detection in Hydraulic Systems, Valve and Pump Selection According to the System, Hydraulic Calculations. |
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| **MCE797** | **MSc Seminar** | **0** | **2** | **0** | **6** |
| **Purpose and Content** | To equip students with the ability to make presentations on specific topics. |
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| **MCE798D** | **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. |
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| **MCE798T** | **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. |
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| **MCE799** | **MSc Thesis Research** | **0** | **1** | **0** | **26** |
| **Purpose and Content** | To impart the ability to conduct scientific research, access information, and evaluate and interpret knowledge. Master's thesis work. |
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| **MCE724** | **Multiscale Materials Design** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | To introduce the fundamental principles and theories of nano-materials and technologies developed globally in recent years. To present the nano-scale materials used in nanotechnology, their applications, and superior properties. To provide students with knowledge and skills in nanotechnology, emphasizing that this very new field is closely related to lifelong learning. Introduction to nanotechnology, basic definitions, and global nanotechnology centers, education, and research. Basic physics laws, principles, and theories related to nanotechnology. Nano-Manufacturing Methods and Principles (Surface transport, printing methods, nanolithography, electromagnetic radiation, X-ray lithography, electron beam lithography, ion beam lithography, atomic beam lithography, molecular and nanoparticle beam lithography. Nano-powder synthesis methods, carbon nanotubes. Nano-colloidal systems: Surface modification, hydrophobic and hydrophilic surfaces). |
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| **MCE732** | **Experimental Methods for Engineers** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | This course aims to enhance students' abilities to design experiments, conduct experiments, and analyze and interpret results, particularly in the context of marine engines. Topics covered include experiment definition and design, principles of measurement in engineering, statistical methods in measurement, and analysis of uncertainty and errors in experiments. Calibration and similarity concepts are also addressed. Various measurements, such as pressure, flow, velocity, level, deformation, force, temperature, speed, and moment, are covered, along with principles of current visualization and dynamometer principles. The course also includes experiments on the measurement of electrical quantities and imaging of material microstructure. Other aspects covered are sampling, digital devices, data collection and processing, parallel connection and synchronization of generators, experiments on direct current and alternating current, cylinder wear tests for engines, basic refrigeration system applications, determination of motor performance parameters, strength tests on ship structural elements, climate control experiments, metallographic preparation, microscopic examination, series and parallel pump connection experiments, and continuous and local load losses in pipes. |
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| **MCE752** | **Thermoeconomic Analysis of Thermal Systems** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The purpose of this course is to understand the engineering design process, learn about the characteristics of thermal system components, and their impact on the overall system performance. Additionally, the course aims to design and construct a thermal system with economic evaluations. The application of thermodynamics, fluid mechanics, and heat transfer principles to the design of components and thermal systems is covered. The course involves examining the characteristics of components and their influence on the overall system performance. It also includes the thermo-economic analysis of thermal systems. |
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| **MCE753** | **Advanced Thermodynamics** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | 1- To review the fundamental principles of classical thermodynamics. (First law, second law, availability analysis) 2- To provide information about advanced thermodynamics and a scientific approach. 3- To teach basic applications from thermodynamic concepts to advanced energy systems. Fundamental concepts of thermodynamics, properties of pure substances, Thermodynamic property relationships and equations of state. The second law of thermodynamics, Entropy generation and exergy destruction, Minimization of entropy generation, Exergy analysis for closed and open systems, Combustion and chemical equilibrium, Refrigeration processes. |
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| **MCE755** | **Micro and Nano Manufacturing Technologies** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | The course provides the fundamentals and recent developments in nano and micro processing for modern manufacturing engineering. It imparts knowledge to participants about understanding the characteristics of micro-scale metal cutting, micro and nano abrasive processes, laser microprocessing, and materials in micro and nano molding, as well as how nano and micro devices are designed and produced. Principles of micro and nano fabrication, material removal rates, micro manufacturing using X-ray lithography, microstructure fabrication, micro molding processes, micro molding tools, micro mold design, micro molding applications, limitations of micro molding. Micro processing techniques, meso-micro processing, mechanical micro processing, micro processing theory, micro processing tool design. Micro grinding, diamond micro cutting tools. Laser micro and nano fabrication. Micro processing using water droplets. Diamond nano grinding. Nano processing. Micro and Nano manufacturing. |
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