

# MCE - MECHANICAL ENGINEERING (MCE)

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## **MCE 2203 Applied Statics (2-2-3)**

Covers the fundamentals of particles and rigid bodies equilibrium with engineering applications. Includes equilibrium of forces and moments applied to particles, rigid bodies, and engineering structures; equilibrium in two and three dimensions; free-body diagrams; friction; centroids; centers of gravity; moments of inertia. Laboratory and projects on planar equilibrium, forces in structural members, friction, center of mass, and area moments of inertia.

**Prerequisites:** PHY 1103

## **MCE 2213 Mechanics of Materials (2-2-3)**

Covers concepts of stress, strain, deformation, strain energy and load carrying capacity of structural members subjected to tension, compression, shear, torsion, and bending. Introduces stress-strain transformation relations and mechanical design concepts. Laboratory experiments are conducted covering the course topics.

**Prerequisites:** MCE 2203, MCE 2303

## **MCE 2223 Applied Dynamics (3-1-3)**

Covers kinetics and kinematic analysis of particles and rigid bodies in translation and rotational mechanical systems, position, velocity, acceleration, energy, impulse and momentum. Includes case studies to solve two dimensional problems for particles and rigid bodies. Laboratory experiments on measurement of velocity and acceleration of translational and rotational motion.

**Prerequisites:** MCE 2203, MTH 2103

## **MCE 2303 Material Selection and Testing (3-1-3)**

Apply material selection criteria for specific engineering applications through the understanding and identification of materials, their mechanical properties and material defects. Explain atomic bonding, structure, imperfections, grain-size and re-crystallization and describe material failure and causes of corrosion with prevention methods.

**Prerequisites:** PHY 1103, CHM 1103

## **MCE 2311 Solid Modelling (0-4-1)**

Covers the fundamentals of 2D/3D CAD and the steps involved in the process of designing 3D mechanical components and/or assemblies. Use CAD software for modelling of solids with parametric capabilities, creation of assemblies, design validation and finally the creation of 2D engineering views.

**Prerequisites:** EGN 1133

## **MCE 2323 Manufacturing Technology I (2-2-3)**

Introduce concepts of basic manufacturing processes and fabrication techniques such as metal casting, metal forming, sheet metal processes, manufacture of plastic components and metal joining processes.

**Prerequisites:** MCE 2303

## **MCE 2332 Geometric Dimensioning and Tolerancing (1-3-2)**

Introduce basics of general Tolerancing symbols and terms. Use geometric Tolerancing, datum, material condition symbols, geometric characteristics and position tolerance.

**Prerequisites:** MCE 2311

## **MCE 2403 Thermodynamics (2-2-3)**

Study thermodynamics properties of pure substances, properties and equations-of-state of ideal and real gases used to solve thermodynamic problems. Learn the forms of mechanical work and heat transfer mechanisms. Apply the first law of thermodynamics (conservation of energy) to non-flow processes (closed systems) and flow processes (open systems). Apply the second law of thermodynamics to thermodynamic processes, idealized heat engines, and heat pumps.

**Prerequisites:** PHY 1103

## **MCE 2903 Sophomore Design Project (2-2-3)**

Covers design of a system to solve real-world problems including measurement of mechanical variables like pressure, temperature, force, viscosity using an electronic measurement system. Includes estimation of mechanical physical quantities measurement, accuracy, precision, and performance of the developed solution. Application of applied mechanics, materials selection, and use of programming, math, physics and chemistry in problem solution development including health and safety technology; identification and measurement of HSE variables such as noise pollution, light, work environment, etc.

**Prerequisites:** MCE 2203, MCE 2303, MCE 2311

**Corequisites:** ELE 2153

## **MCE 3203 Applied Mechanical Vibrations (3-1-3)**

Covers the theory of mechanical vibrations occurring in single and multi-degree-of-freedom systems. Explains the principles of vibration control such as vibration isolation and vibration absorbers. Includes laboratory experiments to demonstrate the basic principles of mechanical vibrations.

**Prerequisites:** MCE 2223

## **MCE 3303 Manufacturing Technology II (2-2-3)**

Covers the mechanics of metal cutting and functionality of standard machine cutting tools. Includes different types of metal cutting operations such as turning, milling, drilling and grinding. Understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming.

**Prerequisites:** MCE 2323

## **MCE 3343 Industrial Plant Maintenance (2-2-3)**

Provides review on importance of maintaining equipment and machinery in industry. Covers different types of maintenance such as predictive, preventive, scheduled, corrective, and machine health monitoring. Explores common problems and use of troubleshooting techniques encountered in industrial plants. Introduces different concepts in maintenance management and planning.

**Prerequisites:** MCE 2323

## **MCE 3403 Fluid Mechanics (3-1-3)**

Covers fluid properties and pressure, hydrostatics, and dynamics of fluid flow, friction losses, and sizing of pipes with emphasis is on problem solving. Includes practical experiments to reinforce the theory.

**Prerequisites:** MCE 2403, MTH 2103

## **MCE 3413 Applied Heat Transfer (3-1-3)**

The course covers basic heat transfer laws and applications, including steady-state and transient heat conduction in solids, free and forced convection in fluids, radiation heat exchange and analysis of industrial heat exchangers. Includes engineering applications involving design and selection of heat exchangers and insulation materials.

**Prerequisites:** MCE 3403

**MCE 3503 Mechanical Design (2-2-3)**

Covers concepts and applications of various common mechanical elements including types of loading, flexible power transmission systems, keys and couplings, shafts, fasteners, welded joints and springs. Includes design calculations to select desired components for specified applications. Applies data and decision analysis techniques necessary to design these elements commonly found in mechanical devices and systems.

**Prerequisites:** MCE 2213, (MCE 2903 or MTE 2903)

**MCE 3513 Machine Elements and Mechanisms (2-2-3)**

Extends methods developed in statics and dynamics for the kinematics and dynamics of machine elements. Develops fundamental principles required for the selection of individual elements that compose a machine. Various methods are used to determine displacements, velocities, and accelerations in common mechanisms. Covers Cams & followers and basic motions; static and dynamic force analysis; static and dynamic shaft balancing using laboratory experiments.

**Prerequisites:** MCE 2223

**MCE 3601 Engineering Measurements Lab (0-3-1)**

The course covers measurement techniques and instrumentation used in mechanical engineering considering calibration, precision, accuracy, and error measurements. Conducts experiments for measurement of force, torque, strain, pressure, flow and temperature.

**Prerequisites:** MCE 3403

**MCE 3613 Fluid Power (2-2-3)**

Covers fundamental concepts of fluid power and electro-fluid power systems. Cover principles of fluid power, hydraulic control, related parameters, components, circuits, symbols, and their ability to do work. Introduce troubleshooting techniques in fluid power with emphasis on safety.

**Prerequisites:** MCE 2203

**MCE 4303 Computer Integrated Manufacturing (2-2-3)**

Introduces computerized applications in Manufacturing, Design, Process planning, Manufacturing cost, Layout and Material Handling systems. Includes class projects and laboratory experiments.

**Prerequisites:** MCE 2323

**MCE 4313 Advanced Geometric Dimensioning and Tolerancing (2-2-3)**

Covers tolerances attributed to maximum material boundary (MMB), least material boundary (LMB), and regardless of material boundary (RMB). Cover complex GD&T situations and coaxial tolerances. Runs practical laboratories to enhance students understanding to evaluate and use intermediate and advanced geometric dimensioning techniques.

**Prerequisites:** MCE 2332

**MCE 4323 Non Destructive Testing (2-2-3)**

Covers various Non Destructive Testing methods, theory and industrial applications. Demonstrates differences between non-destructive testing and mechanical testing methods. Applies testing techniques for surface, liquid dye penetration method, thermography, eddy current testing, ultrasonic testing, acoustic emission and radiography testing methodologies.

**Prerequisites:** MCE 2213, MCE 3303

**MCE 4333 Production Planning and Control (2-2-3)**

This course covers the design, development, implementation and management of production planning systems including forecasting, master production scheduling, aggregate planning, material requirements planning, capacity and inventory planning and production activity control. Students will be introduced to contemporary approaches such as just-in-time engineering, theory of constraints and the relationship of enterprise-level planning and control systems to the overall materials flow.

**MCE 4403 Refrigeration and Air Conditioning System (2-2-3)**

Covers classification of refrigeration and air-conditioning systems and their applications in industry. Provides analyses of ideal and actual vapor compression refrigeration cycles, components, and systems. Describes simple vapor absorption systems. Study of psychometrics to determine the properties of moist air. Includes analyses of air conditioning processes, estimation of cooling loads using standard and UAE design conditions, and sizing the ducting system of a central air AC system.

**Prerequisites:** MCE 3413, MCE 2403

**MCE 4413 Turbomachinery (2-2-3)**

Covers concepts, procedures, data and dimensional analysis techniques to evaluate the flow and energy transfer through turbo machines. Includes Euler's turbine equation, thermodynamics, fluid flow in turbomachines, and power-absorbing turbomachines and power-producing machines analyses.

**Prerequisites:** MCE 3403

**MCE 4423 Power Plant Engineering (2-2-3)**

Covers the laws of thermodynamics in the design and optimization of basic energy conversion processes within various power plants. Studies fundamental thermodynamic properties including cycle efficiency and the concepts of nuclear power plants operation as well as economics of power plants.

**Prerequisites:** MCE 2403

**MCE 4433 Internal Combustion Engines (2-2-3)**

Introduce students to fundamentals of Internal Combustion (IC) Engines. Apply thermal-fluid concepts to different types of internal combustion engines. Study various factors like fuels, combustion, heat transfer, friction phenomenon relevant to IC engine power, efficiency and emissions. Run laboratory experiments to learn skills in examination of design features and testing characteristics of different types of IC engines.

**Prerequisites:** MCE 3413, MCE 2403

**MCE 4443 Computational Fluid Dynamics (2-2-3)**

Implements numerical techniques employed in thermofluid analysis. Uses CFD software to model fluid flow in aerospace, automotive, and other engineering applications.

**Prerequisites:** MCE 3413

**MCE 4453 Desalination Engineering (2-2-3)**

Covers different methods of water analysis and treatment about different types of desalination processes, such as, multi-stage and multi effect distillation, reverse osmosis, freezing, and electro-dialysis. Includes the environmental, sustainability, and economical factors that may influence the performance, affordability, and availability of desalination processes. Explores renewable energy technologies used in desalination.

**Prerequisites:** MCE 3413

**MCE 4463 Energy Conservation and Management (2-2-3)**

Covers theoretical and practical concepts related to environmental issues and sustainable development. Includes renewable and non-renewable energy sources and related technical, economical, ethical, and philosophical aspects. Covers available methods for optimizing energy consumption considering air pollution, global warming and impacts on other ecological systems.

**Prerequisites:** MCE 3513, MCE 3413, EGN 2712

**MCE 4503 Finite Element Analysis (2-2-3)**

Introduces the concepts of numerical methods in modelling for engineering problems. Applies basic concepts of finite element methods using spring, bar, beam and triangular elements in different applications such as stress and vibration analysis. Includes CAD tools utilization and laboratory projects and experiments.

**Prerequisites:** MCE 3413, MCE 3513, EGN 2712

**MCE 4513 Integrated Design for Manufacture and Assembly (2-2-3)**

This course introduces and explains the concepts and technology of a modern product manufacturing environment that shows how design and manufacturing are integrated within it. Also, it demonstrates the benefits and applications of computer technology in modern product & process manufacturing and design industries. In addition, it facilitates the understanding of commercial demands on modern manufacturing where economical part manufacturing and assembly using modern tools and techniques are discussed.

**Prerequisites:** MCE 3303

**MCE 4603 Control Systems (2-2-3)**

The course is an introduction to concepts of modern control theories. The modelling of different systems and their representation is presented. The response of the different systems is used in classification into first order and second order systems. The performance specifications of the systems are defined. Based on these specifications, design of classical controllers is implemented on the system. Explains the use of State space representation techniques in analyzing systems.

**Prerequisites:** MCE 2223

**MCE 4613 Robotics and Automation (2-2-3)**

Introduce theoretical concepts and applications of robotic systems. Describe and analyze power sources, drives and transmissions used in various industrial applications. Study the kinematics and kinetics of robotic systems. Learn about sensors, switches, devices, assemblies and maintenance of robotic systems.

**Prerequisites:** MCE 3343, MCE 3513

**MCE 4623 Introduction to Mechatronics (2-2-3)**

Integrate the knowledge gained in mechanical and electrical courses to cover theoretical and real design steps of mechatronic systems. Explore different types of sensors, input/output interfacing circuits, microcontroller programming and actuators, through emphases on practical applications.

**Prerequisites:** ELE 2153, MCE 4603

**MCE 4863 Special Topics in Mechanical Engineering (2-2-3)**

Presents a theoretical or practical topic proposed by the faculty beyond what is offered in existing courses. Can be repeated for credit.

**MCE 4893 Directed Study (2-2-3)**

Provides an opportunity to investigate under faculty supervision beyond what is offered in existing courses.

**MCE 4902 Capstone Design Project I (1-3-2)**

Coordinate to form project teams to propose, plan and design an engineering product. Gain the knowledge to identify design problems to meet industrial needs. Define design projects" criteria, components, resources, implementation schedule, and estimated costs.

**Prerequisites:** MCE 3403, MCE 2903, (EGN 3806 or EGN 3812)

**MCE 4912 Capstone Design Project II (1-3-2)**

Continue on the engineering design project carried forward from the preceding semester. Implement, build, test, evaluate, and analyze the proposed design. Develop and gain organizational, communicational and interpersonal skills.

**Prerequisites:** MCE 4902