COURSES OF NEW STUDY PLAN (STARTED FROM FALL 2017- FIRST SEMESTER OF THE ACADEMIC YEAR 1438-1439 H)

COMPULSORY COURSES

8021201-2 Engineering Drawing (2:1, 3) **Prerequisite:**

This course teaches important communication aspects of Engineering Drawing using AutoCAD. The topics of Engineering Drawing include Geometric and tangency constructions, Isometric drawings, Orthographic projection of engineering bodies, Derivation of different views from isometric drawings, Roles of dimensions on different views, Derivation of missed views from given two views, Intersection of bodies and surfaces and sectioning.

8022101-3 Introduction to Engineering Design 1 (3:2, 2) **Prerequisite: 999806-2 Intensive English Language (2)**

Engineering design: How engineers approach and solve problems; process and product design; quality principles; working in teams; presentation, organization, and assessment of technical work, preparation of brief reports on assigned work, self-regulation or the behaviors associated with taking personal responsibility for time management, learning new material, setting goals, etc...

8022201-2 Production Technology (2:1, 3) **Prerequisite:**

Introduction to principles of production, engineering materials, introduction to metal cutting and machine tools (sawing, drilling, turning, milling, shaping, slotting, grinding), fitting shop, sheet metal work. metal joining (welding and riveting), introduction to metal casting (principle of metal casting, sand casting), introduction to metal forming processes (forging, extrusion, drawing, rolling, wire drawing, spinning). Introduction to linear measurements. Recyclable of work shop wastes.

8022202-2 Introduction to Engineering Design II (2:2, 2) **Prerequisite: 8022101-3 Introduction to Engineering Design I**

Engineering design process. Computer modeling and heuristics for solving problems, in teams, in the areas of comparison of strategies, trade-offs, decision making, stochastic processes, optimization and expert systems. Interpretation of results. Preparation of professional technical reports of engineering work and multimedia presentation.

8022203-3 Dynamics (3:1, 2) **Prerequisite: 8012103-3 Statics**

Introduction to dynamics. Kinematics of a Particle. Kinetics of a Particle. Planer Kinematics of a Rigid Body. Planar Kinetics of a Rigid Body.

8022204-2 Mechanical Drawing (2:1, 3) **Prerequisite: 8021201-2 Engineering Drawing**

Mechanical engineering drawing conventions, abbreviations and system of dimensioning. Organization and preparation of engineering drawings. Drawing of simple machine parts. Extracting front, top and end views from isometric drawing of machine parts. Introduction to SolidWorks for two and three dimensional drafting. Fastening elements, mechanical joints and shaft couplings. Fits and tolerances, Bill of material table. Assembly and detailed drawing of complex machine parts according to ISO standards.

8022205-3 Thermodynamics (3:2, 2) **Prerequisite: 203205-4 Physics**

Thermodynamic concepts. Properties of pure substances. Ideal gases. Work and heat. The First law of thermodynamics. The second law of thermodynamics. Vapor and gas power cycles.

8023101-3 Mechanics of Machines (3:2, 2) **Prerequisite: 8022203-3 Dynamics**

Kinematics of mechanisms, vector method of analysis of plane mechanisms. Static and dynamic analysis of machines, inertia forces, gyroscopic forces, Static and dynamic balancing, balancing machines. Dynamics and balancing of reciprocating engines. Flywheels. Kinematics and dynamics of cam mechanisms. Elements of mechanical vibrations.

8023102-3 Materials Science (3:2, 2) **Prerequisite: 204102-3 General Chemistry**

Engineering materials (types & properties). Crystal structure of metals. Principles of solidification. Binary phase diagrams. Iron-Iron carbide phase diagram. Phase transformations. Heat treatment processes. Engineering alloys and their properties. Corrosion of metals. Introduction to nano materials.

8023201-3 Mechanics of Materials (3:2, 2) **Prerequisite: 8023102-3 Materials Science**
202810257-4 Differential Equations

Introduction to mechanics of materials. Types of stresses. Stress-strain analysis. mechanical properties of materials. Axial loading, torsion, bending, transverse shear, combined loading, and statistically indeterminate structures. Stress and strain transformation. Failure theories. Deflection of beams. Buckling of columns. Energy method, stress-strain relation of Nano-materials.

8023202-3 Mechanical Vibrations (3:2, 2) **Prerequisite: 8022203-3 Dynamics**
202810257-4 Differential Equations

Fundamentals of vibration. Controls and optimization. Analysis and design in time, Laplace and frequency domains. Mathematical description of system response, stability analysis.

8023203-1 Mechanical Engineering Lab 1 (1:0, 3) **Prerequisite: 8023102-3 Materials Science**
8022205-3 Thermodynamics

Different Experimental labs are carried out during this course.

8023204-3 Fluid Mechanics (3:2, 2) **Prerequisite: 203205-4 Physics**

Fluid properties. Fluid statics. Fluid kinematics. Continuity equation. Momentum equations for fluids. Bernolli's equation. Laminar and turbulent flows. Steady flow in pipes. Dimensional analysis.

8024101-3 Manufacturing Processes (3:2, 2) **Prerequisite: 8022201-2 Production Technology**
8023101-3 Materials Science

Machining processes: geometry at single point tool of cutting speeds and feeds, machining time and power consumed, tool materials, applications to Turing, Milling, grinding, honing and lapping. Cutting forces and cooling liquids for machining processes. metal forming processes (forging, extrusion, drawing, rolling, wire drawing). metal casting (principle of metal casting, die casting, special casting processes). Welding processes (Gas welding, Arc welding). Recycle of metal processes.

8024102-3 Heat Transfer (3:2, 2) **Prerequisite: 2023206-3 Numerical Analysis**
8022205-3 Thermodynamics

Introduction to modes of heat transfer; one-dimensional steady state conduction; Two-dimensional steady state conduction; unsteady state conduction, lumped heat capacity system; introduction to convection, Hydrodynamic and thermal boundary layers. Convection in internal and external flows; empirical correlations for forced convection heat transfer; natural convection systems; Introduction to thermal radiation. Introduction to heat exchangers.

8024103-3 System Dynamics and Control (3:2, 2) **Prerequisite: 8023202-3 Mechanical Vibrations**
8023101-3 Mechanics of Machines

Introduction to control systems analysis and design and related concepts. Systems representation: mathematical modeling of physical systems, linearization of nonlinear systems, Block diagram representation, transfer function. Introduction to stability analysis. Dominant poles of high order systems. Control systems design: Design and analysis using root locus. Analysis using frequency response technique. The use of control systems analysis and design software- MATLAB with facility to aid in the analysis.

8024104-3 Machine Elements Design (3:2, 2) **Prerequisite: 8022204-2 Mechanical Drawing**
8023201-3 Mechanics of materials

Introduction to machine element design (steps, consideration and manufacturing), Fits and tolerance, materials selection for design, Factors of safety, calculations and analysis of mechanical stresses on mechanical elements subjected to static and variable loads. Design of mechanical joints, Design of springs, Design of power screws.

8024201-3 Hydraulic Machines (3:2, 2) **Prerequisite: 8023204-3 Fluid Mechanics**

Classification of hydraulic machines. Positive displacement pumps. Centrifugal pumps. Axial pumps. Similarity and performance of hydraulic machines. Hydraulic system components. Introduction to hydraulic turbines. Impulse and Reaction turbines.

8024202-3 Refrigeration and Air Conditioning (3:2, 2) **Prerequisite: 8022205-3 Thermodynamics**

Air Refrigeration Cycles. Vapor compression cycles. Vapor compression refrigeration systems with multiple evaporators and compressors. Introduction to absorption refrigeration. Psychometrics and psychometric processes. Cooling load calculations. Air conditioning components and controls.

802421-3 Measurements and Measuring instruments (3:2, 2) **Prerequisite: 8023204-3 Fluid Mechanics**

Introduction to measurements in science and engineering. Standards and Calibration. Accuracy and precision. Sensitivity and magnification systems. Errors in measurement, Performance characteristics of instruments. Transducers, measurements of force, torque, strain, vibration, temperature, pressure, level and flow. geometric tolerances. Surface texture. Interferometry and laser applications. Inspection and limit gauging. Statistical treatment of experimental data. Regression analysis, signal conditioning, Data acquisition and processing.

8024204-1 Mechanical Engineering Lab 2 (1:0, 3) **Prerequisite: 8024102-3 Heat Transfer**
8024103-3 System Dynamics and Control

Different Experimental labs are carried out during this course.

8024205-3 Machine Design (3:2, 2) **Prerequisite: 8024104-3 Machine Elements Design**

Introduction to Power transmitted elements, Design of rotating shafts, design of keys, Pins and splines, design and analysis of belt drive (flat and v belt), ropes, chains. Rolling contact bearings, selection and mounting. Lubrication and journal bearings. Clutches, coupling and brakes. Gearing: Geometry and force analysis. Design of spur, helical, bevel and worm gears. Gear Box.

8024206-3 Systems of Renewable Energy (3:2, 2) **Prerequisite: 8024102-3 Heat Transfer**

This course provides a comprehensive overview of renewable energy systems, including solar energy, wind power, hydropower, fuel cells, and biomass. The course covers physical and technological principles and impact of energy on the economy and environment.

8025101-2 Senior Project (1) (2:2, 4) **Prerequisite: 8022202-2 Introduction to Engineering Design 2**
Department Approval

8025102-2 Engineering Management (2:2, 0) **Prerequisite: 2024116-3 Probability and Statistics**

The role of engineers in management of engineering organizations, technical control of supervision of these organizations including aspects related to production planning. Decisions Making. Inventory control, human resources control, and financial control. Planning and Forecasting. Project planning and control. Case studies from pertinent engineering problems.

8025103-3 Computer Aided Design (3:2, 2) **Prerequisite: 8024205-3 Machine Design**

Computer Aided design (CAD) environment, 2D and 3D Solid modeling, computer aided manufacturing, numerically controlled (CNC) machine tools, Multidisciplinary System design by computer, system stress analysis, Production system design Planning and control Production system assessment design, Case studies and Applications.

8025201-2 Senior Project (2) (2:2, 4) **Prerequisite: 8025101-2 Senior Project (1)**

8025202-3 Power Plants and Desalination (3:2, 2) **Prerequisite: 8012101-2 Fundamentals of Engineering Economy 8024102-3 Heat Transfer**

Combined power cycles. Geothermal power cycles. Components of power plant. Introduction to desalination, thermal and membrane desalination processes. Economics and environ802ntal impacts of power and desalination plants. Renewable energy coupled with desalination processes.

8025203-1 Mechanical Engineering Lab 3 (1:0, 3) **Prerequisite: 8024203-3 Measurements and Measuring Instruments 8024201-3 Hydraulic Machines**

Different Experimental labs are carried out during this course.

Elective Courses in Level 9

8025104-3 Fluid Dynamics (3:2, 2) **Prerequisite: 8023204-3 Fluid Mechanics**

Review of Mass conservation and Momentum conservation. Behavior of real fluids, incompressible flow around a body, Concepts of Boundary layer, Laminar-turbulent transition, Turbulent boundary layer flow.

8025105-3 Turbo Machinery (3:2, 2) **Prerequisite: 8023204-3 Fluid Mechanics**

Principles of fluid mechanics and thermochemistry of combustion related to turbo machines. Gas turbine cycles for shaft power. Gas turbine cycles for aircraft propulsion. Compressor principles and energy transfer. Turbine principles and energy transfer.

8025106-3 Applied Heat Transfer (3:2, 2) **Prerequisite: 8024102-3 Heat Transfer**

Review of heat transmission and fluid flow. Heat exchanger classifications. Thermal analysis and performance calculation of heat exchangers. Design of gas to gas heat exchanger, gas to liquid heat exchangers and liquid to liquid heat exchangers. Introduction to boiling and condensation process. Cooling tower and condenser analysis. Applications of heat exchangers.

8025107-3 Energy Conversion (3:2, 2) **Prerequisite: 8022205-3 Thermodynamics**

Introduction and basic background, terminology. Fundamentals of energy conversion. Energy conversion matrix. Current and emerging technologies for production of thermal. mechanical, and electrical energy conversion systems. Topics include fossil and nuclear fuels, solar energy, wind energy, fuel cells, and energy storage.

8025108-3 Plasticity (3:2, 2) **Prerequisite: 8023201-3 Mechanics of Materials**

Elastic deformation. Plastic deformation (slip). Twining. Factors affecting plasticity. Critical resolved shear stress. Plastic deformation in polycrystalline materials. Imperfections in crystal structure. Dislocation theory for plastic behavior of metals. Recrystallization. Strain hardening. Yield criteria. Relationship between tensile and shear yield stresses. Theories of plastic flow.

8025109-3 Tribology (3:2, 2) **Prerequisite: 8022204-2 Mechanical Drawing**

Introduction to tribology, Friction, Wear, Lubrication and Lubricants, Fluid film lubrication and Application of Tribology.

8025110-3 Composite Materials (3:2, 2) **Prerequisite: 8023201-3 Mechanics of Materials**

Classification, Applications, Processing and fabrication of composites (metal-matrix, ceramic-matrix, reinforced plastics, honeycomb materials, forming structural shapes), Design Considerations, Laminate structures. Stress-strain characteristics of fiber-reinforced materials. Lamination theory. Nano-Composites. mechanical properties of nano-composites. Failure theories of fiber-reinforced materials. Environmentally induced stresses in laminates.

8025111-3 Fracture in Engineering Materials (3:2, 2) **Prerequisite: 8023201-3 Mechanics of Materials**

Fracture mechanics and fatigue mechanisms: mechanisms of ductile and brittle fracture. Environmentally induced fracture and fatigue. Considerations in design of engineering materials and structures are covered.

8025112-3 Finite Elements Analysis (3:2, 2) **Prerequisite: 2023206-3 Numerical Analysis**

Introduction to finite element analysis, finite element methods for the analysis of solid mechanics, structural, linear and nonlinear analyses, static and dynamics analyses, fluid and heat transfer problems, using finite element analysis software package ANSYS. MEMS and NEMS simulation.

8025113-3 Nanomaterials and Nanotechnology (3:2, 2) **Prerequisite: 8023102-3 Materials Science**

Introduction (definitions, types of nano materials and nano composites, advantages of materials in nano scale). Processing of nano materials. Processing methods for nano composites. Characterization of nano materials and nano composites. Potential applications of nano materials and nano composites. mechanical behavior of nano composites.

8025114-3 Robotics (3:2, 2) **Prerequisite: 8023101-3 Mechanics of Machines**

Introduction to robotics: types and applications, kinematic configurations, forward and inverse kinematic and dynamic analysis. Lagrange formulation method. Path planning and motion programming. Robot control.

8025115-3 Engineering Analysis (3:2, 2) **Prerequisite: 2022101-3 Multi Variable Calculus 2028102-4 Differential Equations**

Properties of the real number system, properties of continuous functions, and sequences of functions. The precise definitions of notions (e.g. limits, continuity, differentiability, integrability).

8025116-3 Modeling and Simulation (3:2, 2) **Prerequisite: 8024103-3 System Dynamics and Control**

Mathematical modeling of physical systems- mechanical, electrical, fluid and thermal systems. Transmission systems, Automobile suspension systems- Numerical solution using Runge-Kutta methods- State-space representations of Dynamic system- Computer simulation with MATLAB software packages- Case studies**.**

8025117-3 Mechatronics System Design **Prerequisite: 8024103-3 System Dynamics and Control**

Introduction to mechatronics. Introduction to main subsystems of mechatronics system; selection criteria, evaluation, synergetic integration. mechatronics (Parallel) design methodology. Introduction to Embedded systems design. Using virtual design programs to test and evaluate subsystem and whole system designs. Case studies.

8025118-3 Industrial Process Control (3:2, 2) **Prerequisite: 8024103-3 System Dynamics and Control**

Revision of fundamentals associated with control theory, and related mathematical theories. Industrial process characteristics, identification, and parameters estimation. Main industrial Processes, Modeling, characteristics and instrumentations; flow, temperature, pressure, and level industrial processes. Industrial control systems: Industrial process control loops categories; main control algorithms design and tuning: On/Off, PID, SC, DCS. SCADA system. Data and interfaces. Types of human interface. Fundamentals associated with the use of control systems analysis and design software- MATLAB with facility to aid in the analysis, design and simulation of control systems/algorithms.

Elective Courses in Level 10

8025204-3 Internal Combustion Engines (3:2, 2) **Prerequisite: 8024102-3 Heat Transfer**

Fundamentals of engines and their types. Characteristics of engine operation and performance. Thermodynamics cycles of engines (ideal and actual). Thermo-chemical and fuels, Induction of air and fuel systems. Turbocharging and supercharging. Combustion and combustion systems in SI and CI engines. Air pollution. Heat transfer in engine.

8025205-3 Energy Efficiency (3:2, 2) **Prerequisite: 8024206-3 Systems of Renewable Energy**

This course provides students with an understanding of how to analyze, identify and improve energy efficiency opportunities in all areas of the energy supply sector. The course covers calculations related to energy conversion and energy auditing. Topics include life cycle cost analysis, economic payback and environmental benefits of energy efficiency. The course culminates with a case study.

8025206-3 Design of Pipe Networks (3:2, 2) **Prerequisite: 8024201-3 Hydraulic Machines**

Review of flow in pipe principles. Pipe network analysis. Design of Pipe Networks. methods for solving steady flow in pipe networks, Economic Network Design. Introduction to transient flow. Water hammer.

8025207-3 Renewable Energy Powered Desalination Processes (3:2, 2) **Prerequisite: 8024206-3 Systems of Renewable Energy**

A course provides a comprehensive overview of current desalination technologies and existing desalination technologies that are suitable for use with renewable energy. A course will provide in depth coverage of all types of solar thermal desalination technologies including: solar stills, membrane and indirect desalination methods. The criteria to be used for comparing solar desalination technologies are presented. Potentials of renewable energy powered desalination to help solve water scarcity, environmental and economic problems are investigated. A team-based student project will be assigned to design renewable energy powered a desalination plant.

8025208-3 Applied Renewable Energy Technologies (3:2, 2) **Prerequisite: 8024206-3 Systems of Renewable Energy**

A course covers the principles and utilization of renewable energy. The course covers practical applications, component design, and theory for systems. The possibility of combining renewable and non-renewable energy technologies in hybrid systems is analyzed. Economic, geographical and environmental considerations are discussed. Challenges for enhancing the future use of renewable energy resources are presented. The course culminates with a renewable energy design project.

8025209-3 Reverse Engineering (3:2, 2) **Prerequisite: 8024205-3 Machines Design**

Effect of reversing engineering in 802chanical design, Reversing engineering techniques, 3D contact and non-contact scanning Pattern recognition steps, Deriving standard and free surfaces equations Recognition of other design characteristics, Rapid Prototyping techniques, Pattern transfer to CAD/CAM systems, Software equipment for reverse engineering.

8025210-3 Material Handling Systems (3:2, 2) **Prerequisite: 8024205-3 Machines Design**

Introduction to materials handling- unit load concept- industrial vehicles/trucks- conveyors Analysis and design - hoisting equipment- bulk handling equipment and systems- robotic handling- auxiliary equipment- organization, maintenance and safety.

8025211-3 Operations Research (3:2, 2) **Prerequisite: 8024101-3 Manufacturing Processes**

Mathematical modeling and operations research. Linear programming. Simplex algorithm. Duality. Transportation and assignment problems. Network models.

8025212-3 Design Optimization (3:2, 2) **Prerequisite: 8024205-3 Machines Design**

Principles of optimum design in mechanical components, systems modeling and optimization, Desirable and undesirable factors in design, objective Functions, constraints, penalty functions, formalized optimization problem statements, Techniques for solving single variable optimization problems, Techniques for solving constrained and unconstrained multi-variable problems, Modeling engineering design problems for optimization, linear and non-linear constrained optimization formulations, multidisciplinary design optimization (MDO) for systems, optimality criteria methods, Computer implementation of optimization schemes with applications Applied examples and case studies.

8025213-3 Advanced Manufacturing Technology (3:2, 2) **Prerequisite: 8024101-3 Manufacturing Processes**

Non-conventional machining: Principles, Ultrasonic machining, Electromechanical Machining, Electro-discharge Machining, Plasma Arc Machining, Laser Beam Machining, Electron Beam Machining. Numerical Control of Machine Tools: Automation of Manufacturing Processes, Types and components of CNC machines, Programming of CNC machines.

8025214-3 Recycling of Industrial Wastes (3:2, 2) **Prerequisite: 8023102-3 Materials Science 8024101-3 Manufacturing Processes**

Importance of recycling. Environ802ntal effect of wastes. Classification and properties of wastes. Sources of solid wastes (types & amounts). Industrial solid wastes. Planning for recycling of solid wastes. Management of wastes: methods of dealing with wastes, methods to disposal of wastes, methods to recycling and reuse wastes. Wastes hazardous management. Recycling Technology. Case studies (plastics, cans, rubber…etc.)

8025215-3 Industrial Automation (3:2, 2) **Prerequisite: 8024103-3 System Dynamics and Control**

Introduction to industrial automation. Overview of: manufacturing operations, industrial control systems; industrial Hardware components; sensors, actuators, ADC, DAC. Basic principles and strategies of automation; Basic elements of an automated system. Automation and Control: Logic control systems, PLC, NC, Microcontrollers. Robotics and Automated Manufacturing Systems; Industrial robotics, Flexible manufacturing systems, Computer Integrated Manufacturing.

8025216-3 Programmable Logic Controllers (3:2, 2) **Prerequisite: 8025118-3 Industrial Process Control**

Introduction to industrial automation; types, classification, components, interrelation, and related concepts for each of industry, manufacturing, production, automation systems. Review of logic, Boolean algebra and programming/program designing. Introduction to Programmable Logic Controllers (PLC) and related concepts: history, classification, working principles, selection criteria. Input/output devices: analog and digital inputs, Sensors, Actuators, Interfaces. PLC Programming; Testing and debugging; Input/output processing, internal relays. Special functions. PLC practical industrial applications.

8025217-3 System Theory (3:2, 2) **Prerequisite: 8024103-3 System Dynamics and Control 8025115-3 Introduction to Real Analysis**

A rigorous introduction to the structure and analysis of linear dynamical systems with inputs and outputs, and the synthesis and design of controllers for such systems. Fundamental concepts of solutions, internal (state- space) and external (input-output map or transfer function) descriptions, controllability and observability, stability of zero solution, canonical forms, realization of state space models from external data, and feedback and its effect on spectral properties. Applications of these basic results to deterministic estimation of state (observer theory) and closed loop stabilization.