Plan of Study: Diploma in Mechanical Engineering

Year I		
Fall Semester		**17 Credits**
Code	**Course Title**	**Credit Hours**
CMPS 100B	Introduction to Technical Computing for the Sciences	3
ENGL 101	Basic Academic English I	3
MATH 199	Calculus I	3
PHYS 170	Fundamentals of Physics I	3
ENGR 105	Engineering Graphics	2
SOCS 102	Omani Society	3
Spring Semester		**16 Credits**
Code	**Course Title**	**Credit Hours**
MATH 120	Geometry and Trigonometry	3
EECE 130	Computers and Programming I	3
ENGR 110	Engineering Workshop	1
ENGL 102E	English for Engineering and science I	3
ENGR 100	Introduction to Engineering	3
MATH 200	Calculus II	3
ENTR 200	Entrepreneurship: Innovation and Creativity	3
Summer Semester		**9 Credits**
Code	**Course Title**	**Credit Hours**
ENGL 203E	English for Engineering and science II	3
MATH 205	Calculus III	3
ENTR 200	Entrepreneurship: Innovation and Creativity	3

Year II		
Fall Semester		**17 Credits**
Code	**Course Title**	**Credit Hours**
EECE 210	Electric Circuits I	3
EECE 210L	Electric Circuits Laboratory I	1
MECH 270	Properties of Materials	3
MECH 272	Mechanical Statics	3
MECH 271	Industrial Maintenance	3
MECH 278	Manufacturing Processes	3
MECH 270L	Solid Mechanics Laboratory	1
Spring Semester		**16 Credits**
Code	**Course Title**	**Credit Hours**
MECH 274	Mechanical Dynamics	3
MECH 274L	Mechanical Dynamics Laboratory	1
MECH 275	Thermodynamics	3
MECH 276	Strength of Materials	3
MECH 277	Fluid Mechanics	3
MECH 277L	Fluid Mechanics Laboratory	1
MECH 279	CAD/CAM and CNC Machines	2
Summer Semester		**0 Credits**
Code	**Course Title**	**0 Credit Hours**
MECH 299	Practical Training	0

Course Description

MECH 270 Properties of Materials (3 crs)

This course covers the different types of materials: metals, ceramics, polymers; type of bonds: Ionic, covalent and metallic bonds; unit cells and crystal structures, points, directions and planes within a unit cell; mechanical properties of materials: strength, toughness, ductility, resilience; failure: fatigue, creep. Thermal properties of materials: heat capacity, thermal expansion, thermal conductivity. Prerequisite: ENGR 100. Annually.

MECH 271 Industrial Maintenance (3 crs)

This course equips students with a variety of technical skill areas such as mechanical installation, power transmission, bearings, shaft alignment, lubrication, fluid power, piping systems, fasteners, and safety at the workplace. Prerequisites: ENGR 100, ENGR 110.

MECH 272 Mechanical Statics (3 crs)

This course covers the following topics: force vector, 2-D system of vectors, moment, couple, resultants, static equilibrium of 2-D forces and moments, centroid, truss, friction. Prerequisites: ENGR 100, PHYS 170, Co-requisite MATH 199.

MECH 274 Mechanical Dynamics (3 crs)

This course covers the following topics: position, velocity and acceleration of a particle, equations of motion for constant acceleration, Newton's Laws, mechanical work, energy and power, impulse, impact, coefficient of restitution, conservation of momentum, and spring stiffness. Prerequisites MECH 272, MATH 200. Annually.

MECH 275 Thermodynamics (3 crs)

This course covers the following topics: basic considerations of the three laws of thermodynamics, open and close systems, two phase systems, steam tables and charts, elementary statistical principles for the prediction of properties of pure substances and mixtures, system and control volume analysis of thermodynamic processes, irreversibility, Entropy, relations for ideal gas mixtures. Prerequisites: ENGR 100, MATH 200.

MECH 276 Strength of Materials (3 crs)

This course covers the different types of stress and strain induced by different types of loading: axial loading, torsion, pure bending: shear force and bending moment diagrams; stress concentration; analysis and design of beams in bending; shearing stresses in beams and thin-walled members; deflection of beams. Co-requisite: MECH 270 and Prerequisite: MECH 272.

MECH 277 Fluid Mechanics (3 crs)

This course covers the basic concepts of fluid mechanics: properties of fluids, pressure and fluid statics, hydrostatic forces, fluid kinematics, conservation of mass, conservation of energy, fluids in rigid body translational and rotational motions, Bernoulli's equation, and momentum analysis of flow systems. Prerequisites: MECH 272, MATH 200.

MECH 278 Manufacturing Processes (3 crs)

This course covers descriptive introduction to a wide variety of manufacturing processes: metal casting, powder metallurgy, sheet metal working, bulk deformation, fundamentals of machining, machining operation and machine tools. The course also covers dimensions, tolerance and surfaces, as well as a review of the classification of materials. Prerequisite: ENGR 100. Annually.

MECH 279 CAD/CAM and CNC Machines (3 crs)

This covers the principles, techniques, and applications of computer numerically controlled (CNC) machine tools. G and M code programming of industrial machines, tooling systems, introduction to Computer Aided Drafting and Manufacturing (CAD/CAM) systems, introduction to the principle of Flexible Manufacturing Systems (FMS), and hands-on training on CNC machine. Prerequisite: MECH 273. Annually.

MECH 299 Practical Training (0 crs)

Eight weeks of supervised project/internship aimed at providing practical experience for Mechanical Engineering diploma students. Prerequisite: Permission of the Instructor.

MECH 371 Heat Transfer (3 crs)

This course covers the mechanism and basic equations for conduction, convection and radiation, steady-state one dimensional conduction heat transfer, Cartesian and cylindrical coordinates, resistance concept for plane wall & radial systems, contact resistance, multi-layer plane walls and radial systems, extended surfaces, forced convection dimensional analysis, natural convection, internal flows in tubes, heat exchangers, LMTD and e-NTU methods of design. Prerequisites: MECH 275, MECH 277. Annually.

MECH 372 Control Systems (3 crs)

This course covers the basic concepts of control theory: plant, controller, process, open-loop, feed-back control; Laplace transform; mathematical modeling of dynamic systems; state-space; Linearization; transient and steady-state responses; stability; frequency-response analysis: bode diagram, Nyquist plots; lab may include software application (e.g. MATLAB or LabVIEW) and/or hardware equipment (inverted pendulum, level, pressure, temperature, motor speed control, etc.). Prerequisite: MATH 210. Annually.

MECH 373 Mechanical Design I (3 crs)

This course covers a review of stress, strain, and deflection; combined loading; Mohr's circles, principal stresses and maximum shear stress; static failure theories; fatigue failure theories; surface failure; design of different mechanical components: shafts, keys, couplings; columns; bearings and lubrication; introduction to finite element analysis (FEA). Prerequisite: MECH 276. Annually.

MECH 374 Instrumentation & Measurements (3 crs) This course covers the whole spectrum of measurement and instrumentation concepts: sensor classification, calibration and characteristics; measurement chain and interfacing concepts; data acquisition, manipulation, transmission, and recording; measurement of various physical variables; computer application (e.g. LabVIEW); and practical team project. Prerequisites: EECE 210 and MATH 205.

MECH 376 Kinematics of Mechanical Systems (3 crs)

This course covers the following topics: kinematics fundamentals, Grashof condition, graphical linkage syntheses, position analysis, computer-aided mechanism design, velocity analysis using graphical and analytical methods, acceleration analysis using analytical and graphical methods, dynamic force analysis, balancing of rotating machineries. Prerequisite: MECH 274. Annually.

MECH 400 Practical Training (0 crs)

Supervised project/internship aimed at providing practical experience for Mechanical Engineering bachelor students. Prerequisite: Permission of the Instructor.

MECH 401 Final Year Project I (0 crs)

A supervised project, normally in groups of three students, aimed at providing a practical experience in some aspects of mechanical engineering. Students are expected to complete a literature survey, project specification, critical analysis, and to acquire the necessary material needed for their intended end product.

MECH 402 Final Year Project II (3 crs)

A course in which the students integrate their acquired knowledge and skills to deliver the product researched and planned in MECH 401. Prerequisite: MECH 401.

MECH 413 Air Conditioning (3 crs)

This course covers the following: review of basic concepts and fundamentals of thermodynamics, psychrometry, human comfort, heat transfer in residential building, heating load calculations, cooling load calculations, required air quantities for cooling or heating. Prerequisite: MECH 275. Annually.

MECH 431 Mechanical Vibrations (3 crs)

This course covers the response of discrete single, two- and multi-degree of freedom systems to vibration, free and forced vibration, response of damped and undamped systems to vibration, damping cases: underdamped, critically damped and overdamped systems, Lagrange's equation, base excitation, rotating imbalance, vibration Isolation, and introduction to human responses to vibration. Prerequisite: MECH 274, Co-requisite MATH 210. Annually.

MECH 314 Fluid Power (3 crs)

This course covers the following topics: fundamental concept of fluid power transmission, properties of conventional fluid, control valves, positive and non positive displacement pumps, compressors, motors, cylinders, electro-hydraulic and pneumatic valves, graphical symbols, circuit and systems, compressible fluid properties, and applications of fluid power. Prerequisite: MECH 277.

MECH 410 PLC and Industrial Automation (3 crs)

This course covers PLC operation, PLC memory, ladder logic; structured logic, flowchart-based, and state-based design, instruction list and structured text programming, Interface of sensors, actuators, and I/O devices, selecting PLC, projects. Prerequisite: MECH 374.

MECH 412 Internal Combustion Engines (3 crs)

This course covers the fundamental principles underlying the theory and analysis of reciprocating internal combustion engines, fuels, carburetion, combustion, exhaust emissions, detonation, fuel injection, and factors affecting performance. Prerequisite: MECH 275.

MECH 414 Gas Turbines (3 crs)

This course covers the thermodynamic and aerodynamic theory that forms the basis of gas turbine design: shaft power cycles; gas turbine cycles; turbofan and turbojet engines; design and analysis of centrifugal and axial flow compressors and turbines. Prerequisites: MECH 275 and MECH 277.

MECH 415 Steam Turbines (3 crs)

This course covers the following topics: impulse and reaction steam turbines, steam turbine cycles, flow of steam in nozzles, design aspects of turbines, stage losses and efficiency, velocity diagrams; impulse and reaction blading velocities; nucleation, condensation and two-phase phenomena in flowing steam. Prerequisites: MECH 275 and MECH 277.

MECH 416 Fluids Engineering Application (3 crs)

This course covers the following topics: potential flow and boundary layer analysis; lift and drag; flow separation; viscous internal channel flow and lubrication theory; compressible flow in nozzles and ducts; normal shock waves and channel flow with friction or heat transfer; fluid machinery including pumps and hydraulic turbines. Prerequisite: MECH 277.

MECH 417 Thermal Power Plant (3 crs)

This course covers the fundamental principles, theory, design and operation of thermal power plants. It also covers available technologies behind the existing thermal power plants and the up-to-date technologies available for future plants. Topics covered include: thermodynamic power cycles, energy conversion, boilers and furnaces, energy economy and analysis and sustainable power generation. Prerequisites: MECH 275 and MECH 277.

MECH 430 Mechatronics and Intelligent Machines Engineering (3 crs)

This course covers the following topics: electromechanical systems and mechatronics; data; numbering systems, microcontroller, assembly language programming, A/D and D/A conversion; parallel I/O, programmable timer operation, interfacing sensors and actuators, applications; design project and implementation of a mechatronics system. Prerequisite: MECH 374.

MECH 441 Mechanical Design II (3 crs)

This course covers the design and selection of mechanical elements including gears, (spur, helical, bevel, and worm gears), springs, screws and fasteners, clutches and brakes, belts and chain drive. The course also includes practical sessions and team project. Prerequisite: MECH 373.

MECH 444 Environmental Impacts of Energy Systems (3 crs)

This course talks about world energy resources and classifications. It covers sources and effects of air pollution, air quality modeling, Gaussian dispersion models, motor vehicles emissions and noise pollution, mitigation strategies, environmental impacts of electricity generation, pollution control systems, electromagnetic radiations. Prerequisite: ENGR 100.

MECH 450 Computer Applications in Mechanical Engineering (3 crs)

This course teaches students how to use computer software to solve problems from various topics of mechanical engineering; topics may include but not restricted to stress analysis, vibration, heat transfer, and fluid flow. Computer applications may include but not restricted to the use of finite element method software, MATLAB and CFD. Prerequisite: EECE 130, and one of the following: MECH 277, MECH 371, MECH 373, MECH 431.

MECH 453 Robotics (3 crs)
This course covers the following topics: introduction to robotics, coordinate systems, robot arms, end effectors, sensors, application of sensors in robots, programming of robots, safety considerations. Prerequisite: MECH 374.

MECH 454 Artificial Intelligence (3 crs)
This course covers the following topics: introduction to artificial intelligence (AI), knowledge perception, predicate logic, machine learning, decision tree learning, two and multiple layers artificial neural networks (ANN) , logic programming, genetic algorithms, genetic programming. Prerequisites: EECE 130 and MATH 335.

MECH 455 Hydraulics (3 crs)
This course covers the fundamental and operating principles of hydraulics and pumps/turbines: applied principles and practical features of hydraulics and pumps/turbines, internal flow in conduits, turbo-machinery, classifications of pumps, Classifications of hydraulic turbines. Prerequisite MECH 277.

MECH 490 Renewable Energy (3 crs)
This course covers the whole spectrum of renewable energy: wind, solar, tidal, biomass, etc. The course also covers hybrid system as well as nuclear energy and its role in the 21st century (and beyond) and how it fits in with other forms of "renewable energy". Prerequisite: MECH 275.

MECH 499 Special Topics in Mechanical Engineering (3 crs)
This independent course will cover a particular topic, varying from semester to semester, in which there is a particular student or staff interest. Prerequisite: Permission of the Instructor and approval of the Department.

MECH 270L Solid Mechanics Laboratory (1 crs)
This laboratory covers different experiments related to properties of materials; experiments include Hooke's law, tensile test, bending test, creep test, hardness test, impact test, torsion test, and fatigue test. Co-requisite: MECH 270.

MECH 274L Mechanical Dynamics Laboratory (1 crs)
This laboratory covers the following experiments: falling objects, projectile motion, acceleration and force, Newton's third law, tension, conservation of momentum, conservation of energy: free fall, pendulum, spring, roller coaster; oscillation; rotational inertia. Prerequisite: MECH 274.

MECH 277L Fluid Mechanics Laboratory (1 crs)
This laboratory covers different experiments that may include: measurement of flow rate, Bernoulli's theorem, center of pressure, floatation characteristics, centrifugal pumps, cavitation in centrifugal pumps, characteristics of two pumps in series, pipe friction losses, friction in bends and fittings, momentum of flow, Pelton turbine, hydraulic Ram Pump, free and forced vortices. Co-requisite: MECH 277.

MECH 315L Thermal Laboratory (1 crs)
This laboratory is meant to compliment the thermodynamics and heat transfer courses. Experiments include: linear heat conduction, radial heat conduction, combined convection and radiation, extended surface heat transfer, heat exchangers, saturation pressure, expansion processes of a perfect gas, steam power plant cycle. Co-requisite: MECH 371.

MECH 413L HVAC and Refrigeration Laboratory (1 crs)
This laboratory covers the following experiments: different air conditioning processes, sensible heating, sensible cooling, humidification, heating and humidification, cooling and dehumidification. It also covers experiments on the refrigeration cycle, cooling towers and small and ducted split systems. Prerequisite: MECH 413.

MECH 444L Fuel Cell Laboratory (1 crs)
This laboratory covers the following experiments: the basic functions of the fuel cell system, the characteristic curve

of a fuel cell, parameters influencing the characteristic curve, determination of the hydrogen current curve, efficiency of the fuel cell stack, set-up of a fuel cell power supply, efficiency of a fuel cell power supply, characteristic curves of the solar panel, solar power-fuel cell hybrid, parallel and series switching of fuel cells, and examples of fuel cell applications. Prerequisite: ENGR 100.