DEPARTMENT OF MECHANICAL ENGINEERING

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Mission

The Mechanical Engineering Department is devoted to educating exemplary mechanical engineers by instituting best learning practices that drive knowledge, build skills and competencies, inspire learners to define a purpose, develop a passion to forever learn, cultivate a sense of responsibility toward the profession, society and environment, and attain the ability to confront challenges, and in so doing contribute to the advancement of the community.

Objectives

The educational objectives of the ME program are determined to support career advancement of the graduates and as they pursue their career goals, the graduates will:

1. be competent to handle complex engineering tasks and provide innovative solutions through the integration of best practices,
2. be recognized for their ability to pursue graduate studies in mechanical engineering and related interdisciplinary areas,
3. demonstrate leadership in their fields of expertise and service to local and international communities.

Learning Outcomes

Upon completion of the program graduates shall be able to:

a. an ability to apply knowledge of mathematics, science, and engineering,
b. an ability to design and conduct experiments, as well as to analyze and interpret data,
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability,
d. an ability to function on multidisciplinary teams,
e. an ability to identify, formulate, and solve engineering problems,
f. an understanding of professional and ethical responsibility,
g. an ability to communicate effectively,
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context,
i. a recognition of the need for, and an ability to engage in life-long learning,
j. a knowledge of contemporary issues,
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Degree Requirements

The undergraduate curriculum for the degree of Bachelor of Engineering in Mechanical Engineering consists of 150 credit-hours of course work in addition to ICDL, where the standard duration of study is 4 years including two summer terms.

Career Opportunities

Mechanical engineers attain a broad spectrum of skills sought by almost every profession. Industries, enterprises, and service providers requiring mechanical engineering skills include: power generation and distribution, building and construction, medicine and pharmacology, aerospace, automotive, food, process, security, computers and electronics, renewable energy, consulting, entertainment, water resources, sports, environmental institutions, and government. Most importantly, you can imagine something that never was and make it a reality! There is so much work to be done to guarantee the future of mankind and mechanical engineers can tap the possibilities through the spirit of innovation and entrepreneurism.

Program Overview
The student's study plan is given to every ME student upon his/her enrollment. The ME curriculum consists of the following components:

I. Common Requirements	**Credits**
General Education Requirements	20
Basic Sciences and Mathematics	26
General Engineering topics	15
II. ME Program-Specific Requirements	**Credits**
A. Engineering topics from outside the major	11
B. Mechanical Engineering Core	61
C. Mechanical Engineering Technical Electives	12
D. Final Year Project	4
E. Internship	1

I. Common Requirements

The list of the Common Requirement courses and their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalog.

II. General Engineering

The general engineering component includes 15 credits distributed as follows:

Course	Title	Credits	Prerequisite
COMP 208	Programming I	3	-
CVLE 210	Statics	3	-
INME 221	Engineering Economy	3	-
MCHE 201	Engineering Drawings and Graphics	3	-
MCHE 213	Dynamics	3	-

These two general engineering courses offered by the ME department are described below.

MCHE 201 ENGINEERING DRAWING AND GRAPHICS (3Crs.: 1Lec,4Lab): Constructional Geometry-constructing tangents. Plane curves and polygons. Orthographic drawing and theory of sketching shapes and surface identification. Orthographic projection of views. Sectional views and conventions. Pictorial drawing. Applications of Auto-CAD software for 2D drawings.

MCHE 213 DYNAMICS (3Crs.:3Lec,0Lab): Kinematics of a particle. Kinetics of a particle and system of particles: Free-body diagram and concept of equilibrium, Newton's laws of motion, Work and energy principle, Linear impulse and momentum principle. Planar motion and kinematics of rigid bodies.

III. ME Program-Specific Requirements

A. Engineering topics from outside the major

This part of the ME curriculum includes 11-credit courses offered by other engineering programs. These courses are listed in the table below.

Course	Title	Credits	Pre-/Co-requisites
INME 211	Engineering Materials and Technology	3	Pre: PHYS 282
INME 212	Metal Shaping	3	Pre: INME 211
POWE 211	Electric Circuits (for Mechanical Engineering students)	3	Pre: PHYS 281
POWE 335	Electric Drives (for Mechanical Engineering students)	2	Pre: MCHE 214 Co: MCHE 416

Descriptions of this group of courses are given below.

INME 211 ENGINEERING MATERIALS AND TECHNOLOGY (3Crs.:2Lec,2Lab): Introduction to material and material properties, iron and steel. Structure of metals, principles of materials properties, theory of elasticity, metal alloys, strengthening by heat treatment, material selection for different engineering applications and micro structure of materials, ferrous materials, non-ferrous materials, polymers and composites. ***Pre-req.: PHYS 282.***

INME 212 METAL SHAPING (3Crs.:2Lec,2Lab): Fundamentals of casting and metal casting processes. Metal forming. Bulk and sheet metalworking. Material removal processes. ***Pre-req.: INME 211.***

POWE 211 ELECTRIC CIRCUITS (for Mechanical Engineering students) (3Crs.:3Lec,0Lab): Circuit variables. Ohm's law. Kirchhoff's laws. Series and parallel resistors. Voltage and current divider circuits. Delta-to-Wye transformation. Node-voltage method. Mesh-current method, Thevenin equivalent circuit. Operational amplifiers. Sinusoidal steady-state analysis and power computations. Balanced-three phase circuits. Active filter circuits. ***Pre-req.: PHYS 281.***

POWE 335 ELECTRIC DRIVES (for Mechanical Engineering students) (2Crs.:2Lec,0Lab): DC motors. DC motor drives. Single-phase and three-phase induction motors. Induction motor drives. Synchronous motors. Stepping motors. Universal motor. Switched-reluctance motors. ***Pre-req.: MCHE 214, Co-req: MCHE 416.***

B. Mechanical Engineering core courses

The Mechanical Engineering core courses are listed in the table below.

Course	Title	Credits	Pre-/Co-requisites
MCHE 214	Fundamentals of Mechatronics	2	Pre: POWE 211; Co: MCHE 214L
MCHE 214L	Fundamentals of Mechatronics Lab	1	Co: MCHE 214
MCHE 216	Dynamics of Machinery I	3	Pre: MCHE 213
MCHE 315	Instrumentation and Measurement	2	Pre: MATH 381, MCHE 214; Co: MCHE 315L
MCHE 315L	Instrumentation and Measurement Lab	1	Co: MCHE 315
MCHE 311	Mechanics of Materials	3	Pre: CVLE 210; Co: INME211
MCHE 312	Machine Design I	3	Pre: MCHE 201, MCHE 311
MCHE 317	Dynamics of Machinery II	3	Pre: MCHE 216
MCHE 321	Thermodynamics I	3	Pre: PHYS 282
MCHE 322	Thermodynamics II	3	Pre: MCHE 321
MCHE 331	Fluid Mechanics I	3	Pre: PHYS 282
MCHE 332	Fluid Mechanics II	3	Pre: MCHE 331
MCHE 411	Machine Design II	3	Pre: MCHE 312, MCHE 317
MCHE 418	Dynamic Systems	3	Pre: MATH 283, MCHE 317
MCHE 416	Mechatronics System Design	2	Pre: COMP 208, MCHE 315; Co: MCHE 416L, POWE 335
MCHE 416L	Mechatronics System Design Lab	1	Co: MCHE 416
MCHE 421	Heat Transfer	3	Pre: MATH 284, MCHE 321; Co: MCHE 429
MCHE 422	Refrigeration and Air Conditioning	3	Pre: MCHE 421
MCHE 429	Thermo-fluids Lab	2	Pre: MCHE 332; Co: MCHE 421
MCHE 500	Research Methodology	2	Pre: ENGL 300
MCHE 515	Control Systems	2	Pre: MCHE 418; Co: MCHE 515L
MCHE 515L	Control Systems Lab	1	Co: MCHE 515
MCHE 521	Thermal Power Stations	3	Pre: MCHE 322
MCHE 531	Pump Technology	3	Pre: MCHE 332
MCHE 534	Fluid Thermal System Design	3	Pre: MCHE 531

MCHE 214 FUNDAMENTALS OF MECHATRONICS (2Crs.:2Lec,0Lab): Introduction to mechatronic systems. Basic electronic components. Overview of analogue and digital electronic circuits. Semiconductors and the PN Junction. Diode circuits and applications. Rectification – half- and full-wave. Bipolar junction transistors. IGBT and MOSFET operation and circuits. Motor drives. Operational amplifiers. Applications. ***Pre-req.: POWE 211; Co-req.: MCHE214L***.

MCHE 214L FUNDAMENTALS OF MECHATRONICS LAB (1Cr.:0Lec,2Lab): Passive electronic components. Laboratory instruments. Voltage-divider and bridge circuits. RC filters and lead-lag networks. LEDs. Zener regulator. Diode rectifier circuits. BJT, IGBT, and MOSFET applications. Op-amp circuits. Filters and oscillators. ***Co-req.: MCHE 214.***

MCHE 216-DYNAMICS OF MACHINERY I (3Crs.:3Lec,0Lab): Principles of motion generation and introduction to the concepts of mobility, degrees of freedom and kinematic chains. Kinematics analysis of linkage mechanisms. Types and synthesis of cam-follower mechanisms for specified follower motion. Synthesis of linkage mechanisms for motion, path and function generation. ***Pre-req.: MCHE 213.***

MCHE 315 INSTRUMENTATION AND MEASUREMENT (2Cr.:2Lec,0Lab): Elements of a measurement system. Classification of sensors. Sensor characteristics. Sensor types. Statistical analysis of data, curve fitting, and uncertainty analysis. Physical principles. Interfacing concepts - amplification, filtering, A/D conversion. Pre-req.: ***MATH 381 and MCHE 214, Co-req.: MCHE 315L.***

MCHE 315L INSTRUMENTATION AND MEASUREMENT LAB (1Cr.:0Lec,2Lab): Introduction to LABVIEW. Experiments to measure various physical quantities. Data acquisition and analysis using NI-ELVIS platform. Typical laboratory experiments involve building signal conditioning circuits for thermocouples, thermistors, photodiodes, strain gauges, accelerometers, etc. Team project to design and develop a measurement system***. Co-req.: MCHE 315.***

MCHE 311 MECHANICS OF MATERIALS (3Crs.:3Lec,0Lab): Introduction to the mechanics of deformable bodies considering linear material response. Load-stress, stress-strain, and strain-displacement relations. Tension/compression of rods and trusses, torsion of shafts, bending in beams, bucking of columns, and pressure vessels. Analysis of combined loading. Mohr circle analysis. Stress-strain transformations. Statically indeterminate structures. ***Pre-req.: CVLE 210; Co-req.: INME 211.***

MCHE 312 MACHINE DESIGN I (3Crs.:3Lec,0Lab): Overview of the mechanical design process. Analytical concepts and tools for the design of machine elements. Failure theories. Design for strength under static and fatigue loading. Design for rigidity. Design of shafts. Design of non-permanent joints and power screws. Design of permanent joints. Design of mechanical springs. ***Pre-req.: MCHE 201 and MCHE 311.***

MCHE 317 DYNAMICS OF MACHINERY II (3Crs.:3Lec,0Lab): Types of gears and gear tooth terminology for different types of gears. Force Analysis for spur gearing. Kinematic analysis of ordinary and planetary gear trains. Kinetostatic analysis of rigid mechanisms. Balancing of mechanisms and rotating machinery. Flywheel design. ***Pre-req.: MCHE 216.***

MCHE 321 THERMODYNAMICS I (3Crs.:3Lec,0Lab): Introduction and basic concepts. Properties of pure substances. Energy analysis of closed systems. Mass and energy analysis of control volumes. Second law of Thermodynamics. Heat engines and Carnot cycle. Refrigerators and heat pumps. Entropy. Gas power cycles and ideal cycles for reciprocating engines. Vapor refrigeration cycles. Introduction to psychrometry. ***Pre-req.: PHYS 282.***

MCHE 322 THERMODYNAMICS II (3Crs.:3Lec,0Lab): Rankine cycle. Reheat and regenerative steam power generation plants. Gas turbines and Brayton cycle including regeneration, inter-cooling, and reheat. Cogeneration and combined cycles. Thermodynamic analysis of power plants. Steam flow through nozzles. Steam flow through turbines, Classification of steam turbines, Forces exerted on different types of turbine blades. Research by topics. ***Pre-req.: MCHE 321.***

MCHE 331 FLUID MECHANICS I (3Crs.:3Lec,0Lab): Fluid static, Forces on immersed surfaces, buoyancy and stability of floating bodies, Fluid Flow kinematics, fluid masses subjected to acceleration, vortex motion, hydrodynamics, momentum equation, Euler's and Bernoulli's equations, fluid flow in pipelines***. Pre-req.: PHYS***

282.

MCHE 332 FLUID MECHANICS II (3Crs.:3Lec,0Lab): Fluid flow kinematics for three-dimensional fluid motions. Elementary hydrodynamics. Basic and combined flow field applications. Dynamics of compressible and incompressible flow. Continuity equation. Navier-Stokes equations, Dimensional analysis using PI-Theorem. Boundary layers. Lift and drag Forces. Fluid film lubrication. ***Pre-req.: MCHE 331.***

MCHE 411 MACHINE DESIGN II (3Crs.:3Lec,0Lab): Analysis and synthesis of various types of gear trains. Geometry and force analysis of helical, bevel and worm gears and gear trains. Design of gear drives for strength using AGMA standards for spur, helical, bevel and worm gearing. Rolling-contact bearings. Design of belt and chain drives. Design of clutches and brakes. Team project to formulate and design a mechanical system for a useful purpose. ***Pre-req.: MCHE 312 and MCHE 317.***

MCHE 418 DYNAMIC SYSTEMS (3Crs.:3Lec,0Lab): Introduction to dynamic modeling of mechanical, electrical, thermal and fluid systems. State-space equations. Analysis of linear systems. Time- and frequency-domain analysis. Laplace transform techniques. Nonlinear systems. Introduction to dynamic systems characteristics and performance. Simulation using Matlab and Simulink. ***Pre-req.: MATH 283 and MCHE 317.***

MCHE 416 MECHATRONICS SYSTEM DESIGN (2Crs.:2Lec,0Lab): Introduction to designing mechatronic systems and embedded technology platforms for real-time control. Microcontroller programming. A/D and D/A conversion. Hardware/software development tools. Programmable timers. Digital circuits and digital logic. ***Pre-req.: COMP 208 and MCHE 315, Co-req.: POWE 335 and MCHE 416L.***

MCHE 416L MECHATRONICS SYSTEM DESIGN LAB (1Cr.:0Lec,2Lab): Introduction to basic electronics, introduction to Arduino, serial connection, analog and digital I/O, motor speed control, data display. Team project to develop a mechatronic system. ***Co-req.: MCHE 416***

MCHE 421 HEAT TRANSFER (3Crs.:3Lec,0Lab): Concepts and laws of conduction, convection and radiation heat transfer and their application to solving engineering thermal problems. Steady and transient heat conduction. Heat generation. Extended surfaces. External and internal forced convection of laminar and turbulent flows. Natural convection. Introduction to Heat exchangers. Thermal radiation, view factors, and radiation exchange between gray bodies. Boiling and condensation. ***Pre-req.: MATH 284 and MCHE 321, Co-req: MCHE 429.***

MCHE 422 REFRIGERATION AND AIR CONDITIONING (3Crs.:3Lec,0Lab): Introduction to refrigeration methods: Air refrigeration, steam jet, thermoelectric, absorption, vapor compression system, psychometric processes and cycles, cooling and heating loads, duct design, air conditioning systems, noise criteria, fan selection**,** air outlet types and selection**.** ***Pre-req.: MCHE 421.***

MCHE 429 THERMO-FLUIDS LAB (2Crs.:0Lec,4Lab): Experiments relevant to thermodynamics, heat transfer, thermal processes, fluid systems and hydraulic machines. Measurement of thermal conductivity, convective heat transfer coefficients, and heat by radiation. Testing various heat exchangers. Control of thermo-fluid measured variables. Basic flow fields and combined flow. ***Pre-req.: MCHE 332; Co-req.: MCHE 421.***

MCHE 500 RESEARCH METHODOLOGY (2Crs.:2Lec, 0Lab): Steps for conducting a successful research: formulating a research problem, conceptualizing a research design, constructing an instrument for data collection, writing a research proposal, collecting data, processing & displaying data, writing a research report. ***Pre-req.: ENGL300.***

MCHE 515 Control Systems (2Crs.:2Lec,0Lab): Transfer function for various dynamic systems. Block reduction techniques. Performance of first-, second-, and higher-order systems. Steady-state error. Stability analysis and Routh-Hurwitz criterion. Root-locus techniques. Design of PID controllers. Dynamic compensators. Frequency response and Bode plots. ***Pre-req.: MCHE 418; Co-req.: MCHE 515L.***

MCHE 515L Control Systems Lab (1Cr.:0Lec,2Lab): Analysis of various control systems in Matlab and Simulink. Design of PID controllers using the control toolbox. Control experiments that includes: DC Motor and inverted pendulum. Team project. ***Co-req.: MCHE 515.***

MCHE 521 THERMAL POWER STATIONS (3Crs.:3Lec,0Lab): Steam power plants. Thermal analysis of steam generators. Water treatment for steam generators. Thermal analysis of condensers. Thermal analysis of cooling towers. Types of feedwater heaters and thermal analysis. Construction of steam turbines. Gas turbines and combined cycles. Overview of solar power plants. Overview of nuclear power plants. ***Pre-req.: MCHE 322.***

MCHE 531 PUMP TECHNOLOGY (3Crs.:3Lec,0Lab): Introduction to pumps. Pump classifications. Centrifugal pump construction. Pump performance curves, operating points, discharge regulation, similarity, speed variation, velocity triangle and cavitation. Pumps in series and parallel. Multi-stage pumps, axial flow pumps. Viscosity density and temperature effect on the pump performance. Effect of air entraining vortex from pump suction side. Priming of pumps.. Axial, radial and mixed flow pumps design. Forces acting on different rotating elements, gland packing seals and mechanical seals. ***Pre-req.: MCHE 332.***

MCHE 534 FLUID THERMAL SYSTEM DESIGN (3Crs.:3Lec,0Lab): Specifications of pumps. Design, operation selection, and maintenance of water pumps. Pump stations design. Specifications of fans, compressors, and blowers. Design, operation and fans selection for ventilation systems. Fire pump specifications and safety codes. Mechanical specification codes and standards. Application of thermo-fluid system design in water heating radiators system including boiler & heat exchanger. Chiller piping system applications. Pipe network systems. Team projects. ***Pre-req.: MCHE 531.***

C. Mechanical Engineering Technical Electives

The ME curriculum includes two 3-credit hour courses as technical electives. The courses are chosen from the courses listed in the table below with their descriptions given thereafter.

Course	Title	Credits	Pre-/Co-requisites
MCHE 461	Applied Robotics	3	Pre: MCHE 213 and either MCHE 315 or COMP 431
MCHE 512	Mechanical Vibrations	3	Pre: MCHE 418
MCHE 513	Finite Element Analysis – Theory and Applications	3	MCHE 312 or CVLE 312
MCHE 514	Programmable Logic Controllers	3	Pre: MCHE 315
MCHE 517	Design of Planar Mechanisms	3	Pre: MCHE 317
MCHE 518	Product Design and Development	3	Pre: MCHE 411
MCHE 523	Thermal Equipment Design	3	Pre: MCHE 421
MCHE 525	Renewable Energy Technologies	3	Pre: MCHE 321
MCHE 526	Energy Management	3	Pre: MCHE 321
MCHE 527	Gas Turbines Technology	3	Pre: MCHE 322
MCHE 530	Pipe-line Engineering	3	Pre: MCHE 332
MCHE 533	Hydraulic Machinery and Stations	3	Pre: MCHE 332
MCHE 535	Hydraulic Circuits	3	Pre: MCHE 331
MCHE 536	Hydraulic Equipment	3	Pre: MCHE 535
MCHE 537	Pneumatic Circuits and Applications	3	Pre: MCHE 331
MCHE 538	Compressed Air Technology	3	Pre: MCHE 331
MCHE 539	Gas Dynamics	3	Pre: MCHE 321 and MCHE 331
MCHE 561	Robotic Control and Intelligent Systems	3	Pre: MCHE 461
MCHE 562	Sensors and Actuators	3	Pre: MCHE 315
MCHE 563	Applied Engineering Optimization	3	Pre: MCHE 411
MCHE 564	Automotive Engineering	3	
MCHE 565	Technology Ventures	3	Pre: MGMT 002 and INME 221
MCHE 571	Refrigeration and HVAC Applications	3	Pre: MCHE 422
MCHE 572	Water Desalination Technologies	3	MCHE 421
MCHE 573	Operation and management of Thermal Power Stations	3	Pre: MCHE 521
MCHE 574	Acoustical Analysis of Mechanical Systems	3	Pre: MCHE 332 and MCHE 422
MCHE 581	Computational Fluid Dynamics	3	Pre: MCHE 332 and MCHE 421

Description of Technical Elective Courses

MCHE 461 APPLIED ROBOTICS (3Crs.:2Lec,2Lab): Robot architecture, subsystems, and applications; mechanisms and drives; forward and inverse kinematics; trajectory planning; dynamics and control; actuators and drive electronics; sensors and interface; mobile robots and navigation; intelligence; collaborative learning; team project. ***Pre-req.: MCHE 213 and either MCHE 315 or COMP 431.***

MCHE 512 ENGINEERING VIBRATIONS (3Crs.:3Lec,0Lab): Introduction to vibration and the free response, forced response of un-damped and damped systems, vibration isolation, vibration absorbers, multiple degree of freedom systems, vibration measurement, distributed parameter systems. ***Pre-req.: MCHE418.***

MCHE 513 FINITE ELEMENT ANALYSIS – THEORY AND APPLICATIONS (3Crs.:3Lec,0Lab): Introduction to the theoretical basis of finite element method and its application in solving engineering problems. Topics covered include: Overview of the finite element solution; basic finite elements; modeling considerations; static, modal and dynamic analysis of structures and mechanical systems; solution of field problems; commercial finite element software package. Project. ***Pre-req.: MCHE312 or CVLE 312.***

MCHE 514 PROGRAMMABLE LOGIC CONTROLLERS (3Crs.:2Lec,2Lab): 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; development of PLC-based systems; lab experiments. Projects. ***Pre-req.: MCHE 315.***

MCHE 517 DESIGN OF PLANAR MECHANISMS (3Crs.:3Lec,0Lab): Kinematics chains, creation of mechanisms, and mobility analysis, synthesis of single- and multi-loop mechanisms for various motion requirements, synthesis of multi-loop mechanisms, synthesis of geared-linkage mechanisms, Synthesis of mechanisms for instantaneous motion generation, Optimum synthesis of mechanisms. Computer-aided analysis and synthesis. Project. ***Pre-req.: MCHE 317.***

MCHE 518 PRODUCT DESIGN AND DEVELOPMENT (3Crs.:3Lec,0Lab): Modern tools and methods involving product design and development process. Product planning; Idea generation; concept generation; concept selection; functional analysis; engineering design process for systems and components; economic and environmental considerations; reliability analysis; product safety; Team project to transform idea into a product. ***Pre-req.: MCHE 411***.

MCHE 523 THERMAL EQUIPMENT DESIGN (3Crs.:3Lec,0Lab): Introduction to heat exchangers. LMTD method. ε-NTU method. Heat transfer and pressure drop correlations. Double-pipe heat exchangers. Shell-and-tube heat exchangers. Compact heat exchanger design (dry cooler, cooling and dehumidifying coil, indirect evaporative cooler). Direct contact heat exchangers. Computer applications. ***Pre-req.: MCHE 421.***

MCHE 525 RENEWABLE ENERGY TECHNOLOGIES (3Crs.:3Lec,0Lab): The course provides students with the fundamentals, design tools, and state-of-the-art alternative energy technologies. Emphasis is given to solar energy fundamentals, design and performance evaluation of solar collectors, passive and active applications of solar energy, thermal and electric energy storage. Other alternative energy technologies such as wind, hydro, geothermal, ocean thermal energy conversion are introduced. The economics of alternative energy and their potential in the Arab region is highlighted. ***Pre-req.: MCHE 321.***

MCHE 526 ENERGY MANAGEMENT (3Crs.:3Lec,0Lab): The course introduces the concepts and techniques of energy management and conservation based on the national statistics of energy supply and demand. Scope of the energy problems and approaches to provide solutions; energy auditing; improving energy utilization in space conditioning and steam, hot water and compressed air systems; energy savings opportunities in refrigeration and cooling systems; insulation; and electrical energy conservation are highlighted. ***Pre-req.: MCHE 321.***

MCHE 527 GAS TURBINES TECHNOLOGY (3Crs.:3Lec,0Lab): Gas turbine cycles for industrial applications. Gas turbine cycles for aircraft engines. Design of centrifugal and axial compressors. Design of radial and axial turbines. Types of combustors. ***Pre-req.: MCHE 322.***

MCHE 533 HYDRAULIC MACHINERY AND STATIONS (3Crs.:3Lec,0Lab): Hydraulic turbines, Pelton wheel, Francis, propeller and Kaplan turbines, construction, design factors, discharge regulation and part load performance, model testing, cavitations and turbine selection, hydropower plants, types, capacity, number of units, pump storage projects, hydro-power plants in Lebanon. ***Pre-req.: MCHE 332.***

MCHE 530 PIPE-LINE ENGINEERING (3Crs.:3Lec,0Lab): Pipes in parallel and series, three pipe reservoirs , Pipe Network single- and two- phase flow for incompressible flow in pipelines, Water Hammer, pipes, fittings, valves, accessories, standards, pipeline installation, operation, monitoring and maintenance. ***Pre-req.: MCHE 332.***

MCHE 535 HYDRAULIC CIRCUITS (3Crs.:2Lec,2Lab): Design of basic hydraulic circuits, elements of hydraulic circuits and design factors, Positive displacement oil pumps as sources of hydraulic power, oil reservoirs, pipes, control valves: pressure, direction and flow control, fluid power actuators: hydraulic cylinders, hydraulic motors, standard symbols according to ANSI Standard and graphical representation, basic hydraulic circuits and applications in practice. ***Pre-req.: MCHE 331.***

MCHE 536 HYDRAULIC EQUIPMENT (3Crs.:3Lec,0Lab): Hydraulic system design, design problems & analysis, applications: hydraulic presses, shearing machines, hydraulic cranes, hydraulic lifts, loaders, excavators, mixers, concrete pump, pile drilling machine, hydraulic equipment maintenance and troubleshooting. ***Pre-req.: MCHE 535.***

MCHE 537 PNEUMATIC CIRCUITS AND APPLICATIONS (3Crs.:3Lec,0Lab): Elements of pneumatic circuits and design factors, Compressed air characteristics, System components, Compressors, Air reservoirs, Actuators, Cylinders, Motors, Pneumatic system control, Standard symbols and graphical representation, Basic pneumatic circuits and applications in practice. ***Pre-req.: MCHE 331.***

MCHE 538 COMPRESSED AIR TECHNOLOGY (3Crs.:3Lec,0Lab): Compressed air system definition and its applications in industry, System components: Compressors, Air reservoirs, Pipes, Air treatment devices: dryers, filters. System leakage resources & Control. Maintenance and Troubleshooting***. Pre-req.: MCHE 331.***

MCHE 539 GAS DYNAMICS (3Crs.:3Lec,0Lab): One-dimensional steady motion with area change, flow in ducts with friction, flow with heating and cooling, normal and oblique shock waves, applications and analysis in aero jet engines and components. ***Pre-req.: MCHE 321 and MCHE 331.***

MCHE 561 ROBOTIC CONTROL AND INTELLIGENT SYSTEMS (3Crs.:3Lec,0Lab): Robotics and robot subsystems and architectures. Kinematics and workspace of serial and parallel-drive manipulators. Static force and torque analysis. Trajectory planning, dynamics and control. Metrics of robot performance. Walking machines and mobile robots. Intelligent systems. Computer-aided analysis. Project. ***Pre-req.: MCHE 461.***

MCHE 562 SENSORS AND ACTUATORS (3Crs.:3Lec,0Lab): Introduction to contemporary sensor and actuator technologies. Smart sensor and actuator materials (piezoelectric, shape memory alloys, electro-rheological, etc.). Application Specific Integrated Circuits (ASIC). Smart sensors and sensor fusion. Project. ***Pre-req.: MCHE 315.***

MCHE 563 APPLIED ENGINEERING OPTIMIZATION (3Crs.:3Lec,0Lab): Problem definition, objective functions and constraint; local vs. global optimization methods; deterministic vs. stochastic methods; linear and non-linear programming methods; gradient-based methods; combinatorial optimization techniques: Genetic algorithm, simulated annealing, tabu search, and ant colony; applications to various mechanical engineering problems; computer-aided solutions; project. ***Pre-req.: MCHE 411.***

MCHE 564 AUTOMOTIVE ENGINEERING (3Crs.:3Lec,0Lab): Engine parts. Fuel systems. Mechanical and electronic ignition systems. Engine performance. Automotive brakes. Suspension systems. Steering systems. Description of power transmission. Cooling and lubrication systems.

MCHE 565 TECHNOLOGY VENTURES (3Crs.:3Lec,0Lab): This course teaches students how to articulate a well-reasoned, easily understood business plan, understand the product realization process, set and achieve targets, prepare budgets, find capital by effectively communicating the idea to those who can finance it, hire the right mix of marketing and technical talent, know the market by engaging in real time market research, and focus on the customer; team project. ***Pre-req.: MGMT 002 and INME 221.***

MCHE 571 REFRIGERATION AND HVAC APPLICATIONS (3Crs.:2Lec,2Lab): Evaporator types and selection, condenser types and selection, compressor types and selection, expansion devices types and selection, refrigeration piping design, HVAC specifications codes and standards, air refrigeration system, absorption refrigeration system, multi-stage compression systems, water piping systems, air duct systems, cold store design. ***Pre-req.: MCHE 422.***

MCHE 572 WATER DESALINATION TECHNOLOGIES (3Lec,0Lab): This course surveys the state-of-the-art in water purification by desalination and filtration. Fundamentals and thermal analyses of desalination plants are introduced; existing desalination technologies including SSE, SSE-VCS, MEV, MSF, and RO systems; factors affecting the performance or the affordability of desalination technologies; economics, operation and maintenance; treatment of corrosion and scale deposits. ***Pre-req.: MCHE 421.***

MCHE 573 OPERATION AND MANAGEMENT OF THERMAL POWER STATIONS (3Crs.:3Lec,0Lab): Various systems and cycles used in producing electrical power. An overview on various types of plants operating on fossil fuels and nuclear energy. Emphasis is on gas turbine, steam turbine, combined cycle plants and traditional steam-generation plants burning fossil fuel such as natural gas or oil. Boiler room operation and management, water treatment, boiler devices and their control systems, boiler testing and maintenance, turbine governing systems types and operation, variable load management and power plants economics and power distribution systems. ***Pre-req.: MCHE 521.***

MCHE 574 ACOUSTICAL ANALYSIS OF MECHANICAL SYSTEMS (3Crs.:3Lec,0Lab): Fundamentals of acoustics and acoustic measurements. Community reaction to noise. Noise control within Buildings. Noise in ductwork systems. Computer software applications. ***Pre-req.: MCHE 332 and MCHE 422***

MCHE 581 COMPUTATIONAL FLUID DYNAMICS (3Crs.:3Lec,0Lab): Introduction to the methods and analysis techniques used in computational solutions of fluid mechanics and heat transfer problems; finite difference method; partial differential equations; discretization approaches; stability, consistency, and convergence; finite-volume formulations; explicit and implicit methods; code and solution verification; incompressible flows; validation and uncertainty quantification; simulation and design using commercial CFD code. ***Pre-req.: MCHE 332 and MCHE 421.***

D. Final Year Project

MCHE 501 FINAL YEAR PROJECT I (1Cr) / MCHE 502 FINAL YEAR PROJECT II (3Crs) After completing 114 credits of course work, the student becomes eligible to sign up for the Final Year Project (FYP) that extends over two semesters; beginning in Fall-semester and ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, and give a presentation on a significant, relevant, and comprehensive engineering problem. The FYP is intended to stimulate student innovation and critical thinking, and build skills in formulating, designing, developing, building, communicating, and managing engineering projects. The project aims to provide students with a transitional experience from the academic world to the professional world.
Refer to the Final Year Project Policy for more details.

E. Internship

MCHE 499 INTERNSHIP (1Cr): professional training which should not be less than four weeks. The training is followed by a presentation session where the students are supposed to present what they have learned.
Refer to the department policy for further details.

Study Plan
Bachelor of Engineering in Mechanical Engineering (150 Credits)

First Semester (16 Credits)		**Crs.**	**Pre/Co-requisites**
BLAW 001	Human Rights	1	
CHEM 241	Principles of Chemistry	3	Pre: CHEM 110
MATH 281	Linear Algebra	3	Pre: MATH 112
MCHE 201	Engineering Drawing and Graphics	3	
MCHE 213	Dynamics	3	
PHYS 282	Material Properties and Heat	3	

Second Semester (18 Credits)		**Crs.**	**Pre/Co-requisites**
COMP 208	Programming I	3	
CVLE 210	Statics	3	
INME 211	Engineering Materials and Technology	3	Pre: PHYS 282
MATH 282	Calculus	3	Pre: MATH 111
MCHE 216	Dynamics of Machinery I	3	Pre: MCHE 213
PHYS 281	Electricity and Magnetism	3	Pre: PHYS 112

Summer 1 (8 Credits)		**Crs.**	**Pre/Co-requisites**
ARAB 001	Arabic Language	2	
ENGL 001	General English	2	
	General Electives[1]	4	

Third Semester (18 Credits)		**Crs.**	**Pre/Co-requisites**
MATH 283	Differential Equations	3	Pre: MATH 281, MATH 282
MCHE 311	Mechanics of Materials	3	Pre: CVLE 210, Co: INME 211
MCHE 317	Dynamics of Machinery II	3	Pre: MCHE 216
MCHE 321	Thermodynamics I	3	Pre: PHYS 282
MCHE 331	Fluid Mechanics I	3	Pre: PHYS 282
POWE 211	Electric Circuits (for Mechanical Engineering students)	3	Pre: PHYS 281

Fourth Semester (18 Credits)		**Crs.**	**Pre/Co-requisites**
MATH 284	Numerical Analysis	3	Pre: MATH 283
MATH 381	Probability and Statistics	3	Pre: MATH 282
MCHE 214	Fundamentals of Mechatronics	2	Pre: POWE 211
MCHE 214L	Fundamentals of Mechatronics Lab	1	Co: MCHE 214
MCHE 312	Machine Design I	3	Pre: MCHE 311, MCHE 201
MCHE 322	Thermodynamics II	3	Pre: MCHE 321
MCHE 332	Fluid Mechanics II	3	Pre: MCHE 331

Summer 2 (8 Credits)		**Crs.**	**Pre/Co-requisites**
ENGL 211	Advanced Writing	2	Pre: ENGL 001
MGMT 002	Entrepreneurship I	2	
	General Electives[1]	4	

Fifth Semester (18 Credits)		Crs.	Pre/Co-requisites
ENGL 300	Speech Communications	2	Pre: ENGL 211
CHEM 405	Solid State Chemistry	2	Pre: CHEM 241
INME 221	Engineering Economy	3	
MCHE 315	Instrumentation and Measurement	2	Pre: MATH 381, MCHE 214, Co: MCHE 315L
MCHE 315L	Instrumentation and Measurement Lab	1	Co: MCHE 315
MCHE 411	Machine Design II	3	Pre: MCHE 312, MCHE 317
MCHE 421	Heat Transfer	3	Pre: MATH 284, MCHE 321, Co: MCHE 429
MCHE 429	Thermo-fluids Lab	2	Pre: MCHE 332, Co: MCHE 421

Sixth Semester (17 Credits)		Crs.	Pre/Co-requisites
INME 212	Metal Shaping	3	Pre: INME 211
MCHE 418	Dynamic Systems	3	Pre: MATH 283, MCHE 317
MCHE 416	Mechatronics System Design	2	Pre: COMP 208, MCHE 315, Co: MCHE 416L, POWE 335
MCHE 416L	Mechatronics System Design Lab	1	Co: MCHE 416
MCHE 422	Refrigeration and Air Conditioning	3	Pre: MCHE 421
POWE 335	Electric Drives (for Mechanical Engineering)	2	Pre: MCHE 214, Co: MCHE 416
	Technical Elective[2]	3	

Seventh Semester (16 Credits)		Crs.	Pre/Co-requisites
MCHE 499	Internship	1	
MCHE 500	Research Methodology	2	Pre: ENGL 300
MCHE 501	Final Year Project I	1	Pre: ENGL 211, Co: MCHE 500
MCHE 515	Control Systems	2	Pre: MCHE 418, Co: MCHE 515L
MCHE 515L	Control Systems Lab	1	Co: MCHE 515
MCHE 521	Thermal Power Stations	3	Pre: MCHE 322
MCHE 531	Pump Technology	3	Pre: MCHE 332
	Technical Elective[2]	3	

Eighth Semester (13 Credits)		Crs.	Pre/Co-requisites
ENGR 001	Engineering Ethics	1	
MCHE 502	Final Year Project II	3	Pre: MCHE 501
MCHE 534	Fluid Thermal System Design	3	Pre: MCHE 531
	Technical Electives[2]	6	

[1] selected form the list of university elective courses.
[2] selected form the list of Mechanical Engineering elective courses.

Courses offered for other majors

The Mechanical Engineering Department offers three courses for other engineering majors. These courses are described below.

MCHE 202 MECHANICAL ENGINEERING FOR BUILDINGS (3Crs.:3Lec,0Lab): Water supply for buildings; pumping systems; waste systems; sump pumps; heat losses and thermal insulation; ventilation and air conditioning; sound insulation; elevators and escalators, and fire fighting.

MCHE 301 HVAC AND SANITATION FOR ARCHITECTS (2Crs.:1Lec,2Lab): This course addresses two technical fields, HVAC and Sanitation. HVAC: Introduction to air conditioning and mechanical installations in buildings and indoor spaces, general consideration, various heating and cooling systems, ventilation and air conditioning of various types, Installations and control of systems. Sanitation: Sanitary engineering issues, dampness: Sources and methods of insulation, water supply treatment and distribution, sanitary fixtures, installation and connections, treatment of soiled water, rainwater drainage and storm sewers.

MCHE 407 THERMAL AND HYDRO POWER STATIONS (3Crs.:3Lec,0Lab): Thermal Power Stations: Introduction to power generation; modern power plant layouts; gas fired, combined cycle, nuclear, and renewable energy; thermodynamic principles including Carnot cycle, Rankine cycle, Brayton cycle, and combined cycles; combustion processes, steam generations and boiler systems; steam turbines systems; gas turbine systems, combined cycle power plants and cogeneration; condensers and cooling technologies. Fluid Mechanics and Hydraulics Applications: Introduction to fluid mechanics and application fields, fluid Properties; fluid statics: pressure measurements and forces on submerged surfaces; fluid flow kinematics: velocity, acceleration, flow field types and applications; fluid dynamics: mass and energy conservation, continuity, Bernoulli's equation, fluid flow measurements, flow through pipes; fluid mechanics and hydraulic applications: pumps, turbines and fluid system design (water supply and firefighting system).