Descriptions of ME/AME Courses

ME 201 Dynamics (3-0-3)
Kinematics of rectilinear and curvilinear motion of particles. Dynamics of particles and systems of particles. Kinematics of rotation and plane motion of rigid bodies. Work and energy relations. Impulse and momentum principles. Dynamics of rigid bodies in plane motion.
Prerequisites: CE 201, CE 202

ME 203 Thermodynamics I (3-0-3)
Control mass and control volume, properties of a pure substance and ideal gas, work and heat. First law of thermodynamics applied to closed and open systems, internal energy, enthalpy. Second law of thermodynamics, reversible and irreversible processes, Carnot cycle, entropy and entropy generation. Applications of steady state steady-flow, uniform-state uniform-flow, and other processes.
Prerequisites: MATH 102, PHYS 102

ME 204 Thermodynamics II (3-0-3)
Irreversibility and availability. Power and Refrigeration cycles: steam power cycles, air-standard power cycles, and refrigeration cycles. Gas-gas and gas water vapor mixtures. Psychrometrics. Thermodynamic relations: the Clapeyron equation, the Maxwell relations, and enthalpy and entropy departures. Chemical reactions: fuels and combustion processes.
Prerequisite: ME 203

ME 205 Materials Science (2-3-3)
Atomic bonding in solids, bonding forces and energies, primary and secondary bonds. The structure of crystalline solids, lattice, unit cell, and crystal systems, density computation, crystal directions and planes, linear and planar atomic densities. Impurities and imperfections in solids: point, linear and interfacial defects. Atomic movement and diffusion. Mechanical properties of metallic materials, elastic and plastic deformation. Strengthening mechanisms, recrystallization and grain growth. Phase diagrams of single phase and multiphase materials with emphasis on iron-iron carbide system. The basics of materials characterization and mechanical testing will be covered in the lab.
Prerequisites: CHEM 101, MATH 102

ME 207 Materials Science for CHE (2-0-2)
Atomic bonding in solids, bonding forces and energies, primary and secondary bonds. The structure of crystalline solids, lattice, unit cell, and crystal systems, density computation, crystal directions and planes, linear and planar atomic densities. Impurities and imperfections in solids: point, linear and interfacial defects. Atomic movement and diffusion. Mechanical properties of metallic materials, elastic and plastic deformation. Strengthening mechanisms, recrystallization and grain growth. Phase diagrams of single phase and multiphase materials with emphasis on iron-iron carbide system.
Prerequisites: CHEM 101, MATH 102

ME 210 Mechanical Engineering Drawing & Graphics (2-3-3)
Graphical interpretation of orthographic projection to include auxiliary views, section views, dimensioning, translation of design instructions into detail and assembly drawings, drawing conventions including weldments, piping, surface finish notation and selection of tolerances based on design requirements.

ME 216 Materials Science and Engineering (3-0-3)
Review of atomic bonding in solids. Metallic crystal structures (crystallographic points/directions, planes and density computation). Imperfections in solids. Mechanisms of diffusion (steady and non-steady state diffusion). Elastic and plastic deformation of metals. Design problems based on mechanical properties. Strengthening mechanism in metals. Design based on cold and hot working of metals. Binary phase diagrams and the Fe-C system. Basics of phase transformations with emphasis on phase transformations in Fe-C system. Applications of steels and cast irons. Composite Materials.
Prerequisites: CHEM 101, MATH 102
Corequisite : ME 217

ME 217 Materials Lab (0-3-1)
Materials characterization: metallography, microstructure analysis using optical microscopy and x-ray diffraction, scanning electron microscopy. Mechanical testing to measure materials properties: hardness, tensile, flexural, impact, torsion, fatigue, and creep. Phase diagrams, cold working, heat treatment of carbon steels.
Corequisite : ME 216

ME 218 Introduction to Mechanical Engineering Design (1-3-2)
Mechanical engineering design process. Open-ended problem solving. Teamwork. Team-based design projects. Estimation, modeling and basic science principles related to project. Manufacturing, assembly and testing. Communication skills in design, Ethical issues in design.
Prerequisites: PHYS 102, ME 210

ME 301 Machine Design I (3-0-3)
Design process, review of stress, strain and deformation analysis as applied to mechanical design; properties of materials; static failure theories; designing against fatigue failures; element design; shafts, keys, couplings, power screws; bolted, riveted and welded joints.
Prerequisites: CE 202, ME 218

ME 302 Machine Design II (3-0-3)
Machine element definition, the purpose of use, types, followed by kinematics (displacement, speed, and acceleration with trajectory if needed) and force analysis. Design of power and motion transmission elements spur, helical, bevel and worm gears; cams and followers; flexible drives (belts and chains); Design of power and motion control clutches and brakes, couplings, flywheels and mechanical springs; Elements for shaft support: bearings (journal and anti-friction). Elements for assembly and casing design: non-permanent and permanent joints i.e. rivets, screws, and welded joints.
Prerequisite: ME 301
Corequisite : ME 303

ME 303 Mechanical System Design Lab (0-3-1)
Design project based learning to include: Machine elements with kinematics (displacement, speed, and acceleration with trajectory if needed) and force analysis; Design of power and motion transmission elements spur, helical, bevel and worm gears; cams and followers; flexible drives (belts and chains); Design of power and motion control clutches and brakes, couplings, flywheels and mechanical springs; Elements for shaft support: bearings (journal and anti-friction); Elements for assembly and casing design: non-permanent and permanent joints i.e. rivets, screws, and welded joints. The design project considers stress analysis using FEM, cost analysis and the use of standards.

Corequisite : ME 302

ME 311 Fluid Mechanics (3-0-3)
Definition and properties of fluids. Fluid statics with applications. Basic fluid dynamic equations of continuity, energy and momentum with applications to different flow situations and flow measurement. Viscous effects, boundary-layer concepts, laminar and turbulent flow in pipes, open channel flow, fluid dynamics forces on immersed bodies. Modeling and dimensional similarity. Introduction to turbomachinery.
Prerequisites: MATH 201, ME 201, ME 203

ME 315 Heat Transfer (3-0-3)
Introduction to heat transfer by conduction, radiation and convection. Electric network analogy. Steady state solution for heat conduction in plane and radial walls, composite walls, walls with energy generating sections, and extended surfaces (fins). Introduction to multi-dimensional conduction. Unsteady heat transfer to plates, cylinders and spheres. Black- and gray-body radiation systems. Practical hydraulic and thermal analysis of convection with applications to heat exchangers.
Prerequisites: ME 204, ME 311

ME 316 Thermo-Fluids Lab (0-3-1)
Experimentation of the fundamental elements of theory and practice in fluid mechanics and heat transfer. Uncertainty analysis; flow measurements; pipelines and energy losses; hydraulic systems; temperature measurements; heat transfer by conduction, convection and radiation; heat exchanger design and performance evaluation.
Prerequisite: ME 311
Corequisite: ME 315

ME 322 Manufacturing Processes (3-0-3)
Manufacturing methods of metals and alloys including metal casting, welding, bulk forming, sheet metal forming, and machining processes. Both quantitative and qualitative study of manufacturing processes with emphasis on process selection for optimum design. Guidelines and best practices for ease of manufacturing. Design of simple casting molds, sheet metal blanking/punching dies and machining processes. 3D printing technologies and impact on rapid prototyping and manufacturing.
Prerequisites: CE 101 or ME 210, ME 216, ME 217

ME 323 Manufacturing Laboratory (0-3-1)
The laboratory experiments and demonstrations are focused on lab learning of various manufacturing processes related to metrology, material testing, machining including CNC and conventional machine tools, welding processes, die casting facilities, plastic processing, and sheet metal processing to demonstrate and give students a hands on experience of different manufacturing processes.
Corequisite: ME 322

ME 398 Internship (0-0-6)
A period of 16 weeks of industrial employment where Applied Mechanical Engineering students work in appropriate industries or firms. Students are evaluated on their performance on the job and are required to submit an extensive formal report on their experience in addition to making a presentation before an examining committee.
Prerequisites: BUS 200, ENGL 214, ME 301, ME 315

ME 399 Summer Training (0-0-0)
A continuous period of 8 weeks of summer training spent in the industry working in any of the fields of mechanical engineering. The training should be carried out in an organization with an interest in one or more of these fields. On completion of the program, the student is required to submit a formal written report of his work.
Prerequisites: BUS 200, ENGL 214, ME 204

ME 401 System Dynamics & Control (3-0-3)
Dynamics of mechanical, electrical, fluid and thermal systems. Transfer function and block diagram representations. Analysis and simulation of dynamic systems in the time and frequency domains. Design of basic controllers in the time and frequency domains. Stability of open- and closed-loop dynamic systems.
Prerequisites: EE 234, EE 235, MATH 202, ME 315
Corequisite: ME 402

ME 402 Measurements and Control Laboratory (0-3-1)
Design of experiments, sensors selection, wiring and calibration, uncertainty analysis, data acquisition, Introduction to LabVIEW software. Measurements of pressure, temperature and flow. Design and implementation of different control actions to electromechanical, fluid and thermal systems. Lab projects include measurements and control of mechanical or thermal systems.
Corequisite: ME 401

ME 408 Rapid Prototyping and Digital Manufacturing (2-3-3)
3D Printing technologies including SLA, SLS, SLM, LOM, and FDM, concept modeling, rapid prototyping and digital manufacturing technologies. Preparation, consideration factors, and analysis of rapid prototyping. Advantages and limitations of the various rapid prototyping technologies. Rapid tooling. Making informed rapid prototyping choices. Group projects to gain hands on experience in Rapid Prototyping and parts realization.
Prerequisites: ME 322, ME 323

ME 409 Design and Manufacturing of Composite Structures (3-0-3)
Basics in the design and manufacture of fiber-reinforced polymer composite structures, key aspects of composites design, various methods of composites manufacture, micromechanics, mechanical performance, durability, repair, recycling and applications of composites.
Prerequisites: ME 322, ME 323

ME 410 Introduction to Ceramics (3-0-3)
Atomic bonding, crystal structure, defects, physical properties, phase diagrams, and ceramic microstructure; Classification of ceramic materials including oxides, silicates, carbides, nitrides, glasses, cements, clays, refractories, and glass-ceramics; Ceramic synthesis and processing; Ceramic properties including mechanical, thermal, dielectric, magnetic, and optical.
Prerequisite: ME 205 or ME 207 or ME 216

ME 411 Senior Design Project I (1-0-1)
This is the first part of the capstone design course for ME program. Students form teams to design, and produce a prototype of a product or system of their own design. The design process includes formulation of the problem statement, establishment of objectives, technical literature, concept generation and consideration of alternative solutions, feasibility study, engineering design procedure and analyses, prototype fabrication and testing. The design should take into

consideration appropriate standards and constraints such as cost, safety, reliability, ethics and environmental and social impact. Submission of a preliminary technical report is required.
Prerequisites: BUS 200, ME 315
Corequisites: ME 302, ME 303

ME 412 Senior Design Project II (0-6-2)
This is the second part of the capstone design course for ME program. Continuation and completion of the project started in ME 411. An oral presentation and the submission of a final technical report of the design project are required.
Prerequisite: ME 411

ME 415 Senior Design Project (0-9-3)
This one-semester capstone design course is restricted for AME program. Students form teams to research, design, and produce a prototype of a product or system of their own design. The design process includes formulation of the problem statement, establishment of objectives, concept generation and consideration of alternative solutions, feasibility study, engineering design analyses, and prototype fabrication and testing. The design should take into consideration appropriate standard and constraints such as cost, safety, reliability, ethics and environmental and social impact.
Prerequisite: ME 398
Corequisites: ME 302, ME 303

ME 417 Mechanics of Machines (3-0-3)
Synthesis and graphical method of analysis of plane mechanisms: kinematics and kinetics of 2D mechanisms. Design of cam-follower mechanism. Static and dynamic balancing. Introduction to kinematics of basic industrial robots.
Prerequisite: ME 201

ME 418 Advanced Manufacturing and Design (2-3-3)
CNC machining, abrasive and non-traditional metal removal processes, powder metallurgy, and ceramics processing. Manufacturing with polymers. Design considerations in manufacturing. Rapid Prototyping and 3D Printing current applications and future trends. Design for manufacturability and economics of manufacturing, cycle times and cost analysis.
Prerequisites: ME 322, ME 323

ME 420 Materials Selection and Design (3-0-3)
Mechanical design process, materials properties and indices, product shape, multiple constraints, conflicting objectives, hybrid materials, impact of materials selection on the environment, extensive case studies.
Prerequisite: ME 205 or ME 207 or ME 216

ME 421 Automotive Design and Engineering (3-0-3)
Major systems and subsystems of a vehicle will be discussed. Engineering metrics and design requirements will be presented for major sub systems of a vehicle. Vehicle dynamics, aerodynamics, safety, fuel economy, and performance will be explained using real world examples and relevant engineering analysis. Automotive materials, manufacturing, and future trends in mobility will also be discussed.
Prerequisites: EE 234, ME 301, ME 322

ME 422 Propulsion Systems (3-0-3)
Aerothermodynamics of aerospace vehicle engines, combustion, thrust and efficiency. Gas turbine engines: turbojet, turbofan, turboprop; ramjet and scramjet, typical engine performance. Aerothermodynamics of inlets, combustors and nozzles. Introduction to propellers, turbo compressors and turbines. Introduction to rockets and performances of rocket vehicle engines. Chemical and electrical driven rocket engines.
Note: Not to be taken for credits with AE 422
Prerequisites: ME 204, ME 311

ME 423 Energy Conversion (3-0-3)
Energy sources and their classification. Conventional energy conversion; power plant and vapor cycles. Renewable energy; solar energy with emphasis on solar cells, wind energy, OTEC systems, geothermal energy. Nuclear fission and types of fission reactors.
Prerequisite: ME 315

ME 424 Maintenance Engineering (3-0-3)
Introduction to maintenance engineering; Condition monitoring of machines, plants & structures, various methods of condition monitoring: vibration acoustic emission, temperature, etc. and their practical applications. Interpreting the results of condition monitoring. Economics of Maintenance, Optimal maintenance strategies: Inspection intervals planning for maintenance crew, forecasting the spare parts and determining optimal stocking policy.
Corequisite: Junior Standing in ME or AME

ME 425 Compressible Fluid Flow (3-0-3)
Fundamentals of compressible fluid flow. Flow through frictional pipes, flow through ducts with heat transfer, normal shock waves, two-dimensional shock waves, and linearized flow.
Note: Not to be taken for credits with AE 325
Prerequisite: ME 311

ME 427 Turbomachinery (3-0-3)
Thermo-fluid dynamics aspects of fluid flow, kinematic relations and efficiencies of turbomachines. Two dimensional cascades; Turbine and Compressor cascade correlations and performance. Axial Turbines (two dimensional analysis), Axial Flow Compressors and Fans (two dimensional analysis), Centrifugal Compressors and Fans, Radial Flow Turbines, and preliminary design fundamentals of turbomachines and three dimensional considerations.
Prerequisites: ME 204, ME 311

ME 428 Structure of Flight Vehicles (3-0-3)
Statically determinate and indeterminate structures; aerodynamic and inertia loads, load factors; elasticity of structures, stress-strain relationships; mechanical properties of vehicle materials; fatigue; strength-weight comparisons of materials; sandwich constructions; stresses in beams, shear flow in thin webs, closed-section box beams; deflection analysis of structural systems; Castigliano's theorems, Rayleigh-Ritz method, finite difference method; redundancy in structures.
Note: Not to be taken for credits with AE 328
Prerequisites: CE 202, MATH 201

ME 429 Energy Efficiency and Auditing (3-0-3)
Overview on energies and energy auditing standard processes, understanding and analysis of energy bills, economic and life cycle costing analysis, fundamentals of electric systems, lighting,

electric motors and drives, Building Envelop (revisions of modes of heat transfer, Insulation and building codes), HVAC, boilers and steam distribution systems, compressed air systems, renewable energy systems and waste water management, human behavior and facility energy management.
Prerequisite: Senior Standing in ARE or in EE or in ME

ME 430 Air Conditioning (3-0-3)
Thermodynamics of moist air; construction of the psychrometric chart; psychrometric processes; psychrometric systems; industrial processes, air conditioning systems; Air Conditioning for comfort and health- Indoor air quality, cooling and heating load calculations, duct design and air distribution methods; cooling towers.
Prerequisite: ME 315 or CHE 300

ME 431 Refrigeration (3-0-3)
Mechanical vapor compression refrigeration cycles (single-stage and multi-stage); refrigerant compressors; refrigerants; absorption refrigeration systems; thermoelectric cooling; flash cooling; gas cycle refrigeration; ultra-low-temperature refrigeration (cryogenics); food refrigeration; transport refrigeration; Design and performance evaluation problems in refrigeration systems and applications.
Prerequisite: ME 315

ME 432 Internal Combustion Engines (3-0-3)
Engine anatomy, designs, classifications, and configurations. Combustion chemistry and energy analysis. Idealized cycles of internal combustion engines. Spark-ignition (SI) and compression-ignition (CI) engines. Low-temperature-combustion (LTC) and gasoline-compression-ignition (GCI) engines. Engine performance parameters. Engine knock. Fuel octane and cetane numbers. Super and turbocharging. Engine emissions and control.
Prerequisite: ME 204 or CHE 303

ME 433 Fundamentals of Combustion (3-0-3)
Combustion modes. Chemical thermodynamics and chemical kinetics. Conservation equations of reacting flows. Multi-species transport. Ignition, flammability, and extinction. Premixed and Non-premixed flames. Combustion instabilities. Turbulent combustion. Liquid and solid burning. Pollutant Emissions.
Prerequisite: ME 204

ME 434 Wind Engineering (3-0-3)
Basic Meteorological Aspects; Meteorological Measurements; Fundamentals of Wind Speed; Wind Power Resource Assessment; Introduction to Wind Speed Analysis, Power Generation; Wind Power Economics, and Mitigation of Green House Gases Tools; Wind Turbine Technology and Selection; Introduction to Wind-Diesel Hybrid Power System Design and Optimization.
Prerequisite: ME 311 or Equivalent

ME 435 Thermal Power Plants (2-3-3)
Forms of energy, oil, gas and coal. Combustion processes, energy cycles. Steam generators and their component design, turbines, load curves. Field trips to power plants and other energy installations during laboratory hours.
Prerequisite: ME 315

ME 436 Fluid Power Systems (3-0-3)
Study of fluid power systems as used in industrial applications to transmit power by the flow of hydraulic fluids. Fluid power circuit diagrams including components such as valves, pumps, motors, filters, reservoirs and accumulators. Analysis of fluid leakage, hydrostatic transmissions, hydraulic stiffness, and performance of positive displacement pumps and motors.
Prerequisite: ME 311

ME 437 Design and Rating of Heat Exchangers (3-0-3)
Heat transfer mechanism leading to basic heat exchanger equations; classification and analyses of heat exchangers including geometry; heat transfer and flow friction characteristics; compact and shell and tube heat exchanger application and design procedures; fouling and its effect on life cycle analysis; maintenance methodology; flow induced vibration and noise in heat exchangers.
Prerequisite: ME 315

ME 438 Pumping Machinery (3-0-3)
Terminology and description of typical pump machinery. Momentum and energy transfer between fluid and rotor; Performance characteristics of centrifugal and axial flow fans, compressors and pumps; Various types of losses; Axial and radial thrust in dynamic pumps and thrust balancing device; Common problems in centrifugal pump operation; Positive displacement pumps; Water hammer problems in pump systems; Special problems in pump design and applications.
Prerequisite: ME 311

ME 439 Solar Energy Conversion (3-0-3)
Thermal aspects of solar energy conversion. Solar radiation measurement and prediction. Selected topics in heat transfer. Flat plate and focusing collector analysis. Solar energy storage. Solar systems including hot water, space heating and cooling, distillation and thermal power conversion.
Prerequisite: ME 315 or CHE 300

ME 440 Convective Heat and Mass Transfer (3-0-3)
Boundary layers; laminar boundary layer heat transfer; turbulent boundary layer heat transfer; free convection boundary layers; enclosures; convection mass transfer; boiling and condensation; pool boiling; two-phase flow; laminar and turbulent film condensation.
Prerequisite: ME 315

ME 441 Energy and the Environment (3-0-3)
General introduction. Engineering and environment. Overview of environmental issues. Case studies in design for the environment. Automobiles and the environment. Batteries and the environment. Power plants and the environment. Refrigeration and the environment. Environmental life cycle assessments. Pollution control technologies and instrumentation. Thermodynamic assessment of environmental impacts. Case studies in mechanical engineering for environmental modeling. Smog control. CFCs and ozone layer. Acid rain. Global warming and climate change. Toxic metals. Environmental policy. Economic analysis. Environmental risk and decision.
Prerequisite: ME 203 or Equivalent

ME 442 Design of PV-Solar Systems (3-0-3)
Photovoltaic (PV) systems, solar radiation, site surveys and preplanning for photovoltaic systems, photovoltaic system components and configurations, cells, modules, and arrays for photovoltaic systems, batteries, charge controllers, and inverters, photovoltaic system sizing, photovoltaic systems mechanical integration, photovoltaic systems electrical integration, installation, commissioning, maintenance, and troubleshooting, photovoltaic systems economic analysis. PV Systems Design Software will be used throughout the course.
Prerequisites: EE 234, EE 235

ME 443 Mechanics of Robotic Manipulators (3-0-3)
Basic configurations of robots and their industrial applications, Kinematics of robotic manipulators; coordinate transformations and workspace calculations, Robotic forces, moments, torques and compliant motions, Introduction to robot motion dynamics and control.
Prerequisite: ME 301

ME 444 Introduction to Mechatronics (2-3-3)
A multidisciplinary course that introduces the design and realization of mechatronics; Electro-mechanical systems controlled by microcontroller technology; Instrumentation and measurement system analysis and design; sensors and actuators; computer data acquisition and control; The integration of mechanisms, materials, sensors, interfaces, actuators, microcontrollers, and information technology.
Prerequisites: EE 234, EE 235

ME 445 Principles of Nanostructure Materials & Sensor Technology (3-0-3)
Technological needs, justification and scope; Nanostructure materials and their properties; Top down and bottom up manufacturing techniques as typified by electrochemical and laser machining, chemical vapor deposition (CVD), Physical vapor deposition (PVD), Sputtering, Sol-gel synthesis and Ball milling; Industrial applications and future potential; Introduction to sensor basics; Primary sensor mechanisms, electrical measurement techniques, Characterization of sensors, Sensor fabrication principles; Enabling technologies; Applications in Saudi oil, gas, petrochemical industry and utilities.
Prerequisite: ME 205 or ME 207 or ME 216

ME 446 Computational Fluid Dynamics and Heat Transfer (3-0-3)
Introduction to computational fluid dynamics as an engineering tool for the analysis and design of thermal-fluid systems; Fundamental equations of fluid mechanics in differential and integral form and common approximations; Discretization and solution methods for incompressible flow; Application of numerical techniques to the solution of some practical fluid flow and heat transfer problem; Turbulence models and their implementation in CFD; Application of commercial CFD codes to illustrative fluid flow and heat transfer problems.
Prerequisite: ME 315

ME 447 Intelligent Energy Systems (3-0-3)
Overview of systems engineering concepts; fundamentals of energy systems; energy and the environment; instrumentation and control of energy systems; energy systems control fundamentals; energy systems control design. Development of intelligent control for energy systems, automation network protocols, distributed control systems, and smart grids. Application of multi-agent methods for energy monitoring and management, Internet of Things (IoT) to energy systems, big data analytics for energy systems, power over Ethernet (PoE) for energy systems.

Prerequisite: Senior Standing

ME 449 Introduction to Atomistic Simulation (3-0-3)
Classical and quantum mechanics techniques for atomistic simulations, Essentials of statistical thermodynamics and quantum mechanics concepts, Classical molecular dynamics, Density functional theory. Materials properties: Band structure, elastic constant, thermal conductivity, Phonons and vibrational spectroscopies, free-energy calculations, diffusion coefficients, viscosity, surface chemistry, Transition State Theory.
Prerequisite: Senior Standing

ME 453 Polymer Sustainability (3-0-3)
Concepts of polymer sustainability. Biodegradation of polymers and approaches toward synthesizing biodegradable polymers. Health impact of polymers and various additives used in plastics industry. Managing plastic waste, recycling of polymers, life-cycle assessment, and circular economy of polymers.
Prerequisite: Senior Standing

ME 455 Mechatronic Design (2-3-3)
Advanced mechatronic theories and computational methodologies in modeling and control of mechatronics systems. Artificial Intelligence and Machine Learning applications in Robotics. System stability, controllability, observability, minimal realizations and optimal/sub-optimal solution options. Mechatronic design for mass production/manufacturing.
Prerequisites: EE 234, EE 235

ME 456 Fundamentals of Nondestructive Evaluation (3-0-3)
Principles of ultrasonic and elastic wave propagation; Ultrasonic transducers, and instrumentation; Ultrasonic inspection techniques; Defects and material ultrasonic characterization; Introduction to acoustic emission AE techniques; AE data collection and analysis; Industrial applications of AE; Basic principles of magnetic particle inspection MPI; MPI techniques and equipment; Application of MPI; Fundamental Eddy current concepts; Eddy current instrumentation, and inspection principles; Techniques for liquid penetrant inspection, and applications; Fundamental theory of radiation; Equipment, and inspection techniques for radiation testing; Selected radiographic application; Radiation safety.
Prerequisite: Junior Standing

ME 457 Failure of Materials and Prevention (3-0-3)
Stiffness and strength limited designs; major modes of failure of engineering materials: fracture, fatigue, creep rupture, oxidation of high temperature alloys, corrosion, friction and wear; basics of non-destructive testing and inspection.
Prerequisite: ME 205 or ME 207 or ME 216

ME 458 Design of Thermo-Fluid Systems (3-0-3)
Application of thermodynamics, mechanical engineering design, fluid mechanics, and heat transfer in the design of thermo fluid systems. Introduction to system-oriented design methods. Thermo fluid system component analysis, selection and design. Component and system modeling, simulation, economics and optimization.
Prerequisite: ME 315 or CHE 300

ME 459 Design of Renewable Energy Systems (3-0-3)

Fundamentals of solar radiation, available solar radiation and clearness index, concentrating solar collectors, optical characteristics and performance analysis of concentrating solar collectors. Basics of solar photovoltaic energy generation, configuration and components of solar photovoltaic systems. Basics of wind energy conversion, horizontal and vertical axis wind turbines and their components, power characteristics and efficiency of wind turbines.

Note: Not to be taken for credits with ME 434 or ME 439 or ME 442

Prerequisites: EE 234, EE 235, ME 315

ME 460 Thermal Desalination Systems (3-0-3)

Seawater composition. The need for water desalination. Classification of desalination processes. Single effect evaporation. Thermal vapor compression systems. Multiple effect evaporation. Multistage flash distillation, once through MSF, Brine mixing and recirculation MSF. Reverse osmosis. Desalination using renewable energy sources. Economic analysis of desalination processes

Prerequisite: ME 315 or CHE 300

ME 461 Risk Management Tools in Systems Design and Operation (3-0-3)

The assessment and management of risk, uncertainty, and reliability are critical to the success of any engineering venture today, this course deals with understanding, theory and methodology and tools in assessment and management of risk, uncertainty, and reliability in engineering systems and enterprises. Quantification of Risk and its Impact. Applications will be explored through case studies in some of the following area; environmental, water resources and technology management, clean energy, safety-critical systems, and reliability modeling of multiple failure modes in complex systems. Risk Assessment and management in systems operation.

Prerequisite: Senior Standing

ME 462 Products and Systems Reliability (3-0-3)

Fundamentals of probability theory. Reliability in Design- Probabilistic models of load (stress) and resistance (strength) variables. Stress-strength interference models in probabilistic design. Monte Carlo simulation. Hazard functions and reliability models for random and wear-out failures. Hazard plotting and reliability estimation. System reliability – series, parallel , and n-out of k and series parallel systems, Failure rate endurance testing and failure data analysis. Accelerated life testing. Reliability in systems operation: availability, spare parts computation and maintenance strategies. Use of Excel and other reliability software in reliability analysis and predictions.

Prerequisite: ME 301

ME 463 Tool Design (3-0-3)

Limits, fits, tolerance charts. Part analysis, process selection and operations sequence planning. Integrating and combining operations. Workpiece control, cutting tools, dies, and work holding devices. Tooling Design in manufacturing - specifically for machining, and sheet metal forming Metal cutting economics and process selection.

Prerequisites: ME 322, ME 323

ME 467 Tribology in Design (3-0-3)

Fundamentals of tribology: Contact mechanics, surface energy, elastic and elastoplastic deformation, surface interactions at the macro- and micro-scale, friction theories and wear mechanisms. Temperatures in sliding contacts, hydrodynamics and boundary lubrication.

Friction and wear control through lubrication, materials selection, and coatings; case studies of tribology applied in components design.
Prerequisites: ME 301, ME 322

ME 468 Casting and Welding Engineering (3-0-3)
Metallurgical and engineering principles applied to melting, casting and solidification. Testing and evaluation of castings; Foundry processes; Introduction to the metallurgy of welding; Material and process selection, codes and specifications, weldment design and testing; Welding defects; Analysis of industrial welding processes; Laboratory experience in foundry, production and evaluation of weldments; Casting and welding demonstrations, experimentation and project(s) work will be conducted in Casting and Welding areas of ME Workshop. Two industrial visits will be made.
Prerequisites: ME 322, ME 323

ME 469 Computer-Aided Manufacturing (3-0-3)
High volume discrete parts production systems; CAD/CAM fundamentals; Numerical Control (NC) manufacturing systems. Part Programming; NC justification, advances in NC (CNC, DNC, adaptive control); Tooling for NC and CNC; Overview of group technology, flexible manufacturing systems (FMS), and robotics in manufacturing. Related laboratory experiments, CNC Programming, and projects will be done on CNC machines and associates CAD/CAM software available in ME Workshop.
Prerequisites: ME 322, ME 323

ME 470 Product Design and Development (3-0-3)
Opportunity identification; Creativity and Innovation; Concept Development Processes; Product concepts; Concept evaluation; Building and testing of models and prototypes; Product economics and Product management; Teamwork. Multidisciplinary project planning and execution.
Prerequisite: Junior Standing

ME 471 Mechanical Metallurgy (3-0-3)
Review of mechanical properties of metals and alloys. Introduction to theory of elasticity. Elements of theory of plasticity; flow curve, yield criteria, plastic stress-strain relationship, introduction to slip-line fields. Metallurgical aspects of plastic deformation. Metalworking processes: Forging, rolling, extrusion, and drawing.
Prerequisites: ME 216, ME 217

ME 472 Corrosion Engineering (3-0-3)
Technical and economical aspects of corrosion problems. Types of corrosion; pitting, crevice, intergranular, galvanic and stress corrosion cracking. Mechanisms and prevention of corrosion failures. Cathodic protection of pipelines and submerged structures. Principles of inhibition of corrosion in process industries. Behavior of iron, copper, aluminum and their alloys in corrosive environments. Metallurgical aspects of corrosion. Design considerations in prevention of corrosion failures.
Prerequisites: ME 216, ME 217

ME 474 Physical Metallurgy (3-0-3)
Review of crystal structures, dislocation and slip phenomena, plastic deformation. Metals and alloy systems. Diffusion in solids Strengthening mechanisms. Heat treatment of metals, phase transformations. Metallurgical aspects of failure.
Prerequisites: ME 216, ME 217

ME 475 Mechanical Behavior of Materials (3-0-3)
Elements of theories of elasticity and plasticity. Dislocations and plastic deformation. Behavior of materials under static loading. Fracture and fracture mechanics. Fatigue, creep, impact, and wear failures. Environmentally induced cracking. Basic metallurgical failure analysis. Laboratory demonstrations and experimental projects.
Prerequisites: ME 216, ME 217, ME 301

ME 476 Non-Metallic Materials (3-0-3)
Structures, mechanical properties, and processing of ceramics, polymers, and composites. Electrical and thermal properties. Case studies on the use of non-metallic materials in applications related to energy, desalination, aerospace, and civil infrastructure.
Prerequisite: ME 205 or ME 207 or ME 216 or Consent of the Instructor

ME 477 Non-Ferrous Extractive Metallurgy (3-0-3)
Physical and chemical principles involved in the extraction of non-ferrous metals. Principles of hydrometallurgical and pyrometallurgical processes. Extraction of aluminum, copper, nickel, silver and gold. Refining processes for non-ferrous metals.
Prerequisites: ME 204, ME 216, ME 217

ME 478 Iron and Steel Making (3-0-3)
Introduction to extractive metallurgy and iron ore dressing including the following topics: iron ores, mining, and ore dressing. Production of pig iron. The blast furnace. Production of steel. Bessemer process, basic oxygen process, open-hearth process, direct reduction process, and electric-furnace process. Continuous casting.
Prerequisites: ME 216, ME 217

ME 479 Modern Materials (3-0-3)
Electrical, magnetic, optical and thermal properties of materials. Modern materials and applications: thermoelectric materials, high temperature materials and coatings, carbon fiber composites, cellular materials.
Prerequisites: ME 216, ME 217

ME 480 Plastics Materials and Processing (3-0-3)
Thermoplastic and thermosetting polymers, their properties and engineering applications. Plastic manufacturing processes, equipment and mold design. Plastic materials and process selection.
Note: Not to be taken for credits with CHE 463
Prerequisite: ME 205 or ME 207 or ME 216 or CHEM 451

ME 482 Mechanical Vibrations (3-0-3)
Free and forced vibrations; Applications to systems with one-, two-, and multi-degree of freedom; Viscous, hysteretic, and Coulomb damping; Response to general periodic excitations; Transient vibration and the phase method; Principal and coupled coordinates; Dynamic vibration absorbers; Energy methods and Rayleigh's principle; Laboratory sessions on vibration measuring instruments, vibration measurement techniques, and experiments to illustrate various vibration phenomena studied.
Prerequisite: ME 201

ME 483 Mechanisms (2-3-3)
Kinematic pairs, kinematic chain, mobility of planar and space mechanisms, inversion. Vector and complex algebra methods of analysis of plane mechanisms. Centros and mechanical

advantage. Hartmann's construction and Euler-Salvary equation. Kinematics of gears and simple, compound, reverted and epicyclic gear trains. Synthesis and analysis of cam mechanisms. Universal joints. Synthesis of function, path and motion generating mechanisms. Laboratory sessions to include graphical and computer methods of analysis and synthesis of mechanisms.
Prerequisite: ME 417

ME 484 Acoustics (3-0-3)
Fundamentals of vibrations. Plane and spherical acoustic waves. Radiation, transmission and filters. Loudspeakers and microphones. Speech, hearing, noise and intelligibility. Architectural acoustics. Acoustic measurements and demonstration of measurement apparatus. Case studies.
Prerequisite: ME 201

ME 485 Mechanical System Design (3-0-3)
Mechanical systems: definition and classification; the engineering design process; Need, identification and problem definition; Concept generation and evaluation; Embodiment design. Modeling and simulation; Materials selection and materials in design; Materials processing and design; Design for X. Risk, reliability and safety; Robust and quality design; Economic decision making; Cost evaluation; Legal and ethical issues in design; Detail design; Case studies; Projects.
Prerequisites: ME 302, ME 303

ME 486 Optimization of Mechanical Systems (3-0-3)
Formulation and simulation of mechanical engineering systems involving dynamics, kinematics, and machine design and thermo-fluid systems; The concept of optimization; Analytical and numerical methods such as unconstrained and constrained optimization, Lagrange multipliers, linear programming for optimum design of mechanical systems. Lab demonstration sessions involve formulation and solution of optimization problems using computers and existing software packages during the design process.
Prerequisites: ME 301, ME 315

ME 487 Mechanics of Materials (3-0-3)
Analysis of stress and strain in two and three dimensions. Equilibrium, compatibility and stress-strain relations. Analysis of torsion; non-circular sections. Saint-Venant's theory, membrane analogy, hollow sections. Thick walled cylinders. Membrane stresses in thin shells. Bending of flat plates. Energy theorems.
Prerequisite: ME 301

ME 488 Systems Control (3-0-3)
Classical control techniques: basic control actions; Design of system by means of root-locus method and Bodes plots; Control system synthesis. Modern control techniques: state variable representation. State variable feedback; Linear quadratic controller; Laboratory demonstration sessions involve utilization of control of software for analysis and design of control system.
Corequisite: ME 401

ME 489 Finite Element Analysis in Mechanical Design (3-0-3)
Introduction to Finite Element Method and its application in different mechanical problems including: static loading of beam and beam structure, free vibration of beam and beam structures, 2-D plane stress and plane strain, elasticity, and 2-D steady state heat conduction. Using a commercial FE software, in solving various 2-D and 3-D design problems.

Prerequisite: ME 301

ME 490 Special Topics in Mechanical Engineering (3-0-3)
In-depth study of topics chosen from areas of emerging and current interests to mechanical engineering faculty, students, and the local industry. The specific topic and course description will be made available to students one semester in advance.
Prerequisite: To be set by the ME Department

ME 491 Special Topics in Energy (3-0-3)
In-depth study of topics related to Energy that attract the interests of mechanical engineering faculty, students, and the local industry. The specific topic and course description will be made available to students one semester in advance.
Prerequisite: To be set by the ME Department

ME 492 Special Topics in Dynamics & Control (3-0-3)
In-depth study of topics related to Dynamics and Control that attract the interests of mechanical engineering faculty, students, and the local industry. The specific topic and course description will be made available to students one semester in advance.
Prerequisite: To be set by the ME Department

ME 493 Special Topics in Materials & Manufacturing (3-0-3)
In-depth study of topics related to Materials and Manufacturing that attract the interests of mechanical engineering faculty, students, and the local industry. The specific topic and course description will be made available to students one semester in advance.
Prerequisite: To be set by the ME Department

ME 495 Undergraduate Research (3-0-3)
A course for ME senior students to be involved in one of the ongoing research projects under the supervision of ME faculty. The course is intended to expose the student to the process of scientific research. The student is expected to acquire research skills and methodologies including formulation of a research plan, design and execution, laboratory techniques, data collection, assessment, analysis, and presentation. Work may be of experimental, theoretical, or design nature related to Mechanical Engineering.
Prerequisite: Senior Standing or Consent of the Instructor