Catalogue 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.
Prerequisite: CE 201

ME 203 Thermodynamics I (3-0-3)
System and control volume concepts. Properties of a pure substance. Work and heat. The first law of thermodynamics as applied to a system and a control volume, internal energy, enthalpy. The second law of thermodynamics. Carnot cycle, entropy, reversible and irreversible processes. Applications of steady-state, steady-flow, uniform-state, uniform-flow, and other processes.
Prerequisite: MATH 102, PHYS 102

ME 204 Thermodynamics II (3-0-3)
Vapor power cycles, Rankine, reheat, and regenerative cycles. Maxwell relations, ideal and real gases, equations of state, generalized charts. Gas-vapor mixtures, psychrometric charts, ideal solutions. Chemical reactions. Fuels and combustion processes.
Prerequisite: ME 203

ME 205 Materials Science (2-3-3)
Introduction to the properties of engineering materials: mechanical, electrical, and chemical. Fundamentals of crystallography. Impurities and imperfections in solids. Atomic vibrations and diffusion. Single phase metals and alloys; elastic and plastic deformation, recrystallization, fracture, fatigue, and creep. Multiphase materials; phase diagrams with emphasis on iron-iron carbide system. Heat treatment processes such as annealing, normalizing, and quenching. Studies of widely used engineering materials; steels, plastics, ceramics, concrete, and wood.
Note: For non-ME students
Prerequisite: CHEM 102, MATH 102

ME 210 Mechanical Engineering Drawing & Graphics (2-3-3)
Graphical Interpretation of machine components and assemblies through the study of orthographic projection to include auxiliary views; section drawings and full dimensioning; translation of design instruction into detailed and assembly drawings; drawing conventions including weldments, piping, referencing and surface finish notation; selection of tolerances based on design requirements.

ME 216 Materials Science and Engineering (3-0-3)
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, line and interfacial defects. Atomic vibration and diffusion. Mechanical properties of materials. Elastic and plastic deformation and recrystallization. Phase diagrams of single phase & multiphase materials with emphasis on iron-iron carbide system (steel & cast iron). Thermal processing of metals & alloys: annealing, normalizing, quenching and tempering, composite materials, polymers. Impact, fracture, fatigue and creep properties and introduction to fracture mechanics.
Corequisite: ME 217
Prerequisite: CHEM 101, MATH 102, PHYS 102

ME 217 Materials Lab (0-3-1)
The laboratory experiments are focused on introducing the basic techniques of metallographic, sectioning, polishing, etching, light metallographic and microstructure analysis. Determining mechanical properties (hardness, tensile, fatigue and creep properties) of steels, cast irons and nonferrous as well as some polymeric materials and their structure properties relationship. Emphasizing and illustrating importance of these properties in manufacturing and design. Simple spread sheet based data analysis using the hardness, tensile, fatigue and creep tests results.
Corequisite: ME 216

ME 218 Introduction to Mechanical Engineering Design (1-3-2)
Tools for design process; Introduction to Mechanical engineering design process; Applications of scientific and engineering tools; Open-ended problem solving; Team-based projects; Design for manufacture; Ethical issues in design process; Communication skills.
Prerequisite: PHYS 102, ME 210

ME 307 Machine Design I (3-0-3)
Design process, review of stress, strain and deformation analysis as applied to mechanical design; properties of materials; review of static failure theories; designing against fatigue failures; element design; shafts, keys, couplings, power screws; bolted, riveted and welded joints.
Corequisite: ME 322, ME 323
Prerequisite: ME 218, CE 203

ME 308 Machine Design II (3-3-4)
Design of elements: bearings (journal and anti-friction), springs, spur, helical, bevel and worm gears; flexible drives (belts and chains); clutches and brakes; design optimization. Laboratory sessions to supplement and to apply the material covered in the lectures. Consideration of manufacturing aspects of the design (limits and fits). Study of projects considering the different stages of their design, manufacturing and assembly.
Prerequisite: ME 307

ME 309 Mechanics of Machines (3-0-3)
Kinematics of mechanisms, vector method of analysis of plane mechanisms. Static and dynamic analysis of machines, inertia forces, gyroscopic forces. Static and dynamic balancing, balancing machines. Dynamics and balancing of reciprocating engines. Flywheels, kinematic and dynamic analysis of cam mechanisms. Elements of mechanical vibrations, critical speeds and torsional vibrations.
Prerequisite: ME 201

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.
Prerequisite: MATH 201, ME 201, ME 203

ME 315 Heat Transfer (3-0-3)
An introduction to heat transfer by conduction, radiation, and convection. Steady-state solution for heat conduction applied to wall and pipe insulation, heat sources, and extended surfaces

(fins). Unsteady heat transfer to plates, cylinders and spheres (Heisler charts). Black and gray body radiation systems and electric network analogy. Practical hydraulic and thermal analysis of forced and natural convection system with application to heat exchangers.
Prerequisite: ME 311

ME 316 Thermofluids Lab (0-3-1)
This lab course will deal with equal emphasis on fluid mechanics and heat transfer. All experiments conducted in this lab combine elements of theory and practice. Many of the concepts and basic theories which the student learns in the lectures of ME 311 and ME 315 are demonstrated and confirmed in the lab through different experiments.
Corequisite: ME 315
Prerequisite: ME 311

ME 322 Manufacturing Processes (3-0-3)
Manufacturing methods of metals and plastics including: metal casting, bulk forming, sheet metal forming, machining, welding, and plastic processing. Both quantitative and qualitative study of manufacturing processes with emphasis on process selection for optimum design.
Corequisite: ME 323
Prerequisite: CE 101 or ME 210, ME 216, ME 217

ME 323 Manufacturing Lab (0-3-1)
This lab course is a co requisite of ME 322. The laboratory experiments and demonstrations are focused on lab learning of various manufacturing processes –mainly casting, welding, sheet metal, extrusion forging, polymers processing, precision measurements and metrology – dimensional variability modeling, machining (turning, drilling, and Milling) processes and Process Capability, CAD /CAM and CNC machining demonstration – Using the spreadsheet based data analysis of experimental data obtained in various experiments. Possible Industrial trips
Corequisite: ME 322
Prerequisite: CE 101 or ME 210, ME 216, ME 217

ME 350 Begin Cooperative Work (0-0-0)
See contents in ME 351.
Prerequisite: Same as in ME 351

ME 351 Cooperative Work (0-0-9)
A period of 28 weeks of industrial employment for Applied Mechanical Engineering students to 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.
Prerequisite: ENGL 214, ME 307, ME 309, ME 315

ME 352 End Cooperative Work (0-0-0)
See contents in ME 351.
Prerequisite: Same as in ME 351

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.
Prerequisite: ENGL 214, Junior Standing, Approval of the Department

ME 406 Manufacturing and Design (3-0-3)
Dimensional metrology, basic statistical concepts in characterizing the variability of measurements, and introduction to statistical manufacturing process control. Process capability analysis. Design considerations in manufacturing. Abrasive machining and non-traditional metal removal processes, CAD/CAM - Numerical Control machining. Powder metal processing. Manufacturing with Polymers, Rapid Prototyping. Design for Manufacturability and Economics of Manufacturing. Design and Manufacturing Case Studies.
Corequisite: ME 407
Prerequisite: (ME 322 and ME 323) or ISE 322

ME 407 Advanced Manufacturing Lab (0-3-1)
Laboratory demonstrations and experiments and hands on experience of: Measurements (Dimensional Metrology), Variability and Distributions, Manufacturing Tolerances and Process Capability Studies, Surface Roughness Analysis, Experimental Data Analysis to Develop Empirical Models-Use of Excel, and other statistical software's, Advanced Experiments in Machining. Machining Forces and Torque Models. Non Traditional manufacturing, CAD/CAM and CNC machining, Polymers processing and Rapid Prototyping. Integrated Manufacturing Project.
Corequisite: ME 406
Prerequisite: (ME 322 and ME 323) or ISE 322

ME 408 Rapid Prototyping and Digital Manufacturing (2-3-3)
The Rapid Prototyping course highlights the many technologies (3D Printing, SLA, SLS, SLM, LOM, and FDM) and concept modeling, rapid prototyping and digital manufacturing technologies, along with common features, that are available within the industry. Preparation, consideration factors, and analysis of rapid prototyping and other valuable topics are included in the course. 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.
Prerequisite: Senior Standing, ME 322, ME 323

ME 409 Design and Manufacturing of Composite Structures (3-0-3)
This course provides basic competency in the design and manufacture of fiber-reinforced polymer composite structures. It will provide knowledge and understanding of the key aspects of composites design and various methods of composites manufacture. In addition, the course will introduce micromechanics, mechanical performance, durability, repair, recycling and applications of composites.
Prerequisite: Senior Standing

ME 410 Ceramics (3-0-3)
Fundamentals of ceramic materials including: 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 216 and ME 217) or ME 205

ME 411 Senior Design Project I (1-0-1)
This capstone design project course integrates various components of the curriculum in comprehensive engineering experience so that the basic sciences, mathematics, and engineering sciences which the student has learned in his freshman-to-senior years of study can be applied. It

considers design of a complete project or system including establishment of objectives and criteria, formulation of the problem statements, preparation of specifications, consideration of alternative solutions, feasibility considerations, and detailed engineering designs. The design should take into consideration appropriate constraints such as economic factors, safety, reliability, ethics and environmental and social impact. Submission of a written report is an essential requirement for completion of the course. Team design projects, where appropriate, are highly encouraged.
Prerequisite: ME 307**,** Senior Standing

ME 412 Senior Design Project II (0-6-2)
Continuation and completion of project started in ME 411. Oral presentation and submission of final written report of the design project are essential requirements for the completion of the course.
Prerequisite: ME 411

ME 413 Systems Dynamics and Control (2-3-3)
Dynamics of mechanical, fluid, electrical and thermal systems. Equations of motion. Dynamic response to elementary systems. Transfer functions and pole-zero diagrams. Simulation of dynamics of complex systems. Dynamic stability of systems. Open and closed-loop systems. Basic control actions. Laboratory sessions involve use of computers for simulation of dynamic systems and analysis of control systems.
Prerequisite: MATH 301, ME 201

ME 414 Design Project I (1-0-1)
This is first part of AME specific Capstone Design Project course introduced to prepare a professionally written ME416 proposal by the project team and advisor as perquisite course for ME416. This course will facilitate the ground work completed in every respect to complete the meaningful projects in ME 416 from the day 1 of the project. And the proposal should be in a prescribed form with Gantt chart, and budget with material procurement forms (strategy and approval of ME workshop as well as other lab resources commitment), expected project deliverables and well defined roles of multiple faculty (if involved) in supervision of the project. The video lectures of the ME 414 with all prescribed forms with instructions will be available to all the enrolled students on the Web with some model (sample) project proposals. Team design projects, where appropriate, are highly encouraged. Students will work closely with their project adviser and are expected to spend about 3 hours per week /per student on the project.
Corequisite: ME 307

ME 416 Design Project II (0-6-2)
The second part of this capstone design project course is completed in semester following the COOP Training and integrates various components of the curriculum in comprehensive engineering experience so that the basic sciences, mathematics, and engineering sciences which the student has learned in his freshman-to-senior years of study can be applied. It considers design of a complete project or system including establishment of objectives and criteria, formulation of the problem statements, preparation of specifications, consideration of alternative solutions, feasibility considerations, and detailed engineering designs. The design should take into consideration appropriate constraints such as economic factors, safety, reliability, ethics and environmental and social impact. Oral presentation and submission of final written report of the design project are essential requirements for the completion of the course. Students Project Team will work closely with their project adviser and are expected to spend about 6 hours per week /per student on the project.
Prerequisite: ME 414

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, turbocompressors and turbines. Introduction to rockets and performances of rocket vehicle engines. Chemical and electrical driven rocket engines.
Note: Not to be taken for credit with AE 422
Prerequisite: 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 204, 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: Senior Standing in ME or AME

ME 425 Compressible Fluid Flow (3-0-3)
Fundamentals of compressible fluid flow (gas dynamics) in relation to effects of area change (nozzles and diffusers), friction and heat interaction (Fanno and Rayleigh lines and isothermal flow), combustion waves (deflagration, explosion and detonation waves), normal and oblique shock waves and their effects on flow properties (extended diffusers and supersonic airfoils). Applications to flow through pipelines, subsonic, sonic and supersonic flights, turbomachinery and combustion.
Note: Not to be taken for credit 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.
Prerequisite: 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 credit with AE 328
Prerequisite: CE 203

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 204, ME 315

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 204, ME 315

ME 432 Internal Combustion Engines (3-0-3)
Types of engines and their operation; Four and two stroke engines; Thermodynamics of engine cycles; Engine design and performance parameters; Operating characteristics of spark and compression ignition engines; Thermochemistry in-cylinder combustion and combustion abnormalities; Analysis of fuel-air cycles; Analysis of intake, fuel and exhaust systems; Turbocharging and supercharging; Performance characteristics of actual engines.
Prerequisite: ME 204

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)
Wind characteristics, boundary layer, turbulence, surface roughness, and measurements. Loads on static structures, wind tunnel modeling, wind induced vibrations, flutter, buffeting. Additional selected topics such as airborne pollution, sand motion, vehicle aerodynamics.
Prerequisite: ME 311

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 204, 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

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)
The design of photovoltaic solar systems course covers the principles of photovoltaics and how to effectively incorporate photovoltaic systems with emphasis on stand-alone systems with a brief introduction to grid connected electrical systems. The content of the course includes system advantages and disadvantages, site evaluation, component operation, system design and sizing, installation requirements and recommended practices for important applications. Topics include: Introduction to Photovoltaic 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.
Prerequisite: Senior Standing, EE 204, EE 306

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 309

ME 444 Introduction to Mechatronics (2-3-3)
A multidisciplinary course that introduces the design and realization of mechatronics; Electromechanical 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.
Prerequisite: EE 202 or EE 204, Junior Standing

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 216 and ME 217) or ME 205

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 450 Mechanical Engineering Experimentation (2-3-3)
Functional description of measuring instruments. Performance characteristics of instruments. Planning of experiments. Analysis of experimental data. Data acquisition and processing. Measuring devices for Mechanical Engineering applications and selected experiments.
Prerequisite: EE 202 or EE 204, ME 316

ME 451 Design and Analysis of Engineering Experiments (3-0-3)
The course deals with basic statistics, design of experiments, uncertainty and error analysis general characteristics of measurement systems, statistical analysis of experimental data, empirical modeling, experimental uncertainty analysis, as well as guidelines for planning and documenting experiments. Illustrative examples from industry and case studies of planned engineering experiments.
Prerequisite: EE 204, ME 307, ME 315

ME 452 Measurements and Lab Project (0-3-1)
Basic instrumentation and measurements in conducting the experiments -such as force, displacement, pressure, temperature, humidity, fluid level, fluid velocity, and flow rate, etc. Output signals, computerized data acquisition systems. Last 5 lab sessions will be devoted to group projects to integrate the knowledge in developing experimental system and experimental strategy (in ME 451 and ME452) in any of the following area: vibration analysis and condition monitoring, thermofluid, manufacturing processes, materials testing, and characterization, or industry. Projects will be planned by course instructors a head of time (semester prior to teaching) in collaboration with other (Guest) faculty member or specialist from industry). The projects will be assigned at the beginning of the course.
Corequisite: ME 451

ME 459 Design and Operation of Renewable Energy Systems (3-0-3)
The course is primarily devoted to wind power and solar photovoltaic technologies, their engineering fundamentals, conversion characteristics, operational considerations to maximize output, and emerging trends. Explores all aspects of a variety of wind and solar energy systems, including both stand-alone and grid-connected systems. The discussion of wind power includes the theory of induction machine performance and operation as well as generator speed control, while the solar PV section includes array design, environmental variables, and sun-tracking methods. Latest technologies and developments in the field contra-rotating wind turbines, offshore wind farms, and photovoltaic technologies. Determining economic profitability of potential RE energy projects primarily wind and solar. Use of software tools in integrating the components of RE projects including energy storage, power electronics, and design of both stand alone and grid connected system, plant economics.
Prerequisite: Senior Standing, EE 204, EE 306

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, ME 204

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 nout 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 307

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.
Prerequisite: ME 307

ME 464 Quality in Manufacturing (3-0-3)
Principles of dimensional metrology and geometrical accuracy. Concepts of attaining and maintaining manufacturing accuracy. Principles of precision measuring instruments and machines. Process capability evaluation and quality control.
Prerequisite: ME 322, ME 323

ME 465 Designing Robust Products and Systems (3-0-3)
This course will introduce the Taguchi design improvement technique. Students will gain handson application experience to design robust products and processes as well as solve production problems by reducing performance variations. The tools to robustly design components, products and systems and their manufacturing process will be reviewed. The course emphasized the use of Taguchi's Robust Design Technique as an effective ways to reduce the product design cycle, especially when coupled with computational simulation techniques. Real-life examples will be used to show the applicability of Taguchi's methodology to optimize products, components and processes. Main topics covered by the course are: Introduction to the Engineering Design Process, Design of Experiments using the Taguchi Method, Robust Design.
Prerequisite: ME 406 or ME 451

ME 466 Fundamentals of Heat Treatment (3-0-3)
Principles of phase transformations, heat treatment, and mechanical properties as applied to ferrous and non-ferrous metals and alloys. Heat treatment processes including: normalizing, hardening, tempering, annealing, surface hardening. Applications of heat treatment and surface hardening techniques; Experimental aspects of heat treatment science and technology will be covered using lab resources of Materials Science Lab, Advanced Materials Science Lab and ME Workshop.
Prerequisite: ME 322, ME 323

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.
Prerequisite: 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.
Prerequisite: ME 322, ME 323

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 slipline fields. Metallurgical aspects of plastic deformation. Metalworking processes: Forging, rolling, extrusion, and drawing.
Prerequisite: ME 216, ME 217

ME 472 Corrosion Engineering I (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.
Prerequisite: ME 216, ME 217

ME 473 Corrosion Engineering II (3 - 0 - 3)
Review of important principles of corrosion protection; Effect of atmospheric composition, climatic condition and industrial pollution on metallic corrosion; Erosion and cavitation; Highpressure and high-temperature corrosion; Corrosion in steam generation plants, pressure vessels and its mitigation; Reinforced concrete corrosion; Design of cathodic protection systems for various structures; Surface preparation, applications and designing of coating systems; Seawater-induced corrosion and scaling in major desalination plant components; Laboratory studies related to inspection and testing of coating, evaluation of inhibitors, cathodic protection measurements and corrosion resistance of materials.
Prerequisite: ME 472

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.
Prerequisite: 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. Use of relevant software for data analysis.
Prerequisite: ME 307

ME 476 Non-Metallic Materials (3-0-3)
Structure of nonmetallic materials. Ceramic materials, glass and vitreous products, concrete and related materials of construction, refractory materials, composite materials, polymers.
Prerequisite: ME 216, ME 217

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.
Prerequisite: 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.
Prerequisite: ME 216, ME 217

ME 479 Modern Materials (3-0-3)
Electrical, magnetic, optical and thermal properties of materials. Advanced ceramics, composites. Advanced engineering plastics. High temperature materials. Advanced coatings. Advanced material processing such as rapid solidification and powder metallurgy; selection of modern materials.
Prerequisite: 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.
Prerequisite: ME 205 or (ME 216 and ME 217)

ME 481 Advanced Dynamics (3-0-3)
The foundation of dynamics leading to Lagrange's equations and Hamilton's principle. Variation problems in mechanics. General three-dimensional kinematics and dynamics. Stability of motion. Self-excited vibrations, and non-linear vibrations.
Prerequisite: ME 201

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 309

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, MATH 301

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.
Prerequisite: Senior Standing

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.
Prerequisite: ME 307, ME 315

ME 487 Mechanics of Materials (3-0-3)
Analysis of stress and strain in two and three dimensions. Equilibrium, compatibility and stressstrain 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: CE 203

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 413

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 307

ME 490 Special Topics in Mechanical Engineering (3-0-3)
Prerequisite: To be set by the ME Department

ME 491 Special Topics in Energy (3-0-3)
Prerequisite: To be set by the ME Department

ME 492 Special Topics in Dynamics & Control (3-0-3)
Prerequisite: To be set by the ME Department

ME 493 Special Topics in Materials & Manufacturing (3-0-3)
Prerequisite: To be set by the ME Department

ME 494 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: Senior Standing

ME 495 Directed Research / BSc Research Thesis (3-0-3)
A well monitored and structured BSC Thesis/Directed Research Course for Active Research Projects-which could be taken only as a onetime Elective Special Topic. It is only open to students having a GPA of 3 or above and consent of instructor is mandatory. Faculty conducting the course must submit a formal well written program of research work and deliverables and grading policy in semester prior to enrollment for approval from department. Students can start working on the topics a head of time prior to formal enrollment as a course after its approval.
Prerequisite: Senior Standing or Consent of the Instructor