MECHANICAL ENGINEERING (MECH)

MECH 211 Computer Aided Design (2 semester hours)
Introduction to computer aided design techniques and applications to design and manufacturing problems. Topics include: computer graphics for geometric design, design of curves and shapes, numerical methods for CAD and optimization. Practice and use of solid modeling software package. Mechanical Engineering majors only.

MECH 212 Mechanics of Materials (3 semester hours)
This course will focus on the fundamental analysis of stresses, strains, and deflections of loaded members. Students will learn to analyze members undergoing axial, torsion, and bending loads. Students will be introduced to the simple design of members for failure prevention through component sizing and material selection. Prerequisite: ENGR 200.

MECH 213 Dynamics (3 semester hours)
Introduction to Newtonian vector mechanics; Planar and three-dimensional kinematics and kinetics of particles and rigid bodies; rectilinear and curvilinear motion of a particle; rigid body motion; application of principle of work and energy, and principle of impulse and momentum. Prerequisite: ENGR 200. Corequisite: MATH 234.

MECH 214 Materials Science (3 semester hours)
A study of metallic, polymeric, and ceramic materials, emphasizing dependence of mechanical and electrical properties on solid-state bonding forces and micro-structure. Mechanical properties of materials. Introductory design considerations. Prerequisites: CHEM 111 and CHEM 114.

MECH 223 Thermodynamics (3 semester hours)
The fundamental concepts of classical thermodynamics including properties, work and heat; first and second laws; entropy; irreversible processes; and thermodynamic analysis of power cycles and refrigeration cycles. Prerequisites: MATH 132 and PHYS 101.

MECH 298 Special Studies (1-3 semester hours)

MECH 301 Measurements and Controls (3 semester hours)
An introductory course into the design, analysis, and control of experimental measurements. Different measurement techniques are analyzed for: strain, pressure, temperature, and velocity. Statistical techniques such as least-squares regression, statistical confidence and error analysis are covered. The dynamic response of control systems using Laplace transforms and control methods are also covered. Prerequisite: MATH 245.

MECH 302 Thermal Science and Energy Lab (2 semester hours)
Team-based experimental projects in the disciplines of fluid mechanics, heat transfer, and thermodynamics; lab safety, instrumentation, test planning, data analysis and report writing. Prerequisites: MECH 223 and MECH 322.

MECH 303 Solid Mechanics and Materials Laboratory (2 semester hours)
Students, working both individually and in teams, will conduct experiments using modern equipment and contemporary methods in solid mechanics and materials science. Lab safety, experimental methods, statistical data analysis, interpretation, and report writing will be emphasized. Prerequisites: MECH 212 and MECH 313.

MECH 310 Machine Design (3 semester hours)
Failure analysis of common mechanical elements; analysis, design, and selection of standard mechanical elements such as shafts and shaft components, non-permanent and permanent joints, mechanical springs, bearings, gears, clutches, brakes, couplings, flywheels, and flexible mechanical elements; team-based design analysis project. Prerequisites: MECH 211 and MECH 212.

MECH 312 Vibrations (3 semester hours)
Fundamentals of vibration of mechanical systems; free and forced vibration of single degree of freedom systems with and without damping; viscous and structural damping; instrumentation for vibration measurements; transient and steady-state response; two and higher degree-of-freedom systems; natural frequencies and mode shapes of vibration; vibration absorption and isolation. Prerequisites: MECH 213 and MATH 245.

MECH 315 Metlrgcl Materials Eng (3 semester hours)
A concise introduction to the relationship of the microstructures and processing of metallic, ceramic, polymer, and composite materials and their relation to the properties required in engineering design.

MECH 321 Energy Systems (3 semester hours)
Review of energy equation and principles of thermodynamics; entrop and exergy. The fundamentals on conventional and renewable energy resources including the basics of conventional energy conversion. Additional topics will include the environmental impacts of energy consumption and economic considerations. Lecture, 3 hours. Prerequisite: MECH 223.

MECH 322 Fluid Mechanics (3 semester hours)
Properties of fluids, fluid statics and dynamics; energy equation; momentum equation; differential and integral approach; drag and lift analysis; turbulent and laminar flow; loses in pipes. Prerequisites: MATH 234; MATH 246 or concurrent enrollment.

MECH 323 Heat Transfer (3 semester hours)
Fundamentals of heat transfer mechanisms: conduction, convection, and radiation; steady state and transient conduction; forced and free convection; heat exchangers; radiation between surfaces. Prerequisites: MATH 245 and MECH 223.

MECH 340 Engineering Systems II (3 semester hours)
Process dynamics, instrumentation and feedback applied to automatic process control.

MECH 342 Mech Engr Lab II (2 semester hours)
A continuation of MECH 341 with projects in the disciplines of metallurgy and heat transfer. Lab safety, statistical data analysis, and report writing are emphasized.

MECH 345 Intro to Probability & Stats (1 semester hour)
Fundamentals of probability and statistics. Conditional probability, independence, random variables, distributions, densities. Experimental error analysis. Statistical confidence. Sampling. Statistical process control, X-R charts. Quality assurance.

MECH 353 Heat Transfer (3 semester hours)
The basic laws of conduction, convection, and radiation heat transfer. Thermal analysis and design of components and devices. Numerical analysis of heat conduction problem.

MECH 398 Special Studies (1-3 semester hours)

MECH 399 Independent Studies (1-3 semester hours)
May not be taken as a required course.

MECH 401 Design Capstone Project I (3 semester hours)
Preliminary phases of the capstone project; industrial-sponsored and student design competition team projects; defining the project requirements, developing and refining a design concept, incorporating design standards, and validating the design performance through analysis and testing; formal and informal project reviews and reports; guest lectures by industry experts. University Core fulfilled: Flags: Engaged Learning.

MECH 402 Design Capstone Project II (3 semester hours)
Final phases of the capstone project; industrial-sponsored and student design competition team projects; design iterations, component interaction and interfacing; fabrication and assembly; validating the design performance through experimental testing of the system components and subsystems; formal and informal project reviews and reports; guest lectures by industry experts. Prerequisite: MECH 401. Senior standing required.

MECH 410 Design and Manufacturing Laboratory (2 semester hours)
Introduction to common methods and technologies used in product design and development; design for manufacturing (DFM) guidelines; rapid prototyping and CNC machining; a comprehensive design and manufacturing project; technical reports.

MECH 412 Control Systems (3 semester hours)
Introduction to basic engineering techniques for modeling and controlling of dynamic systems, including mechanical, fluid, thermal, and electrical systems; analysis of transient and steady state response; application of root locus and frequency response methods in control system design; PID controllers. Prerequisites: ENGR 160 and MECH 312.

MECH 441 Mech Eng Lab III (2 semester hours)
Laboratory applications of vibrations and data acquisition; elasticity, buckling, material testing; compressible flow and jet engine testing; and computer-aided manufacturing such as NC machining, rapid prototyping, investment casting, and robotics.

MECH 483 Elements of Design (3 semester hours)
The philosophy of design. Development of the methods of design. Application of the analysis of mechanical systems for stress, deflection, buckling, fatigue, and general reliability to the design of components such as springs, power screws, fasteners, bearings, and gears.

MECH 484 Mechanical Engr Design (3 semester hours)
Design projects. The philosophy and methodology of design is applied to the design of mechanical engineering systems. Steps include project definition, feasibility study, generation of candidate solutions, analysis, synthesis, decision making and component selection. Project record book, design drawings, design reviews, oral presentations, and a final report are required.

MECH 498 Special Studies (1-3 semester hours)

MECH 499 Independent Studies (1-3 semester hours)
May not be taken as a required course.

MECH 509 Failure Analysis (3 semester hours)
An overview of how failures occur in systems. Failure modes like brittle fracture, creep, fatigue, and environmentally assisted cracking for metals, polymers, composites, and ceramics are described and discussed. A brief introduction to fracture mechanics is included. The nondestructive and destructive analytical tools to study failures, such as optical and scanning electron microscopy, metallography, hardness testing, and conductivity testing are described. The steps to conduct a failure analysis are discussed. Senior or graduate standing required. Majors only.

MECH 510 Computer-Aided Manufacturing (3 semester hours)
A comprehensive study of manufacturing with a focus on automation, flexible automation, group technology, process planning, and design for manufacturability. Principles and applications of computer numerical control (CNC) and NC programming, rapid prototyping, robotics, and quality engineering are introduced through lab work. Senior or graduate standing required. Majors only.

MECH 511 Materials Selection in Design (3 semester hours)
Application of principles of materials engineering to selection of materials for optimized engineering design, case studies in failure analysis, and process optimization. Senior or graduate standing required. Majors only.

MECH 515 Composites (3 semester hours)
Forms and properties of resins, fibers and composites; material and structural design and analysis; manufacturing, machining and assembly; quality assurance and testing; metal and ceramic based materials; information resources. Senior or graduate standing required. Majors only.

MECH 516 Finite Elements Methods (3 semester hours)
Introduction to the theory and application of finite element methods. Review of the fundamentals of analytical models, elasticity, and structural mechanics. Review of matrix theory and calculation of variations. General process for the development of a finite element solution. Derivations of basic elements, including those for trusses, plane stress and plane strain, beams, plates, and solids. Discussion of the issues of conformity and completeness. Higher order interpolation functions and isoparametric elements. Solutions and applications to problems in structural mechanics, heat transfer, structural dynamics, and elastic stability. Practical examples. Senior or graduate standing required. Majors only.

MECH 517 Fracture Mechanics (3 semester hours)
Introduction to concepts of fracture mechanics of engineering materials. These include stress analysis of cracks, fracture toughness, transition temperature, micro-structural aspects, and fatigue crack propagation behavior. Senior or graduate standing required. Majors only.

MECH 518 Design for Manufacturing (3 semester hours)
Fundamentals of designing machine, sheet metal, and plastic parts and deciding which type of part should be used for a given application. Design of subsystems and assemblies using the rules of datum features, design intent, and geometric dimensioning and tolerancing. Design for manufacturing, assembly, serviceability, and the environment. Hands-on design projects. Senior or graduate standing required. Majors only.

MECH 519 Advanced Vibrations (3 semester hours)
Vibration of discrete and continuous systems, including single and multiple degree-of-freedom systems as well as strings, rods, beams, and membranes. Theoretical and experimental methods for the determination of natural frequencies and mode shapes, as well as solving forced vibration problems. Discussion of applications, such as vibration measurements, signal processing, and vibration control. Introduction to nonlinear vibrations. Senior or graduate standing required. Majors only.

MECH 520 Computational Fluid Dynamics (3 semester hours)
In-depth study of applied computational methods for solving problems involving fluid and heat transport. Course will include both commercially available codes as well as self-generated solving routines. Topics include: numerical solutions to PDEs, steady flow solutions, unsteady flow solutions, flows involving heat transfer. Prerequisite: CIVL 310 or MECH 322. Senior or graduate standing required. Majors only.

MECH 524 Alternative Energy Systems (3 semester hours)
A detailed study of alternative energy technologies including: solar thermal, solar photovoltaic, wind, fuel cells, and geothermal systems will be covered. In-depth analysis of the technical aspects of these systems will be covered while considering economic and environmental constraints. Energy storage and grid integration will also be considered. Senior or graduate standing required. Majors only.

MECH 526 Energy Systems (3 semester hours)
Review of energy equation and principles of thermodynamics; entropy and exergy. The fundamentals of conventional and renewable energy resources including the basics of conventional energy conversion. Additional topics will include the environmental impacts of energy consumption and economic considerations. Senior or graduate standing required. Majors only.

MECH 528 Advanced Dynamics (3 semester hours)
An overview of how failures occur in systems. Failure modes like brittle fracture, creep, fatigue, and environmentally assisted cracking for metals, polymers, composites, and ceramics are described and discussed. A brief introduction to fracture mechanics is included. The nondestructive and destructive analytical tools to study failures, such as optical and scanning electron microscopy, metallography, hardness testing, and conductivity testing are described. The steps to conduct a failure analysis are discussed. Senior or graduate standing required. Majors only.

MECH 529 Advanced Control Systems (3 semester hours)
Modern methods for controller design, including state-space modeling of dynamical systems, state feedback controller design, and state observer design. Linearization on nonlinear systems. Characteristics of linear systems including controllability, observability, and stability. Senior or graduate standing required. Majors only.

MECH 532 Robotics (3 semester hours)
This is a fundamental interdisciplinary robotics course containing both introductory as well as more advanced concepts. The course presents a broad overview of technology, kinematics and control, vision systems, robot languages and programming, applications, economics and social issues. A FANUC CERT LR Mate 200i robot will be used for class projects. Senior or graduate standing required. Majors only.

MECH 533 Additive Manufacturing (3 semester hours)
In this course, current state-of-the-art AM technologies for polymers, metals, ceramics, and composites will be covered in detail. Design, materials selection, innovations and implementations of AM will also be discussed. Upon successful completion of the course, students will understand the operation principles, advantages, and limitations of current state-of-the-art AM techniques alongside AM product development, technology development, and innovation. Senior or graduate standing required. Majors only.

MECH 534 Metallurgical and Materials Engineering (3 semester hours)
Advanced topics in the relationship of the microstructure and processing of metallic, ceramic, and polymeric materials and their relation to the properties required in engineering design. Phase transformations in ferrous and non-ferrous materials. All topics will be discussed in relation to Additive Manufacturing. Senior standing required. Majors only.

MECH 537 Rapid Prototyping (3 semester hours)
The course provides students with an opportunity to conceive, design, and implement a product using rapid prototyping technologies and computer-aided tools. Topics such as principles of rapid prototyping, rapid prototyping materials, reverse engineering, rapid tooling, medical applications, industry perspectives, and current research and developments will be introduced to students through laboratory works. Several rapid prototyping machines will be used for class projects. Senior or graduate standing required. Majors only.

MECH 539 Design for Additive Manufactur (3 semester hours)
what the additive manufacturing can offer. The course starts with discussions on part complexity, instant assemblies, part consolidation, mass customization, freedom from design, light weighting. It will discuss Design for AM guidelines for design parts, AM tooling design, polymer design, metal AM design. It will also discuss the post-processing and the future of additive manufacturing. The students will learn principles for successful engineering design for components for Additive Manufacturing through lecture and projects. Majors only. Senior Standing required.

MECH 541 Compressible Flow (3 semester hours)
Fundamentals of compressible fluid dynamics and application to external and internal flows. Topics covered will include: speed of sound and Mach number, isentropic 1-D flow in variable area ducts, converging nozzles, choking, converging-diverging nozzles, Rayleigh flow (duct flow with heat transfer), Fanno flow (duct flow with friction), normal and oblique shocks, and expansion fans. Majors only. Senior or graduate standing required.

MECH 542 Turbomachinery (3 semester hours)
Compressor, pump, fan selection and applied theory. Senior or graduate standing required. Majors only.

MECH 544 Propulsion (3 semester hours)
This course combines fundamental fluid mechanical and thermodynamic concepts to characterize the components, operation, and performance of internal combustion propulsion devices for aircraft and space vehicles. A practical approach to understanding these devices is also given, supplementing and enhancing the analytical application. The fundamentals of alternative, advanced air breathing and space propulsion concepts are also introduced. Senior or graduate standing required. Majors only.

MECH 545 Fundamentals of Biomedical Engineering (3 semester hours)
Introduction to human physiology and engineering applications foundational to Biomedical Engineering, including neuromuscular and aural physiology; biomechanics; prosthetics; assistive devices; brain-computer interface; stroke and rehabilitation engineering; medical devices; biomaterials; bioMEMS; microfluidics; biomedical imagining; synthetic biology; cellular and tissue engineering. Short Individual and team-based projects involve physiological simulations and literature review. Senior or graduate standing required. Majors only.

MECH 546 Aerodynamics (3 semester hours)
This course will cover materials relevant to external and internal aerodynamics. Students will learn how to formulate and apply appropriate aerodynamic models to predict the forces on and performance of realistic three-dimensional configurations. Flow over lifting bodies will be analyzed especially with regard to flying bodies and ground vehicles. Senior or graduate standing required. Majors only.

MECH 598 Special Studies (1-3 semester hours)
Senior or graduate standing required. Majors only.

MECH 599 Independent Studies (1-3 semester hours)
Senior or graduate standing required. Majors only. May not be taken as a required course.

MECH 604 Engineering Mathematics (3 semester hours)
Advanced topics in applied mathematics in linear algebra and analysis. Vector spaces, linear transformations, determinants, inner product spaces, solution of simultaneous linear equations, LU factorization, solution of algebraic eigenvalue problems by QR and QZ algorithms, linear least square problem and the singular value decomposition. Vector calculus, change of coordinate transformations, Stokes theorem, introduction to calculus of variation, ordinary differential equations, and numerical methods for their solution. Fourier analysis applied to discrete signals. Graduate standing required.

MECH 610 Metallurgical and Materials Engineering (3 semester hours)
Advanced topics in the relationship of the microstructure and processing of metallic, ceramic, and polymeric materials and their relation to the properties required in engineering design. Phase transformations in ferrous and non-ferrous materials. All topics will be discussed in relation to Additive Manufacturing.

MECH 613 Advanced Mechanics of Materials (3 semester hours)
Combined loading, curved bars, energy methods, buckling and elastic stability; inelastic and plastic deformations; and use of computational finite element analysis (FEA) software. Graduate standing required.

MECH 620 Nanotechnology Engineering Topics (3 semester hours)
Exploration of technical topics in nanotechnology to prepare the students to better understand engineering research in nanotechnology. Topics such as nano-physics, quantum mechanics, nano-fluidics, nano-heat transfer, nano materials and tools of nanotechnology will be covered. Applications in engineering and bioengineering will be emphasized. Graduate standing required.

MECH 623 Advanced Thermodynamics (3 semester hours)
Review of advanced topics in classical thermodynamics; topics from statistical thermodynamics including: kinetic theory of gases, distribution of molecular velocity, transport phenomena, quantum mechanics, Bose-Einstein quantum statistics, Fermi-Derac quantum statistics, and thermodynamics properties. Graduate standing required. Majors only.

MECH 625 Advanced Heat Transfer (3 semester hours)
This course will cover fundamentals of conduction, convection, radiation, and basics of heat transfer numerical methods. The focus will be on theoretical and numerical analysis of 2D conduction, conservation of mass, momentum and energy in integral and differential forms; laminar and turbulent, forced, natural convection in internal and external flows, introduction to radiation, basics of numerical methods such as finite difference and finite volume, and introduction to ANSYS Fluent software. Graduate standing required.

MECH 631 Elasticity (3 semester hours)
Analysis of stress and strain, stress tensor, Mohr's circles for stress and strain, Hooke's law and stress-strain diagrams, equations of equilibrium and compatibility, two-dimensional plane problems in elasticity, Airy stress functions, failure criteria, stresses in thin-walled cylinders and spheres, stress concentration factors, stresses in thick-walled cylinders and disks, energy methods. A brief introduction to the mathematics of vector calculus and indicial notation. Graduate standing required.

MECH 634 Fatigue (3 semester hours)
A study of metal fatigue in engineering describing macro/micro aspects, stress life approach, cycling deformation and strain-life approach, as well as the applications of linear elastic fracture mechanics approach to fatigue crack growth. Graduate standing required.

MECH 635 Structural Dynamics (3 semester hours)
Beam vibration; boundary conditions; modes; approximate and exact solutions; general matrix formulations and interrelationships; decoupling by transformation to modal coordinates; free and forced response; experimental approaches; modal truncation; mode acceleration method; component mode synthesis; formulation of large-order system responses (time and frequency domain); load transform matrices; introduction to finite elements. Graduate standing required.

MECH 637 Rapid Prototyping (3 semester hours)
The course provides students with an opportunity to conceive, design, and implement a product using rapid prototyping technologies and computer-aided tools. Topics such as principles of rapid prototyping, rapid prototyping materials, reverse engineering, rapid tooling, medical applications, industry perspectives, and current research and developments will be introduced to students through laboratory works. Several rapid prototyping machines will be used for class projects. Graduate standing required. Majors only.

MECH 638 Random Vibrations (3 semester hours)
Classification and description of random data (stationarity, ergodicity, cross-correlation, cross spectra); stationary random process theory (one or two variables, Gaussian distribution, correlation, spectral density); linear input-output relations (single and multiple inputs, ordinary, multiple and partial coherence); statistical error in random data analysis; bias; digital signal processing (FFT, spectra, coherence, aliasing, windowing, averaging); nonstationary data; specifications for testing for structural and equipment survival. Graduate standing required.

MECH 639 Design for Additive Manufacturing (3 semester hours)
This course provides practical guidance to design parts to gain the maximum benefit from what the additive manufacturing can offer. The course starts with discussions on part complexity, instant assemblies, part consolidation, mass customization, freedom from design, light weighting. It will discuss Design for AM guidelines for design parts, AM tooling design, polymer design, metal AM design. It will also discuss the post-processing and the future of additive manufacturing. The students will learn principles for successful engineering design for components for Additive Manufacturing through lecture and projects. Graduate standing required.

MECH 653 New Product Design and Development (3 semester hours)
Student-conceived and/or corporate-sponsored team projects leading to a final prototype and business plan of a new product. Concept generation, team dynamics, customer needs analysis, product function, risk, decision theory, prototyping, manufacturing planning, specifications, quality function deployment, and cost analysis. Cross-listed with the considerations when developing the design and business plan. Final oral presentation in front of a panel of industry experts in engineering and business. Graduate standing required. Majors only.

MECH 685 Research Project (3 semester hours)
Faculty guided mechanical engineering-related research project. Formal requirements must be obtained from the Program Director. Graduate standing in the Combined B.S./M.S. degree program and consent of the Department and project advisor required. Majors only. Credit/No Credit only.

MECH 686 Master's Thesis (3 semester hours)
The student electing the thesis option must obtain a thesis advisor before Departmental consent will be considered. The student must enroll in the thesis course during two semesters. Formal requirements may be obtained from the Program Director. Graduate standing and consent of the Department and thesis advisor required. Majors only. Credit/No Credit only.

MECH 698 Special Studies (1-3 semester hours)
Graduate standing required. Majors only.

MECH 699 Independent Studies (1-3 semester hours)

MECH 2100 Design and Manufacturing (3 semester hours)
Introduction to the product design process, including design goals and requirements, and concept generation and selection. Use of computer-aided design (CAD) software for basic part modeling, assembly design, and the creation of two-dimensional (2D) manufacturing drawings. Introduction to design for manufacturing (DFM) guidelines, geometric dimensioning and tolerance (GD&T), datums, tolerance types and applications, and true position tolerancing. Laboratory exercises related to the use of manual and computer numerically controlled (CNC) manufacturing machines, including 3D printers, laser cutters, mills and lathes. Prerequisite: ENGR 1300

MECH 2200 Mechanical Engineering Lab I (0 semester hours)
Concurrent laboratory for EECE 2220, MECH 2210, and MECH 2230. Laboratory experiments in the areas of instrumentation and measurement, material science, and thermodynamics.

MECH 2210 Materials Science (4 semester hours)
Introduction to materials, including ferrous and non-ferrous alloys, ceramics, and polymers. Introduction to basic material chemistry, bonding, crystallography, imperfections, thermodynamics and diffusion, and equilibrium phase diagrams. Laboratory exercises related to optical microscopy and the measurement of mechanical properties, including hardness, strength, and electrical resistivity. Prerequisite: CHEM 114 Co-requisite: MECH 2200

MECH 2230 Thermodynamics (4 semester hours)
Thermodynamic properties, work and heat, the first and second laws of thermodynamics, entropy, irreversible processes, intro to exergy analysis, thermodynamic analysis of power cycles and refrigeration cycles, and gas vapor mixtures and air-conditioning. Laboratory exercises related to power and refrigeration cycles. Prerequisites: MATH 132 and PHYS 1100 Co-requisite: MECH 2200

MECH 3100 Mechanical Engineering Lab II (0 semester hours)
Concurrent laboratory for MECH 3110, MECH 3120 and MECH 3130. Laboratory experiments in the areas of mechanics of materials, dynamics and controls, and fluid mechanics.

MECH 3110 Mechanics of Materials (4 semester hours)
Normal stress, shear stress, and material properties. Stress, strain, and deflection for axial loading, torsion, and bending. Statically indeterminate axially and torsionally loaded members. Power transmission of shafts. Column buckling. Combined loading, stress transformations, and stress concentrations. Introduction to failure theories. Use of computer-aided design (CAD) and finite element analysis (FEA) software. Laboratory exercises related to tensile properties of materials, stress concentrations, bending, and column buckling. Prerequisite: EECE 2220 and ENGR 2001 Corequisite: MECH 3100

MECH 3120 Dynamics and Control I (4 semester hours)
Introduction to the dynamics and vibrations of lumped-parameter models of mechanical systems. Force-momentum formulation for systems of particles and rigid bodies in planar motion. Work-energy concepts. Free and forced vibration of single degree of freedom models of mechanical systems. Frequency response functions and system input/output analysis via transfer functions. Proportional“integral“derivative (PID) feedback control. Laboratory exercises related to rigid body motion, free response of oscillatory systems, PID feedback and control, and frequency response analysis. Prerequisites: EECE 2220, ENGR 2001, and MATH 246.

MECH 3130 Fluid Mechanics (4 semester hours)
Fluid statics, fluid dynamics, conservation of mass and momentum, differential analysis of fluid flow, pipe losses, lift and drag, turbulent and laminar flows. Laboratory exercises related to pipe flow, lift and drag, and conservation laws. Prerequisites: EECE 2220 Corequisites: MECH 3100 and MATH 246.

MECH 3200 Mechanical Engineering Lab III (0 semester hours)
Concurrent laboratory for MECH 3210, MECH 3220 and MECH 3230. Laboratory experiments in the areas of machine design, dynamics and controls, and heat transfer.

MECH 3210 Machine Design (4 semester hours)
The nature of mechanical design and materials. Stress and deformation analysis, combined stresses, and stress transformation. Design for different types of loading, including static and fatigue loading. Belt and chain drives, kinematics of gears, and spur gear design. Keys, couplings, seals, and shaft design. Rolling contact bearings. Fasteners, machine frames, bolted connections and welded joints. Use of computer-aided design (CAD) and finite element analysis (FEA) software. Laboratory exercises related to gear, belt, and chain drives, fatigue loading, and connections and joints. Prerequisite: MECH 3110. Corequisite: MECH 3200.

MECH 3220 Dynamics and Control II (4 semester hours)
Continued analysis of dynamics and vibrations of lumped-parameter models, including with two or more degrees of freedom (DOF) and under general forcing. Control design by frequency response and by root locus. Three-dimensional (3D) rotation of rigid bodies, general motion of rigid bodies. Laboratory exercises related to 3D rotation of rigid bodies, 2DOF systems and mode shapes, general forcing, and control design by frequency response and/or root locus. Prerequisite: MECH 3120 Corequisite: MECH 3200

MECH 3230 Heat Transfer (4 semester hours)
Fundamentals of heat transfer mechanisms, including conduction, convection, and radiation. Steady-state and transient conduction. Forced and free convection. Radiation between surfaces. Design and analysis of heat exchangers. Laboratory exercises related to conduction, convection, and heat exchangers. Prerequisites: EECE 2220, MATH 246, and MECH 2230 Corequisites: MECH 3200

MECH 4100 Capstone Design I (3 semester hours)
First half of the year-long and team-based culminating mechanical engineering design project. System requirements, specifications, and engineering standards. Design concept generation and selection. Design analysis and modeling, design for manufacturing and assembly (DFMA), and preliminary prototyping. Use of computer-aided design (CAD) and relevant analysis software. Formal project reviews and design documentation reports. Corequisite: MECH 4190. Senior Standing required.

MECH 4190 Professional Practice (1 semester hour)
teamwork strategies, evaluation of design economics, and project budgeting. Ethics and professional responsibility.

MECH 4200 Capstone Design II (3 semester hours)
Continuation of the year-long and team-based culminating mechanical engineering design project. Design iteration and troubleshooting. Final design manufacturing, assembly, and testing. Validation of design performance through experimental testing of the system components and subsystems. Formal project reviews and design documentation reports.