Course Descriptions

MECH 211
Computer Aided Design
2 Semester Hours
Introduction to computer aided design (CAD) techniques and applications to design, analysis and manufacturing problems. Topics include parametric solid modeling of parts and assemblies, design optimization, two-dimensional drawings, geometric dimensioning and tolerancing and rapid prototyping of assemblies. Students work in teams for their final project and presentation and use SolidWorks as the primary design and analysis software package.
Lecture / Laboratory, 2 hours.

MECH 212
Mechanics of Materials
3 Semester Hours
Development of relationships between loads applied to an elastic body to stresses and deformations produced in the body, the relation between stresses and strains, approaches for finding necessary dimensions of a member with respect to material capabilities and design constraints.
Lecture, 3 hours.
Prerequisites: ENGR 200.

MECH 213
Dynamics
3 Semester Hours
Kinematics and kinetics of particles and rigid bodies, Newton’s Laws, application of principles of work and energy, impulse and momentum, introduction to vibrations.
Lecture, 3 hours.
Prerequisites: ENGR 200 and MATH 234.

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.
Lecture, 3 hours.
Prerequisites: MATH 132.

MECH 260
Nanotechnology
3 Semester Hours
An introduction to the nanotechnology language, relationship between the macroscopic, microscopic, and nanoscopic worlds, and exploring the social and ethical implications. Applications will be covered in biology, medicine, computers, and electronics.
Lecture, 3 hours.
Prerequisites: For non-majors only, MATH 101 or higher, or placement into MATH 106 or higher.
MECH 261  
**Biotechnology**  
3 Semester Hours  
An introduction to the integration of nanotechnology and molecular biology to solve industrial, economic, and medical problems. Such topics will include biological processes, DNA sequencing, recombinant DNA, genes, RNA, proteins, engineering bacteria, cloning, diagnostics, and drug delivery. The social and ethical implications will be covered.  
Lecture, 3 hours.  
Prerequisites: For non-majors only, MATH 101 or higher, or placement into MATH 106 or higher.

MECH 262  
**Information Technology**  
3 Semester Hours  
An introduction to communication systems and data processing. Such topics will include the electromagnetic spectrum, analog/digital transmission, Internet, computers, telephones, cell phones, radio, television, micro/nano-electronics, the history of modern information technology, and the social/ethical consequences.  
Lecture, 3 hours.  
Prerequisites: For non-majors only, MATH 101 or higher, or placement into MATH 106 or higher.

MECH 270  
**Materials**  
3 Semester Hours  
Introduction to the chemistry and physics of different materials. Types of materials (metals, ceramics, polymers, and composites) and the relation between their structure and properties. Selection of materials in different applications.  
Lecture, 3 hours.  
Prerequisites: For non-majors only, MATH 101 or higher, or placement into MATH 106 or higher.

MECH 277  
**Systems of Energy Conversions**  
3 Semester Hours  
Introduction to the engineering disciplines and the fundamentals of energy conversions for non-engineering majors. Topics will include: introduction to different engineering disciplines, defining important parameters used in engineering, engineering components, engineering systems, energy conversion devices, and demonstration of engineering laboratories and equipment.  
Lecture, 3 hours.  
Prerequisites: For non-majors only, MATH 101 or higher, or placement into MATH 106 or higher.

MECH 301  
**Measurements and Controls**  
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.  
Lecture, 3 hours.  
Prerequisites: MATH 245.

MECH 302  
**Thermo, Fluids and Materials Laboratory**  
2 Semester Hours  
Students, working in teams, implement experimental projects in the disciplines of materials science, fluid mechanics, and thermodynamics. Lab safety, instrumentation, test planning, data analysis, and report writing are emphasized.  
Lecture / Laboratory, 2 hours.  
Prerequisites: MECH 223.

MECH 303  
**Energy and Mechanics Laboratory**  
2 Semester Hours  
Students, working in teams, implement experimental projects in the disciplines of energy conversion, solid mechanics and dynamics. Lab safety, instrumentation, test planning, data analysis, and report writing are emphasized.  
Lecture / Laboratory, 2 hours.  
Prerequisite: MECH 212 and 223.
MECH 310
Elements of Design
3 Semester Hours
Design methodologies; static and fatigue failure prevention; the design and selection of various machine elements (gears, bearings, seals, hardware, etc.); design of subsystems and assemblies using the rules of datum features; two-dimensional drawings; geometric dimensioning and tolerancing. Design for manufacturing, assembly, serviceability, and the environment. Design intent documentation and comprehensive design projects.
Lecture, 3 hours.
Prerequisites: MECH 211, 212 and 213.

MECH 313
Materials Science
3 Semester Hours
A study of metallic, polymeric, and ceramic materials, emphasizing dependence of mechanical and electrical properties on solidstate bonding forces and microstructure. Introductory design considerations.
Lecture, 3 hours.
Prerequisites: CHEM 111 and 114.
Corequisite: MECH 302.

MECH 321
Energy Systems
3 Semester Hours
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 such as: levelized cost of energy, payback period and incentives.
Lecture, 3 hours.
Prerequisites: MECH 223.

MECH 322
Fluid Mechanics
3 Semester Hours
Properties of fluids, fluid statics, kinematics, energy, hydrodynamics, momentum and dynamic forces, steady flow of compressible and incompressible fluids.
Lecture, 3 hours.
Prerequisites: MATH 245.

MECH 323
Heat Transfer
3 Semester Hours
Lecture, 3 hours.
Prerequisites: ENGR 160 and MECH 223.

MECH 401
Design Practicum 1
3 Semester Hours
The initial phases of an integrated senior capstone design project that utilizes knowledge learned from the mechanical engineering undergraduate curriculum. Implementation of the design process in order to meet realistic constraints for a given project. Computer aided design (CAD) and analysis of system components and subsystems. Design project reviews and design intent documentation.
Lecture / Laboratory, 3 hours.
Prerequisites: At least senior standing required.

MECH 402
Design Practicum 2
The final phases of the integrated senior capstone design project. Design iterations, component interaction and interfacing, fabrication, assembly and experimental testing of the system components and subsystems. Development and completion of an experimental testing procedure. Final student project presentations and reports.
Lecture / Laboratory, 3 hours.
Prerequisites: MECH 401.
MECH 410  
Design and Manufacturing Laboratory  
2 Semester Hours  
Common design testing procedures and various manufacturing operations. Design for machining, dimensional accuracy and geometric dimensioning and tolerancing. Computer numerically controlled (CNC) machining. Fatigue testing, design of weldments, fastener selection, design of experiments and robotic programming.  
Lecture / Laboratory, 2 hours.  
Prerequisites: MECH 310.

MECH 411  
Entrepreneurial Product Design  
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, and cost analysis. Cross-listed with the business school to include entrepreneurship, marketing, and financial considerations when developing the design and business plan. Final oral presentation in front of a panel of industry experts in engineering and business.  
Lecture / Laboratory, 3 hours.  
Prerequisites: Senior standing required.

MECH 423  
Thermal Systems Engineering  
3 Semester Hours  
Selected topics from thermodynamics, fluid mechanics, and heat transfer to include: review of fundamental concepts; boundary layer theory; isentropic flow through nozzles; shock waves; exergy analysis; gas mixtures; heat exchangers and design.  
Lecture, 3 hours.  
Prerequisites: MECH 223, 322, 323.

MECH 493  
Mechanical Engineering Internship  
1-3 Semester Hours  
Engineering analysis, testing, design, and/or production work conducted by the student in an industrial setting. The work will be supervised jointly by an engineer with the industrial firm and by a mechanical engineering faculty member. The project must be pre approved by the department.

MECH 501  
Eco-marathon Vehicle Practicum  
3 Semester Hours  
Participation in the Shell Eco-marathon Americas student design competition. Computer aided design (CAD), analysis, fabrication and testing of vehicle components and systems. Design of new vehicle components and subsystems in order to improve fuel efficiency through weight reduction, improving vehicle aerodynamics and decreasing rolling resistance.  
Lecture / Laboratory, 3 hours.  
Prerequisites: Senior or graduate standing required.

MECH 504  
Engineering Mathematics  
3 Semester Hours  
Lecture, 3 hours.  
Prerequisites: Senior or graduate standing required.

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 lecture and laboratory work.  
Lecture / Laboratory, 3 hours.  
Prerequisites: Senior or graduate standing required.
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.
Lecture, 3 hours.
Prerequisites: Senior or graduate standing required.

MECH 512
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.
Lecture, 3 hours.
Prerequisites: Senior or graduate standing required.

MECH 513
Metallurgical and Materials Engineering
3 Semester Hours
Advanced topics in the relationship of the microstructures 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.
Lecture, 3 hours.
Prerequisites: Senior or graduate standing required, MECH 313.

MECH 514
Modern Methods in Materials Science
3 Semester Hours
Modern methods of understanding and characterizing the structures of current industrial materials. A range of topics will be discussed, such as electron microscopy, atomic force microscopy, quantitative stereology, quantum mechanics, band structure of solids, diffusion processing, semiconductor devices, microelectromechanical systems, mechanical defects in solids (point, line and planar), quantitative methods in metals, ceramics and composites.
Lecture / Laboratory, 3 hours.
Prerequisites: Senior or graduate standing required, MECH 313.

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.
Lecture, 3 hours.
Prerequisites: Senior or graduate standing required.

MECH 516
Finite Elements Methods
3 Semester Hours
Lecture, 3 hours.
Prerequisites: Senior or graduate standing required.

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.
Lecture, 3 hours.
Prerequisites: Senior or graduate standing required.
MECH 518
Shock and Vibration Engineering
3 Semester Hours
Harmonic Motion; phasors; vibration terminology; energy basics; single degree-of freedom systems (free and forced undamped and damped vibration, free and forced transient vibration); Laplace transform; response spectrum; two-degree-of-freedom systems; frequency response; absorbers; normal modes; coordinate coupling; orthogonality; Lagrange's equation; continuous systems (longitudinal and torsional vibration of a rod); approximate and exact solutions; wave propagation.
Lecture, 3 hours.
Prerequisites: CIVL 200 or MECH 212, MATH 245 and senior or graduate standing required.

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 PDE's, steady flow solutions, unsteady flow solutions, flows involving heat transfer.
Lecture, 3 hours.
Prerequisites: CIVL 310 or MECH 322 and senior or graduate standing required.

MECH 521
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.
Lecture, 3 hours.
Prerequisites: Senior or graduate standing required.

MECH 531
Design of Tribological Systems
3 Semester Hours
Design of systems involving components that undergo surface contact and relative motion. Analytical, computational methods and experimental techniques used to understand the friction, wear and lubrication of such systems. Conventional methods used to investigate surface friction and wear and how to minimize their effects.
Lecture / Laboratory, 3 hours.
Prerequisites: Senior or graduate standing required.

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 LRmate 200i robot will be used for lecture and class projects.
Lecture / Laboratory, 3 hours.
Prerequisites: Senior or graduate standing required.

MECH 538
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.
Lecture, 3 hours.
Prerequisites: Senior or graduate standing required.

MECH 542
Turbomachinery
3 Semester Hours
Compressor, pump, fan selection and applied theory.
Lecture, 3 hours.
Prerequisites: Senior or graduate standing required.
MECH 543
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 airbreathing and space propulsion concepts are also introduced.
Lecture, 3 hours.
Prerequisites: Senior or graduate standing required.

MECH 551
Sustainable Design
3 Semester Hours
This course focuses on design for the environment (DFE) principles and methods to create sustainable products. The major themes include: design for environmental processing and manufacturing; design for environmental packaging; and design for disposal and reuse. Includes life cycle assessment (LCA) software tools, case studies and design projects.
Lecture, 3 hours.
Prerequisites: Senior or graduate standing required.

MECH 599
Independent Studies
1-3 Semester Hours
Prerequisites: Senior standing required.

MECH 611
Advanced Elements of Design
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.
Lecture / Laboratory, 3 hours.
Prerequisites: Graduate standing required.

MECH 612
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, classification of rapid prototyping, rapid prototyping materials, rapid tooling, medical applications, industry perspectives and current research and developments will be introduced to students through lecture and laboratory works. Two rapid prototyping machines (FDM-1650 and Z-Corps Z510) will be used for lecture and class projects.
Lecture / Laboratory, 3 hours.
Prerequisites: 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.
Lecture, 3 hours.
Prerequisites: Graduate standing required.

MECH 621
Solar Thermal Energy Systems
3 Semester Hours
In depth study of solar thermal energy systems. Flat plate collectors, concentrating collectors, hybrid PV/thermal collectors, solar powered heating and cooling.
Lecture, 3 hours.
Prerequisites: MECH 323 (or equivalent) and graduate standing required.
MECH 623
Advanced Thermodynamics
3 Semester Hours
Lecture, 3 hours.
Prerequisites: 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.
Lecture, 3 hours.
Prerequisites: Graduate standing required.

MECH 633
Electronic Properties of Materials
3 Semester Hours
Theory, properties and device applications of materials from the point of view of their dielectric, electrical, optical, and magnetic behavior.
Lecture, 3 hours.
Prerequisites: 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.
Lecture, 3 hours.
Prerequisites: Graduate standing required.

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.
Lecture, 3 hours.
Prerequisites: Graduate standing required.

MECH 643
Advanced Heat Transfer
3 Semester Hours
Review of the modes of heat transfer and conservation principles. Topics include: two and three dimensional conduction; numerical methods; differential equations of laminar boundary layers; momentum transfer and heat transfer for laminar flow inside tubes; momentum transfer and heat transfer for external boundary layers; differential equations of turbulent boundary layers; experimental techniques.
Lecture, 3 hours.
Prerequisites: Graduate standing required.

MECH 651
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 business school to include entrepreneurship, marketing, and financial considerations when developing the design and business plan. Final oral presentation in front of a panel of industry experts in engineering and business.
Lecture / Laboratory, 3 hours.
Prerequisites: Graduate standing required.
**MECH 685**  
*Research Project*  
3 Semester Hours  
Faculty guided mechanical engineering related research project. Formal requirements must be obtained from the Program Director. Prerequisites: Graduate standing in the Combined B.S./M.S. degree program and consent of the Department and project advisor.

**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 must be obtained from the Program Director. Prerequisites: Graduate standing and consent of the Department and thesis advisor.