MECHANICAL (MECH)

MECH2000 ENGINEERING STATICS
The vector approach of the equilibrium of particle and rigid bodies is presented. Trusses, frames, shear and bending moment diagrams, centroids and moments of inertia are studied. ***Prerequisites:*** *MATH1850 or MATH1875 or MATH1877; and PHYS1250 (4 credits)*

MECH2250 ENGINEERING THERMODYNAMICS I
Thermodynamics properties, work and heat interaction are defined. The First and Second laws of thermodynamics are introduced. Conservation of mass and energy and the entropy and the exergy balance relations are applied in analyzing thermodynamic systems. Alternative energy sources and fuel cells are discussed. Psychrometric applications in the air conditioning processes are covered. Laboratory experiences reinforce the classroom theory. ***Prerequisites:*** *MATH1850 or MATH1875; and PHYS1750 (4 credits)*

MECH2300 ENGINEERING GRAPHICS
Basic concepts of engineering graphics, design and sketching, tolerance analysis and ANSI standard drawings are explored using CAD. ***Prerequisite:*** *ENGR1600 (3 credits)*

MECH2400 APPLIED MECHANICS
This course will cover the equilibrium of particles and rigid bodies. Internal forces in structures such as trusses frames and machines are determined. Axial, torsional, bending and transverse stresses in beams and other structures are calculated. Stress transformation is discussed. Topics such as thermal deformation, statically indeterminate structures, Mohr's circle and buckling is also covered. Four laboratory experiments are used to complement the theoretical learning. ***Prerequisites:*** *PHYS1750 and MATH1850 (4 credits) fall*

MECH2500 MECHANICS OF MATERIALS
The concepts of stress and strain and their relation are introduced. Axially loaded members, temperature effect, torsion, bending, combined loading and stress trans-formations are studied. Stability and buckling of columns are discussed. Laboratory experiences reinforce classroom theory. ***Prerequisite:*** *MECH2000 (4 credits)*

MECH2600 MECHANICAL DESIGN & ANALYSIS
This 3-D Computer Aided Design course provides experience in mechanical engineering design and analysis. Assembly component interface tolerance analysis to ensure manufacturability of designs and basic finite element analysis of parts and assemblies are conducted. ***Prerequisites:*** *MECH2000 and MECH2250 and MECH2500 and ENGR1800 (3 credits)*

MECH2750 ENGINEERING THERMODYNAMICS II
Studies vapor power systems including the Rankine cycle and its modifications for use with both fossil and nuclear fuels, vapor compression refrigeration systems, and all-gas cycles including the Brayton cycle and its modifications; the Otto cycle; the Diesel cycle; and supercharging and turbocharging. Introduces the concepts of exergy and second law efficiency. Studies non-reacting mixtures with applications to air/water/vapor mixtures for air conditioning systems and cooling towers. Discusses the elements of optimum power plant design. Laboratory experiences enforce the classroom theory. ***Prerequisite:*** *MECH2250 (4 credits)*

MECH3000 DESIGN OF MACHINE ELEMENTS
This course covers the basic concepts and principles in the design and analysis of machine components. The analysis in design is based on the traditional stress analysis from mechanics of materials and also on the finite element formulation based on theory of elasticity. Plane stress, three-dimensional stress and strain, combined stresses, failure criteria and reliability, fatigue, are considered in the analysis of machine elements: rolling bearings, spur gears, flexible elements, and shafts. ***Prerequisite:*** *MECH2500 (4 credits)*

MECH3025 SCANNING ELECTRON MICROSCOPY: IMAGING, ANALYSIS AND EVALUATION
This course will look at the use of fundamental physics and chemistry principles as a basis for advanced analysis of biological and synthetic objects. An integrated approach of on-line research, lecture, demonstration, and student exploration along with optical and scanning electron microscopy (SEM) will be used to verify findings. physical and elemental details that cannot normally be seen will be imaged and evaluated to gain an understanding of how naturally occurring and engineered products are developed. Based on student interest, additional analysis techniques will also be presented. ***Prerequisites:*** *CHEM1100 and PHYS1250 (4 credits)*

MECH3050 FUNDAMENTALS OF HVAC SYSTEMS
Moist air properties and air conditioning processes will be covered through theory, Psychometrics chart and Laboratory experiment. Building maximum heat loss (heating load in winter) and heat gain (cooling load in summer) calculations will be discussed along with different heating and cooling systems and subsystems such as hot air, hydronic, vapor compression, absorption Refrigeration Cycles. Degree-day and bin methods to estimate building energy consumption will be covered. ***Prerequisite:*** *MECH2250 (4 credits) summer*

MECH3100 ENGINEERING FLUID MECHANICS
Mechanics of fluids with emphasis on control volume analysis are studied. The continuity, energy and momentum principles are applied to real fluids. Additional emphasis is on electromechanical systems and laboratory exercises. ***Prerequisite:*** *MATH2025 and MECH2250 (4 credits)*

MECH3175 MECHANICAL FUNDAMENTALS FOR ROBOTICS
This course covers computational methods in kinematics and dynamics of spatial and planar robotic mechanisms. It introduces the analysis of positions, velocities, accelerations, actuating forces, and actuating torques, as well as industrial robot applications. Students gain hands-on experience in simulating and implementing robotic arms and mechanisms with multiple degrees of freedom. (4 credits) fall

MECH3200 NUMERICAL SIMULATION & CFD
This is an advanced new undergraduate and graduate course that explores the fundamentals of different engineering problems with different simulation techniques and CFD. The course will present several important topics such as modeling techniques and CFD. The topics will cover different techniques to solve multidisciplinary engineering problems. The basic knowledge will be applied to typical problems in aerospace and different engineering applications. ***Prerequisites:*** *MECH3100 and MECH2300 (4 credits)*

MECH3250 INTERMEDIATE MATLAB
The goal of this course is to develop the skills and confidence to use MATLAB as an effective tool in solving engineering problems. The basics of MATLAB will first be reviewed and the expanded upon. A variety of topic will be covered, including object-oriented programming, solving ordinary and partial differential equations, creating GUI's, the use of plot handles, and writing efficient code. ***Prerequisites:*** *ENGR1800 and MATH2500 (3 credits)*

MECH3300 INTRODUCTION TO LabVIEW & DATA ACQUISITION
This course introduces students to the methods and techniques used in LabVIEW and data acquisition. The topics emphasized are basic programming structures and best practices for programing in the LabVIEW environment. Additional topics include the fundamental concepts of data acquisition, techniques to obtain and analyze measurements of physical properties and quantities related to the field of mechanical engineering. ***Prerequisites:*** *MECH2500, MECH2250 and ELEC2799. (4 credits)*

MECH3350 GAS DYNAMICS
This course is an introductory course to the subject of applied Gas Dynamics where the effect of compressibility on fluid flow is introduced. It starts with some basic notions of fluid flow and thermodynamics followed by one dimensional compressible flow. Normal and oblique shock waves. Construction and design of aircraft gas turbine engine. Simulation and CFD analysis of compressible flow and convergent-divergent nozzles. ***Prerequisites:*** *MECH3200 (4 credits)*

MECH3400 RELIABILITY-BASED MECHANICAL DESIGN
Techniques for the quantification of uncertainty and risk inherent in mechanical components and systems; and the implementation of reliability-based design in mechanical components and systems. (4 credits) ***Prerequisite:*** *MECH3000*

MECH3450 ADVANCED DESIGN THEORY FOR MECHANICAL COMPONENTS
Why does a mechanical component with a specified factor of safety as 2.4 still fail? The traditional mechanical component design theory cannot answer this vital design question. The advanced design theory for mechanical components uses reliability to describe the safety of a component and clearly explains that any design component will fail due to the variation of material strength, loading and dimension of the component This course will address techniques for the quantification of uncertainty and risk inherent in mechanical components and implement reliability as the safety index to design mechanical components. ***Prerequisite:*** *MECH2500 (3 credits)*

MECH3599 ENGINEERING MECHANICS
This course covers static equilibrium and dynamic motion. Major components of this course are force vectors, equilibrium of a particle, resultant and internal forces, centroids, center of gravity, stress and strain, torsion, moments of inertia, shearing, deflection, kinematics of a particle, kinetics of a particle, force, acceleration, work and energy, impulse and momentum. The course includes labs that correspond to the lecture material. ***Prerequisites:*** *MATH2025 and PHYS1750 (4 credits)*

MECH3600 MATERIALS SCIENCE
This is an introductory course into the structure and properties of materials. Subjects include the processing of materials, crystal structure, miller indices, composition, alloying, electrical properties, phase diagram, corrosion, diffusion, heat treating, inspection, and testing of materials utilized in the electromechanical field. The lab-oratory activities will reinforce the classroom theory. ***Prerequisite:*** *Junior status and MECH2500 or MECH2400 (4 credits)*

MECH3650 AERODYNAMICS
This course is an introductory course to the subject of Aerodynamics. Fundamentals physical quantities and the source of all aerodynamics forces, continuity, momentum and energy equations. Measurement of airspeed: incompressible flow, subsonic compressible flow, supersonic flow. Introduction to viscous flow, laminar and turbulent boundaries, transition, flow separation. Airfoils, wings and other aerodynamic shapes. Elements of airplane performance, equations of motion, thrust, power and maximum velocity. Principles of stability and control (static and dynamic stability, control), moments on the airplane, absolute angle of attack. Astronautics: differential, Lagrange's and orbit equations. ***Prerequisite:*** *MECH3350 (4 credits)*

MECH3800 SPECIAL TOPICS IN MECHANICAL ENGINEERING
Presents topics that are not covered by existing courses and are likely to change from semester to semester. Refer to the Class Schedule for a specific semester for details of offerings for the semester. (1 - 4 credits)

MECH3850 ENGINEERING DYNAMICS
This course covers the kinematics and kinetics of particles and rigid bodies. Kinetic problems are analyzed by utilizing the second law of Newton, work and energy and impulse momentum methods. Dynamics simulation software is used to reinforce the theory. ***Prerequisites:*** *MECH2000 or MECH2400 and MATH2500 (4 credits) spring*

MECH3900 ENGINEERING HEAT TRANSFER
Conduction, convection, and thermal radiation heat transfer mechanisms are described. Steady-state and transient conduction problems are discussed. Convective heat transfer mechanisms and various correlations to evaluate the heat transfer coefficient are discussed. Heat exchanger analysis and thermal radiation heat transfer between surfaces are presented. ***Prerequisites:*** *MECH2250 and MECH3100 and MATH2500 (4 credits)*

MECH4000 MECHANICAL VIBRATION
General theory of free, damping and forced vibrations with one and two degrees of freedom; vibration suppression and isolation; natural frequencies and mode shapes in continuous mechanical systems through analytical method and numerical simulation. ***Prerequisites:*** *MATH2500 and MECH2500 and MECH3850 (3 credits)*

MECH4040 MECHANISMS AND MACHINES
This course covers the kinematics and dynamics of machinery. While the course is on the topics of analysis of mechanisms and machines, it emphasizes also the use of computer-aided engineering as an approach to the design and analysis. Positional, velocity, acceleration, and force are considered in the traditional analysis of mechanisms and machines. The course is an ideal vehicle for introducing the mechanical engineering student to the process of design, since mechanisms tend to be intuitive for the typical mechanical engineering student to visualize and create. ***Prerequisite:*** *MECH3850 (4 credits)*

MECH4200 SIMULATION BASED DESIGN
This 3-D computer aided design course provides experience in mechanical engineering simulation and design verification analysis. Finite Element Analysis of parts and assemblies are conducted. ***Prerequisite:*** *MECH3000 (4 credits) spring*

MECH4400 ENGINEERING THERMAL DESIGN
Studies vapor power systems including the Rankine cycle and its modifications for use with both fossil and nuclear fuels, vapor compression refrigeration systems, and all-gas cycles including the Brayton cycle and its modifications; the Otto cycle; the Diesel cycle; and supercharging and turbocharging. Introduces the concepts of energy and second law efficiency. Studies non-reacting mixtures with applications to air/water/vapor mixtures for air conditioning systems and cooling towers. Discusses the elements of optimum power plant design. Laboratory experiences enforce the classroom theory. ***Prerequisites:*** *MECH2250 and MECH3100 and MECH3900 (3 credits)*

MECH4425 ADVANCED MECHANICS OF MATERIALS
Stress analysis, the development of strain, stress concentrations, failure theories and fatigue are studied. Shafts, gears, and other elements are also considered. Laboratory problems and appropriate projects are assigned. ***Prerequisites:*** *MECH2500 and ELEC2850 and MATH2025 and MATH2100 (4 credits)*

MECH5000 MECHANICAL ENGINEERING CAPSTONE ANALYSIS
This capstone research-based course is for senior-level mechanical engineering students who will formulate a topic and initiate their capstone project for an innovative technological device or system. Students are encouraged to take an interdisciplinary approach to their design project with research directed by one or more faculty advisors. ***Prerequisite:*** *Senior status (3 credits)*

MECH5500 MECHANICAL ENGINEERING CAPSTONE PROJECT
This capstone project course is for senior-level mechanical engineering students who will formulate a topic and develop a project for an innovative technological device or system. Students are encouraged to take an interdisciplinary approach to their design project, and the work will be performed under the direction of one or more faculty advisors. Course requirements include oral and written progress reports throughout the semester plus a final comprehensive technical report. ***Prerequisites:*** *Senior status and MECH4200 (4 credits)*

MECH6000 ADVANCED AERODYNAMICS
This course covers advanced aerodynamics with an emphasis on the analysis and design of aerospace vehicles, in particular fixed-wing, launch/atmospheric return vehicles. It also addresses rotating systems and focuses on the exact solutions of Navier Stokes equations. Other topics include integrated aerodynamics, high angle-of-attack aerodynamics, hypersonic shock, and expansion relations. (3 credits)

MECH6050 GAS DYNAMICS
This course covers advanced topics in gas dynamics. The course starts with one-dimensional compressible flow. This is followed by a focus on the effect of compressibility on fluid in internal flow, including isentropic flow, normal and oblique shock waves, expansion fan, flows with heat transfer (Rayleigh line), and friction (Fano line). Several computational procedures, such as a non-iterative method to locate a normal shock in converging-diverging nozzles and in a constant area duct with friction, are introduced. (3 credits)

MECH6060 CONTROL OF MECHANICAL SYSTEMS
This course introduces students to the theory, analysis, and design of control systems, including mechanical, electromechanical, fluid, and thermal systems. It covers the modeling of control systems via differential equations and transfer functions, analysis of control systems in the time and frequency domains, stability, and feedback. It provides basic design tools, including root-locus, frequency response (bode plots), and state space methods. Students learn how to use computers for the analysis and design of control systems. (3 credits)

MECH6070 ADDITIVE MANUFACTURING AND PRODUCT DEVELOPMENT
This course addresses predominant additive manufacturing (AM) technologies with an emphasis on related product applications. A contrast to traditional manufacturing processes, the concept of design freedom made available by AM is explored through the principles of design for additive manufacturing (DfAM). Lecture content is reinforced with the use of several commercial-scale 3D printers available to students.(3 credits)

MECH6100 RELIABILITY IN MACHINE DESIGN
This course provides design parameters as random variables and uses reliability as a measurement of component safe status to replace the traditional factor of safety in mechanical design. The course covers the following topics: fundamentals of probability theory; typical types of distributions; reliability computational methods; reliability calculation of a component under static and cyclic loads; component dimension design with required reliability; and introduction to system reliability. Simulation tools are used for reliability calculations and dimension design with required reliability. (3 credits)

MECH6125 INTERNAL COMBUSTION ENGINES
This course is an introduction to the fundamental concepts required for the design and analysis of spark-ignition(SI) and compression-ignition (CI) internal combustion engines. Important design and operating parameters will be covered, such as compression ratio, fuel-air ratio, volumetric efficiency, ignition, and injection timing, mean effective pressure, and specific fuel consumption, as well as their effect on engine performance characteristics. The dynamics of the reciprocating motion of the piston/connecting rod/crankshaft will be analyzed, as well as the thermochemistry of combustion, fuel delivery, and gas exchange processes, with an emphasis on thermodynamic cycle simulation. This course will also discuss subsystems such as air and fuel delivery systems, cooling and lubrication systems, and exhaust system. (3 credits)

MECH6150 SPATIAL MECHANISMS IN ROBOTICS
This course covers the computational methods of spatial mechanisms in kinematics and dynamics in order to solve real-world problems in the manipulation of robots. Students engage in the analysis of and solve problems related to positions, velocities, accelerations, actuating forces, and torques. (3 credits)

MECH6175 PLANAR MECHANISMS AND MACHINES
This course covers the kinematics, dynamics, and statics of machinery. It also emphasizes the use of computer-aided engineering as an approach to the design and analysis of planar mechanics. Position, velocity, acceleration, and force are considered in the vector and matrix form for analysis of mechanisms and machines. (3 credits)

MECH6200 THEORY OF ELASTICITY AND PLASTICITY
This course provides students with fundamental knowledge of the theory of elasticity and plasticity. It covers the following topics: general stress and strain equations, equations of equilibrium and compatibility, and constitutive laws for elastic materials; the Airy stress function and its applications; plate bending; the basic three-dimensional theory of elasticity; and the basic theory of plasticity and yield criteria.(3 credits)

MECH6225 RHEOLOGY AND COMPLEX FLUIDS
This course covers the basic concepts of rheology and the mechanical behavior of fluid systems in engineering applications. It studies rheometers and theoretical aspects of rheology, as well as the basic forces influencing complex fluids and rheology, including van der Waals, electrostatic, and other interactions. Students learn methods of characterizing structure, including scattering techniques, optical polarimetry, and microscopy. (3 credits)

MECH6250 ADVANCED FLUID MECHANICS
This course introduces advanced topics in fluid mechanics, focusing on the mathematical and physical foundations of viscous flow dynamics. Continuity, Navier-Stokes, and energy equations are presented in the context of the differential control volume approach. Methods of boundary-layer flow solutions and turbulent flows in jets and wakes are also covered. (3 credits)

MECH6275 MATERIALS AND METHODS
This course provides advanced knowledge of the behavior of materials. It covers the following topics: notches; fracture mechanics; mechanical behavior of metals, ceramics, polymers, and fiber-reinforced composites; creep; and fatigue. Methods for making materials are introduced in lecture; these include vacuum-bagging of composites and mold design for casting. In addition, simulation methods for evaluating the fatigue and creep behavior of materials are taught.(3 credits)