M E-MECHANICAL ENGINEERING

M E 210. Electronics and System Engineering
3 Credits (2+3P)
Introduction to microcontrollers, measurement systems, motion actuators, sensors, electric circuits, and electronic devices and interfacing. Students required to work individually and in teams to design and test simple electromechanical systems. Restricted to Las Cruces campus only. May be repeated up to 3 credits.
Prerequisite: C- or better grade in MATH 1521G or MATH 1521H or ENGR 190.
Learning Outcomes
1. Ability to apply knowledge if mathematics, science, and engineering;
2. Ability to design and conduct experiments, as well as to analyze and interpret data;
3. Ability to design a system, component or process to meet desired needs within realistic constraints;
4. Ability to identify, formulate, and solve engineering problems;
5. Ability to use the techniques, skills and modern tools necessary for engineering practice.

M E 228. Engineering Analysis I
3 Credits (3)
Introduction to engineering analysis with emphasis on engineering applications. Topics include ordinary differential equations, linear algebra, and vector calculus with focus on analytical methods. May be repeated up to 3 credits.
Prerequisite: C- or better grades in MATH 2530G.
Learning Outcomes
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

M E 234. Mechanics-Dynamics
3 Credits (3)
Kinematics and dynamic behavior of solid bodies utilizing vector methods. May be repeated up to 3 credits.
Prerequisite: A grade of C- or better grade in the following: C E 233 and PHYS 1310G and MATH 1521G or MATH 1521H.
Learning Outcomes
1. Student will be able to apply concepts of kinematics and accelerated motion.

M E 240. Thermodynamics
3 Credits (3)
First and second laws of thermodynamics, irreversibility and availability, applications to pure substances and ideal gases. May be repeated up to 3 credits.
Prerequisite: C- or better grades in PHYS 1310G.
Learning Outcomes
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

M E 261. Numerical Methods
3 Credits (2+3P)
Introduction to programming syntax, logic, and structure. Numerical techniques for root finding, solution of linear and nonlinear systems of equations, integration, differentiation, and solution of ordinary differential equations will be covered. Multi function computer algorithms will be developed to solve engineering problems. May be repeated up to 3 credits.
Prerequisite: C- or better grades in MATH 1521G or MATH 1521H or ENGR 190.
Learning Outcomes
1. Ability to apply knowledge of mathematics, science, and engineering.
2. Ability to identify, formulate, and solve engineering problems.
3. Ability to use the techniques, skills and modern tools necessary for engineering practice.

M E 326. Mechanical Design
3 Credits (3)
Kinematics and dynamics of machinery, analytical and computer-aided design of kinematics, mechanism synthesis involving linkages, cam and gear design, and motion analysis and balancing of forces. Project-based learning of multi-mechanism system design, analysis, fabrication, and evaluation. May be repeated up to 3 credits.
Prerequisite: C- or better in ENGR 234 and C E 301.
Learning Outcomes
1. An ability to perform motion analysis of mechanisms involving various mechanical components such as linkages, cams, and gears.
2. An ability to analyze and balance dynamic forces in machines.
3. Knowledge of how to design mechanism synthesis that can function as required in machines.
4. Understanding of ethics and professional responsibilities in engineering design.

M E 328. Engineering Analysis II
3 Credits (3)
Advanced engineering analysis with emphasis on engineering applications. Topics include systems of ordinary differential equations, Fourier analysis, partial differential equations, and functions of complex variable with focus on analytical methods. May be repeated up to 3 credits.
Prerequisite: C- or better grades in M E 228.
Learning Outcomes
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

M E 331. Intermediate Strength of Materials
3 Credits (3)
Covers stress and strain, theories of failure, curved flexural members, flat plates, pressure vessels, buckling, and composites. May be repeated up to 3 credits.
Prerequisite(s): C E 301 and M E 328.

M E 332. Vibrations
3 Credits (3)
Vibration of single and n-degree of freedom systems considering free, forced, and damped motion. Lagrange s equations. Dynamic stability. Controls. Matrix iteration. May be repeated up to 3 credits.
Prerequisite: M E 328, ENGR 234, and M E 261.
Learning Outcomes
1. An ability to analyze free and forced vibrations of a single degree-of-freedom (DOF) to multi-DOF systems; and an ability to perform modal analysis for engineering structures to understand mechanical vibrations in terms of normal modes.

M E 333. Intermediate Dynamics
3 Credits (3)

Three dimensional kinematics and kinetics, orbal motion, Lagrange s equations, dynamic stability, and controls. May be repeated up to 3 credits.

Prerequisite: M E 328 and ENGR 234.

Learning Outcomes

1. An ability to derive and solve equations of motion for a dynamical system by means of analytical mechanics approach.

M E 338. Fluid Mechanics
3 Credits (3)

Properties of fluids. Fluid statics and fluid dynamics. Applications of the conservation equations continuity, energy, and momentum to fluid systems. May be repeated up to 3 credits.

Prerequisite: C- or better grade in ENGR 234 and in (M E 228 or MATH 392).

Learning Outcomes

1. Ability to apply knowledge of mathematics, science, and engineering;
2. Ability to design and conduct experiments, as well as to analyze and interpret data;
3. Ability to design a system, component or process to meet desired needs within realistic constraints;
4. Ability to identify, formulate, and solve engineering problems.

M E 340. Applied Thermodynamics
3 Credits (3)

Thermodynamic cycles, Maxwell relations, Gibbs and Helmholtz functions, mixtures, psychometrics, chemical reactions, chemical equilibrium. May be repeated up to 3 credits.

Prerequisite: C- or better grades in M E 240.

Learning Outcomes

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

M E 341. Heat Transfer
3 Credits (3)

Fundamentals of conduction, convection, and radiation. Design of heat transfer systems. May be repeated up to 3 credits.

Prerequisite: C- or better grades in M E 240 and in (M E 338 or A E 339).

Learning Outcomes

1. Students have the ability to apply knowledge of mathematics, science, and engineering;
2. Students have the ability to identify, formulate, and solve engineering problems.

M E 345. Experimental Methods I
3 Credits (2+3P)

Emphasis on experimental techniques, basic instrumentation, data acquisition and analysis, and written presentation of results. Includes experiments in dynamics and deformable body mechanics. May be repeated up to 3 credits.

Prerequisite: C- or better grades in (M E 228 or MATH 392), in (M E 210 or PHYS 2140), and in ENGR 234.

Prerequisite/Corequisite: C E 301.

Learning Outcomes

1. Ability to design and conduct experiments, as well as to analyze and interpret data;
2. Ability to communicate effectively;
3. Ability to use the techniques, skills and modern tools necessary for engineering practice.

M E 349. MAE Career Seminar
1 Credit (1)

Seminar course covering topics relevant to mechanical and aerospace engineering juniors (job placement, interviewing techniques, resume preparation, etc.). May be repeated up to 3 credits. Restricted to: M E and A E majors.

Prerequisite: Sophomore Standing.

Learning Outcomes

1. Students will learn how to prepare for their future career by learning job placement, resume preparation, interview skills, and others.

M E 400. Undergraduate Research
1-3 Credits

Performed with the direction of a department faculty member. May be repeated for a maximum of 6 credits.

Prerequisite: consent of faculty member.

M E 401. Heating and Air-Conditioning Systems
3 Credits (3)

HVAC system design including heating and cooling load calculations, psychometrics, piping, duct layout, and system control. May be repeated up to 3 credits.

Prerequisite: A grade of C- or better in E T 306.

Prerequisite/Corequisite: E T 396.

Learning Outcomes

1. Master the use of thermodynamics software, EES for this course, and design software, HVAC Calc for this course.
2. Understand the principles of indoor/outdoor psychrometrics.
3. Calculate the heating/cooling loads.
4. Design/size an HVAC system for a given building through a class project.

M E 405. Special Topics
3 Credits (3)

Topics of modern interest to be offered by the departmental staff. May be repeated up to 12 credits.

Prerequisite(s): Senior standing.

M E 425. Design of Machine Elements
3 Credits (3)

Design and analysis of machinery for load-bearing and power transmission by considering material failure modes such as yielding, fracture, and fatigue. Design and selection of machine elements including threaded fasteners, springs, rolling-element bearings, cams, gears and friction drives. May be repeated up to 3 credits.

Prerequisite: C- or better grades in M E 326.

Learning Outcomes

1. An ability to incorporate analysis and design methods for designing and prototyping machine elements.
2. An ability to recognize the design process, to breakdown this complex process into a series of simple tasks, and to carry out those tasks to achieve the desired design.
3. Knowledges of how to apply the industrial specifications and requirements regarding the design of machine elements.
4. Implementation of these knowledge and experiences to real-world engineering projects with finite element method.

M E 445. Experimental Methods II
3 Credits (2+3P)

Emphasis on experimental techniques, instrumentation and data acquisition in fluid mechanics, heat transfer, and thermodynamics.

Laboratory results will be presented in written and verbal formats. May be repeated up to 3 credits.

Prerequisite: C- or better grades in (M E 338 or A E 339), M E 340, M E 341, and M E 345.

Learning Outcomes

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2. An ability to communicate effectively with a range of audiences

3. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

4. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

M E 452. Control System Design

3 Credits (3)

Introduction to the control of dynamical systems, with a focus on mechanical and aerospace systems, including basic systems theory, controllability / observability, feedback and stabilization, PID controls, root-locus plot, and Bode diagram. May be repeated up to 3 credits.

Prerequisite: M E 261, M E 328 and ENGR 234.

Learning Outcomes

1. Construct a block diagram to find a transfer function for a dynamical system;

2. Analyze control systems by utilizing various linear control theories such as root-locus design method, bode / Nyquist plots, and lead / lag compensation techniques;

3. Design and simulate automatic control systems for mechanical and aerospace engineering applications.

M E 456. Experimental Modal Analysis

3 Credits (3)

Emphasis on hands-on techniques for structural vibration tests for practical applications. Interpretation of experimental results by means of advanced signal processing tools, basic system identification methodology, and reduced-order modeling procedures. May be repeated up to 3 credits.

Prerequisite: M E 328 and M E 261.

Learning Outcomes

1. An ability to experimentally perform modal analysis for multi-degree-of-freedom systems, which can be extended to continuous systems and actual engineering structures.

M E 457. Engineering Failure Analysis

3 Credits (3)

Introduction to failure theories and causes. Topics include general procedures for failure analysis, ductile and brittle modes of failure, elements of fracture mechanics, fractography, and failures in various engineering applications due to fatigue, wear, corrosion, design or processing defects. May be repeated up to 3 credits.

Learning Outcomes

1. Students will learn how to systematically conduct failure analysis, identify cause(s) of failure, suggest remedial steps to prevent failures and/or improve performance for a variety of engineering applications involving metals, polymers, ceramics and composites.

M E 458. Properties and Mechanical Behavior of Materials

3 Credits (3)

Understanding the microstructure of engineering materials and their influence on mechanical behavior. Topics include Material Structure and Physical Properties, Thermodynamics and Kinetics of Materials, Mechanical Properties, Strengthening Mechanisms, Time and Temperature Dependent Behavior, Degradation, Fatigue, and Fracture.

Learning Outcomes

1. Students will learn how to correlate mechanical behavior of materials with their microstructure, processing history and composition.

2. As practicing engineers, they will be able to recognize impact of operating conditions, predict life span, and design materials to improve reliability and efficiency.

3. They will be able to select appropriate materials for a given application from class of materials such as metals, polymers, ceramics and composites.

M E 460. Applied Finite Elements

3 Credits (3)

Introduction to the practical aspects of structural finite element modeling. Course focuses on providing a working knowledge of how to effectively incorporate finite element techniques into the design process. May be repeated up to 3 credits. Crosslisted with: M E 518.

Prerequisite(s): M E 425.

M E 481. Alternative and Renewable Energy

3 Credits (3)

Current and future energy needs of the United States and the world will be considered primarily from the standpoint of renewable energy sources such as solar, wind, ocean, and biomass. Technical, economic, and environmental aspects of each technology will be addressed. May be repeated up to 3 credits.

Prerequisite: M E 341.

Learning Outcomes

1. Understanding of current and future energy needs of the United States and the whole world from the standpoint of renewable energy sources such as solar, wind, ocean, and biomass.

M E 486. Introduction to Robotics

3 Credits (3)

This course provides students with an introduction to the theories and methods for analysis, design, and control of robotic manipulators. This course is devoted to understanding the spatial descriptions and transformations, kinematics, and dynamics of these mechanisms and how to practically implement these concepts into actual robotic manipulators. May be repeated up to 3 credits.

Prerequisite: M E 328 and ENGR 234.

Learning Outcomes

1. Model and analyze the kinematics and dynamics of robotic manipulators;

2. Program and control these robotic platforms;

3. Apply the theoretical methods into industrial robots;

4. Implement the knowledge and experiences in real-world engineering projects.

M E 487. Mechatronics

3 Credits (2+3P)

Introduction to the analysis and design of computer-controlled electromechanical systems, including data acquisition and conversion, force and motion sensors, actuators, mechanisms, feedback control, and robotic devices. Students required to work in teams to construct and test simple robotic systems. May be repeated up to 3 credits.

Prerequisite(s): M E 210 and M E 345.

M E 502. Elasticity I

3 Credits (3)

Introduction to the theory of elastic media with emphasis on understanding the fundamental principles and solution methods used in the analysis of elastic solids and structures. Cartesian tensors are introduced for formulations of general deformations and states of stress. May be repeated up to 3 credits.

Learning Outcomes
1. An ability to understand the fundamental principles and solution methods used in the analysis of elastic solids and structures.
2. Use of cartesian tensors for formulations of general deformations and states of stress.

M E 503. Thermodynamics
3 Credits (3)

A comprehensive study of the first and second laws of thermodynamics, nonequilibrium processes, equations of state, and statistical thermodynamics.

M E 504. Continuum Mechanics
3 Credits (3)

Introduction to the fundamentals of the mechanics for continuous media. This covers the concepts and general principles common to all branches of mechanics to facilitate further study in various fields such as elasticity, plasticity, fluid, and continuum damage mechanics. Computational aspects of the theory are also discussed. May be repeated up to 3 credits.

Learning Outcomes
1. An ability to understand the fundamentals of the continuum mechanics, which covers the concepts and general principles common to all branches of mechanics to facilitate further study in various fields such as elasticity, plasticity, fluid, and continuum damage mechanics.

M E 509. Individualized Study
3 Credits (3)

Individualized study covering specialized topics in mechanical and aerospace engineering. Consent of instructor required.

M E 510. Special Topics
1-6 Credits

Topics in mechanical engineering. May be repeated for a maximum of 6 credits.

Prerequisite: consent of the department head.

M E 511. Dynamics
3 Credits (3)

An advanced study of the dynamical behavior of systems of particles and rigid bodies, with emphasis on the theoretical background of dynamics.

M E 512. Vibrations
3 Credits (3)

Free and forced vibrations for discrete and continuous systems with single or multiple degrees of freedom. Introduction to nonlinear and random vibration and solution techniques for such systems.

M E 517. Nonlinear Dynamics and Chaos
3 Credits (3)

Singular points, periodic solutions, stability, and local bifurcations for ODEs and maps; phase space methods, invariant manifolds, and Poincare maps; nonsmooth, periodic, time-delay, and Hamiltonian systems; perturbation, averaging, and harmonic balance methods; center manifold reduction and normal forms; strange attractors, Liapunov exponents, attractor dimension; dissipative and Hamiltonian chaos

M E 518. Finite Element Analysis
3 Credits (3)

Introduction to finite element method. Topics include mathematical modeling, variational formulation, shape functions, truss, beam, solid, and shell elements. Includes static, dynamic, and nonlinear analysis. May be repeated up to 3 credits. Crosslisted with: M E 460.

M E 527. Linear Systems Theory
3 Credits (3)

Introduction to control of linear multi-input-multi-output (MIMO) systems. Topics include representation of system dynamics using the state-space model, linearization, internal and input-to-output stability, controllability, observability, optimal control, linear quadratic regulator, and observer. May be repeated up to 3 credits.

Learning Outcomes
1. Students are able to design linear multi-input-multi-output (MIMO) control systems.

M E 530. Intermediate Fluid Mechanics
3 Credits (3)

Application of exact and empirical solutions to fundamental flow problems, including viscous and inviscid behavior. These applications establish a theoretical basis for the origin and physical role of common terms in the governing equations.

M E 533. Numerical Methods for Fluid Mechanics and Heat Transfer
3 Credits (3)

Numerical methods for solving differential equations (initial and boundary value problems, eigenvalue problems) with focus on fluid mechanics and heat transfer problems. Concepts such as stability, accuracy, consistency, and systematic errors (phase/amplitude error). Implement and test algorithms for the solution of ordinary and partial differential equations. May be repeated up to 3 credits.

Prerequisite: M E 341.

Learning Outcomes
1. An ability to apply computational approaches to fluid dynamic and heat transfer problems and to understand limitations with respect to stability, accuracy, and error.

M E 536. Hydrodynamic Stability and Turbulence
3 Credits (3)

Introduction to fundamentals of hydrodynamic stability, classical linear stability analysis of parallel shear flows and rotating flows, nonlinear stability, basic concepts in turbulence theory May be repeated up to 3 credits.

Prerequisite: ME 530.

Learning Outcomes
1. An ability to understand fundamentals of hydrodynamic stability, classical linear stability analysis of parallel shear flows and rotating flows, nonlinear stability, basic concepts in turbulence theory.

M E 540. Intermediate Heat Transfer
3 Credits (3)

Fundamentals of conduction, convection, and radiation heat transfer. Emphasis on the application of combined heat transfer to the solution of problems not accessible at the undergraduate level.

M E 557. Engineering Failure Analysis
3 Credits (3)

Introduction to failure theories and causes. Topics include general procedures for failure analysis, ductile and brittle modes of failure, elements of fracture mechanics, fractography, and failures in various engineering applications due to fatigue, wear, corrosion, design or processing defects. May be repeated up to 3 credits.

M E 558. Properties and Mechanical Behavior of Materials
3 Credits (3)

Understanding the microstructure of engineering materials and their influence on mechanical behavior. Topics include Material

Structure and Physical Properties, Thermodynamics and Kinetics of Materials, Mechanical Properties, Strengthening Mechanisms, Time and Temperature Dependent Behavior, Degradation, Fatigue, and Fracture. May be repeated up to 3 credits.
Prerequisite: CHME 361.

M E 570. Engineering Analysis I
3 Credits (3)
Introduction to engineering analysis with emphasis on engineering applications. Topics include linear algebra, linear ordinary differential equations, and linear partial differential equations with focus on analytical methods.

M E 586. Introduction to Robotics
3 Credits (3)
This course provides students with an introduction to the theories and methods for analysis, design, and control of robotic manipulators. This course is devoted to understanding the spatial descriptions and transformations, kinematics, and dynamics of these mechanisms and how to practically implement these concepts into actual robotic manipulators. May be repeated up to 3 credits.
Prerequisite: M E 328 and ENGR 234 or consent of instructor.
Learning Outcomes
1. Students will be able to model and analyze the kinematics and dynamics of robotic manipulators.
2. Students will be able to program and control these robotic platforms.
3. Students will be able to apply the theoretical methods into industrial robots.
4. Students will be able to implement these knowledge and experiences to real-world engineering projects.

M E 587. Mechatronics
3 Credits (2+3P)
Introduction to the analysis and design of computer-controlled electromechanical systems, including data acquisition and conversion, force and motion sensors, actuators, mechanisms, feedback control, and robotic devices. Students required to work in teams to construct and test simple robotic systems. Crosslisted with: M E 487.

M E 598. Special Research Programs
1-3 Credits
Individual investigations, either analytical or experimental. May be repeated for a maximum of 6 credits.

M E 599. Master's Thesis
15 Credits
Thesis.

M E 600. Doctoral Research
1-15 Credits
This course number is used for assigning credit for research performed prior to successful completion of the doctoral qualifying examination.

M E 698. Special Research Programs
1-3 Credits
May be repeated for a maximum of 6 credits.

M E 700. Doctoral Dissertation
15 Credits
Dissertation.