MECHANICAL ENGINEERING AND AEROSPACE ENGINEERING

Undergraduate Program Information

The mission of the Mechanical and Aerospace Engineering Department at New Mexico State University is threefold:

- to educate those who will advance knowledge and become the future leaders of industry and academia;
- to conduct both basic and applied research in mechanical and aerospace engineering and related interdisciplinary areas; and
- to provide service to the profession, to the State of New Mexico, to the country, and to the future development of engineering worldwide.

A critical focus within the department is to afford undergraduates of varying backgrounds and abilities every opportunity for achieving success in the mechanical and aerospace engineering professions. To address this focus, the faculty of the Mechanical and Aerospace Engineering Department, with input from other constituents, have established the following program educational objectives that inform the overall undergraduate programs:

- Our graduates will gain relevant employment and/or pursue a graduate degree.
- Our graduates will advance in their level of workplace responsibility.

Graduate Program Information

Graduate programs of study are available leading to the degrees of

- Doctor of Philosophy in Aerospace Engineering
- Doctor of Philosophy in Engineering with a concentration in Mechanical Engineering.
- Master of Science in Aerospace Engineering,
- Master of Science in Mechanical Engineering,
- Master of Engineering in Aerospace Engineering,
- Master of Engineering in Mechanical Engineering.

Areas of active research in mechanical engineering include the following:

- Computational fluid dynamics,
- Hypersonics,
- Vortex dynamics,
- Energy systems and components,
- Thermal management,
- Surface engineering,
- Computational mechanics with application to material properties,
- Composite materials and nanomaterials,
- Structural damage diagnosis and prognosis,
- Nonlinear dynamics and vibration,
- Reduced order modeling in multibody dynamics,
- Fluid-structure interactions,
- Renewable energy / energy harvesting,
- Bio-inspired and bio-mimetic robotics,
- Advanced manufacturing and medical device.

Areas of active research in aerospace engineering include the following:

- Computational, theoretical, and experimental fluid dynamics,
- Hypersonics,
- Flow control,
- Aero-optics,
- Multi-phase, multi-scale, and reacting flows,
- Rarefied gas dynamics,
- Propulsion,
- Aeroelasticity,
- Structural health monitoring / damage detection,
- Guidance, navigation, and control of space systems,
- Small satellite missions,
- Unmanned aerial systems.

Laboratory facilities supporting graduate research include a large low-speed wind tunnel facility; a shock tunnel facility for hypersonics; computational fluid dynamics lab; robotics, unmanned vehicles, and intelligent systems control lab; autonomous systems lab; mechanical design and advanced materials & structures lab; nonlinear dynamics & energy harvesting lab; computational mechanics of materials and structures lab; non-destructive evaluation lab; medical device & microfabrication research lab; surface-environment interaction research lab; and renewable energy and thermal systems lab. A mechanical testing lab is also available in the College of Engineering.

In addition to fulfilling the basic requirements for admission to the Graduate School, applicants are expected to have an undergraduate degree equivalent to a BS in mechanical or aerospace engineering from a university accredited by ABET. Graduate students whose BS degree is in a discipline other than A E or M E will normally be required to take undergraduate courses in M E or A E in order to prepare for graduate course work; such undergraduate preparatory work will be determined by the graduate coordinator on a case by case basis. A candidate for the master's degree can choose one of two options: a thesis option or a course-only option. Both options require a minimum of 30 credits of graduate study.

Doctoral candidates must complete a program of study determined by the student and his or her advisory committee. The student must successfully pass a written qualifying examination (administered during the student's first year of full-time study) and an oral comprehensive examination administered after approximately 80 percent of the course work is completed. The student must submit and defend an acceptable dissertation based on independent investigation in a field of study approved by the advisory committee. The requirements for the MS and Ph.D. degrees are stated below.

Degrees for the Department

Bachelor Degree(s)

- Aerospace Engineering - Bachelor of Science in Aerospace Engineering (https://catalogs.nmsu.edu/nmsu/engineering/mechanical-aerospace-engineering/aerospace-engineering-bachelor-science-aerospace-engineering/)
- Mechanical Engineering - Bachelor of Science in Mechanical Engineering (https://catalogs.nmsu.edu/nmsu/engineering/

mechanical-aerospace-engineering/mechanical-engineering-bachelor-science-mechanical-engineering/)

Master Degree(s)

- Aerospace Engineering - Master of Engineering in Aerospace Engineering (https://catalogs.nmsu.edu/nmsu/graduate-school/aerospace-engineering-master-engineering/)
- Aerospace Engineering - Master of Science (https://catalogs.nmsu.edu/nmsu/graduate-school/aerospace-engineering-master-science/)
- Mechanical Engineering - Master of Engineering in Mechanical Engineering (https://catalogs.nmsu.edu/nmsu/graduate-school/mechanical-engineering-master-engineering/)
- Mechanical Engineering - Master of Science in Mechanical Engineering (https://catalogs.nmsu.edu/nmsu/graduate-school/mechanical-engineering-master-science-mechanical-engineering/)

Doctoral Degree(s)

- Aerospace Engineering - Doctor of Philosophy (https://catalogs.nmsu.edu/nmsu/graduate-school/aerospace-engineering-doctor-philosophy/)
- Engineering (Mechanical Engineering) - Doctor of Philosophy (https://catalogs.nmsu.edu/nmsu/graduate-school/engineering-mechanical-engineering-doctor-philosophy/)

Minors for the Department

- Aerospace Engineering - Undergraduate Minor (https://catalogs.nmsu.edu/nmsu/engineering/mechanical-aerospace-engineering/aerospace-engineering-undergraduate-minor/)
- Mechanical Engineering - Undergraduate Minor (https://catalogs.nmsu.edu/nmsu/engineering/mechanical-aerospace-engineering/mechanical-engineering-undergraduate-minor/)

Department Head: Jay Frankel, Ph. D.

Associate Department Head: Young Lee, Ph. D.

Professors Abdelkefi, Chaitanya, Frankel, Y. Park; ***Associate Professors*** Drach, Garcia, Gross, Kota, Kuravi, Lee, Shashikanth, Shu, Sun; ***Assistant Professors*** Alaie, Haghshenas-Jaryani, Liu, Wang; ***Professors of Practice*** Waller, Choo

A. Abdelkefi, Ph.D. (Virginia Tech)– Nonlinear dynamics, energy harvesting, aeroelasticity, fluid-structure interaction, vibration and controls; S. Alaie, Ph.D. (UNM)– Implantable microsensors, advanced manufacturing and medical devices; V. Chaitanya, Ph.D. (Johns Hopkins)– Materials characterization, materials degradation, corrosion, electrochemistry, failure analysis, energy, bioengineering, additive manufacturing, food-energy-water nexus; V. Choo (Liverpool)-Composite materials, computer applications; B. Drach, Ph.D. (New Hampshire)– Composite materials, additive manufacturing, biomechanics*; J. Frankel, Department head, Ph.D. (Virginia Tech)– Heat transfer, hypersonics; G. Garcia, Ph.D. (Texas A&M)– Damage detection, experimental mechanics, vibration; A. Gross, DEngr. (Aachen)– Computational fluid dynamics, fluid mechanics, aircraft design and propulsion, unmanned aerial systems, wind energy; M. Haghshenas-Jaryani, Ph.D. (UT Arlington)– Soft robotics, bio-inspired and bio-mimetic robotics, dynamics and control; K. Kota, Ph.D. (Central Florida)*– Heat transfer, functional surfaces, surface-environment interactions, thermal management, space transportation, engineering in public health and medicine*; S. Kuravi, Ph.D. (Central Florida)– Renewable energy, thermal systems, concentrating solar power, thermal desalination, energy storage; Y. Lee, Associate Department Head, Ph.D. (Illinois Urbana-Champaign)- Nonlinear dynamics, fluid-structure interactions; Q. Liu, Ph.D. (Universidad Politécnica de Madrid, Spain)- Computational fluid mechanics, modal analysis, data science, rarefied gas dynamics and multiphase flow; Y. Park, Ph.D. (Iowa)– Design optimization, computational solid mechanics, atomistic and molecular simulations; B. Shashikanth, Ph.D. (Southern California)– Fluid mechanics, dynamical systems, controls; F. Shu, Ph.D. (Purdue)– Experimental fluid dynamics, biofluidics, microfluidics, flow control, and hypersonics; L. Sun, Ph.D. (Brigham Young)– Unmanned systems, towed cable systems, sensor network, cooperative estimation and control, optimal control; J. Waller, Ph.D. (U Akron) - Nondestructive evaluation, additive manufacturing and materials;Y. Wang, Ph.D. (Penn State)– Computational fluid dynamics, multi-phase & reacting flows, aerospace propulsion, bio/micro-Fluidics.*

Aerospace Engineering Courses

A E 339. Aerodynamics I
3 Credits (3)
Fluid properties, conservation equations, incompressible 2-dimensional flow; Bernoulli's equation; similarity parameters; subsonic aerodynamics: lift and drag, analysis and design of airfoils. May be repeated up to 3 credits.
Prerequisite: C- or better grades in ENGR 234 and (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.

A E 362. Orbital Mechanics
3 Credits (3)
Dynamics of exoatmospheric flight of orbiting and non-orbiting bodies; 2-body orbital dynamics and Kepler's laws; orbits in 3 dimensions; orbit determination; orbit design and orbital maneuvers; lunar and interplanetary trajectories. May be repeated up to 3 credits.
Prerequisite: C- or better grades in (M E 228 or MATH 392), ENGR 234, and M E 261.
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.

A E 363. Aerospace Structures
3 Credits (3)
Advanced concepts of stress and strain, introduction to the analysis of aero structures, complex bending and torsion, thin walled sections and shells, computational techniques. May be repeated up to 3 credits.
Prerequisite: C- or better grades in C E 301.
Learning Outcomes

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

A E 364. Flight Dynamics and Controls
3 Credits (3)

Fundamentals of airplane flight dynamics, static trim, and stability; spacecraft and missile six degree of freedom dynamics; attitude control of spacecraft. May be repeated up to 3 credits.
Prerequisite: C- or better grades in (M E 228 or MATH 392), ENGR 234, and M E 261.
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.

A E 400. Undergraduate Research
1-3 Credits (1-3)
Performed with the direction of a department faculty member. May be repeated for a maximum of 6 credits.
Prerequisite(s): Consent of faculty member.

A E 405. Special Topics
3 Credits (3)
Topics of modern interest to be offered by the departmental staff. Consent of instructor required.

A E 419. Propulsion
3 Credits (3)
Propulsion systems, thermodynamic cycles, combustion, specific impulse; principles of gas turbines, jet engines, and rocket propulsion systems. May be repeated up to 3 credits.
Prerequisite: C- or better grades in A E 439.
Learning Outcomes
1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

A E 424. Aerospace Systems Engineering
3 Credits (3)
Basic principles of top down systems engineering and current practice; preliminary and detailed design of aircraft and space vehicles, including requirement, subsystem interaction, and integration, tradeoffs, constraints and non-technical aspects. May be repeated up to 3 credits.
Prerequisite: C- or better grades in A E 362.
Learning Outcomes
1. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
2. an ability to communicate effectively with a range of audiences
3. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
4. 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

A E 428. Aerospace Capstone Design
3 Credits (3+2P)
Team Project-analysis, design, hands-on build test, evaluate.
Prerequisite(s)/Corequisite(s): A E 447. Prerequisite(s): A E 363 and A E 424.

A E 439. Aerodynamics II
3 Credits (3)
Principles of compressible flow, momentum and energy conservation; thermal properties of fluids; supersonic flow and shock waves; basics of supersonic aerodynamics. May be repeated up to 3 credits.
Prerequisite: C- or better grades in (A E 339 or M E 338), M E 240, and (M E 328 or PHYS 395).
Learning Outcomes
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

A E 447. Aerofluids Laboratory
3 Credits (2+3P)
Use of subsonic wind tunnels and other flow to study basic flow phenomena and methods of fluid measurement and visualization. May be repeated up to 3 credits.
Prerequisite: M E 345 or PHYS 325.
Prerequisite/Corequisite: A E 439.
Learning Outcomes
1. Students will be able to write technical reports about aerodynamic experiments and make oral presentations, being familiar with data acquisition, processing and visualization.

A E 451. Aircraft Design
3 Credits (3)
Conceptual design of aircraft based on existing designs, empirical relationships, and theory. Dimensioning, structural design, and performance analysis of major subcomponents such as fuselage, wing, and propulsion system. Static stability and control analysis.
Prerequisite(s): A E 339 and A E 363.

A 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.

A E 464. Advanced Flight Dynamics and Controls
3 Credits (3)
Advanced airplane flight dynamics and stability control system design, longitudinal and lateral autopilots, missile/rocket control systems, and guidance systems.
Prerequisite(s): A E 364 or consent of instructor.

A E 509. Individualized Study
3 Credits (3)
Individualized study covering specialized topics in aerospace engineering. Consent of instructor required. Restricted to A E & M E majors.

A E 510. Special Topics
1-6 Credits (1-6)
Topics in aerospace engineering. May be repeated for a maximum of 6 credits. Consent of instructor required.

A 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.

A 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.

A E 564. Advanced Flight Dynamics and Controls
3 Credits (3)
Advanced airplane flight dynamics and stability control system design, longitudinal and lateral autopilots, missile / rocket control systems, and guidance systems May be repeated up to 3 credits.
Prerequisite(s): A E 364 or consent of instructor.

A E 598. Special Research Programs
1-3 Credits (1-3)
Individual investigations, either analytical or experimental. May be repeated for a maximum of 6 credits. Restricted to A E & M E majors.

A E 599. Master's Thesis
1-15 Credits (1-15)
Thesis. Graded: Thesis/Dissertation.

A E 600. Doctoral Research
1-15 Credits (1-15)
This course number is used for assigning credit for research performed prior to successful completion of the doctoral qualifying examination. Graded: Thesis/Dissertation.

A E 700. Doctoral Dissertation
15 Credits (15)
Dissertation. Graded: Thesis/Dissertation.

Mechanical Engineering Courses

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.

Name: Margaret Vasquez

Office Location: Jett Hall Rm. 104

Phone: (575) 646-3502

Website: https://mae.nmsu.edu/ (http://mae.nmsu.edu)