# COURSES FOR MECHANICAL ENGINEERING

## Mechanical Engineering Courses

**ME121 Introduction to Mechanical Engineering**
Hours 1

An introduction to the discipline of mechanical engineering and the role of the mechanical engineer, including both mechanical and thermal/fluid stems. Focus is on learning about the discipline through a series of student hands-on activities.

Prerequisite(s): UA Math Placement Test Score of 370-439 or ACT Math Subscore of 28 or old SAT Math Subscore of 630 or new SAT Math Subscore of 650 or MATH 112

Prerequisite(s) with concurrency: MATH 113 or MATH 115 or MATH 125 or MATH 126 or MATH 145 or MATH 146 or MATH 227 or MATH 238

**ME215 Thermodynamics I**
Hours 3

Properties of matter; processes in fluids; zeroth; first and second laws; irreversibility.

Prerequisite(s): MATH 126 or MATH 146 or MATH 132

**ME216 Thermal Engineering Survey**
Hours 3

Survey of thermal engineering topics for engineers outside mechanical engineering. To include an overview of subjects typically covered in courses about thermo-dynamics I and II and heat transfer. An emphasis is placed on qualitative concepts of transport and conservation as they relate to thermal-fluids in order to increase the understanding of thermal engineering applications.

Prerequisite(s): MATH 126 or MATH 146

**ME305 Thermodynamics II**
Hours 3

Introduction and analysis of different thermodynamic cycles and factors impacting these cycles. Topics include thermodynamic cycle analysis, thermodynamics of non-reacting and reacting mixtures, power cycles: basic considerations, gas power cycles, vapor and combined power cycles, gas mixtures, air-water vapor mixtures and air conditioning, and chemical reactions from thermodynamics point of view.

Prerequisite(s): ME 215

Prerequisite(s) with concurrency: MATH 227 or MATH 247

**ME309 Heat Transfer**
Hours 3

An overview of the three modes of heat transfer, which includes steady and unsteady conduction, convection and radiation heat transfer.

Prerequisite(s): MATH 238 and ME 215 and AEM 311

**ME349 Engineering Analysis**
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Hours 3

Elements of statistics, matrix algebra, numerical analysis, and differential equations applied to engineering problems; includes extensive computer applications. Computing proficiency is required for a passing grade in this course.

Prerequisite(s): MATH 238

Computer Science

**ME350 Static Machine Components**
Hours 3

This course covers the analysis of stresses and deflections in machine elements like beam supports, rods, and drive shafts. Methods for describing the stresses through von Mises and various failure criteria are also covered. The topics of fatigue, fatigue strength, and endurance limit are also discussed. Also included is the design of connected joints covering both bolted and welded joints.

Prerequisite(s): AEM 250, AEM 251, and ENGR 161 or ENGR 171

**ME351 Finite Element Lab**
Hours 1

This lab provides a working knowledge of finite element (FE) simulation. Upon completion each student will have the ability to set up and run a FE analysis of a realistic engineering assembly, while (a) optimizing computation efficiency,(b) optimizing result fidelity, and (c) employing sound engineering judgment in their assumptions.

Prerequisite(s): ENGR 161 and AEM 250

Prerequisite(s) with concurrency: Co-requisite: ME 350

**ME360 Contrl Instrumnt Components**
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Hours 3

Introduction to selection and use of electrical, pneumatic, and other components of mechanical system instrumentation and control. Specific components include modern electrical measurement devices, signal conditioning, force and torque measurement, proximity sensors, AC and DC motors, etc. Writing proficiency is required for a passing grade in this course. A student who does not write with the skill normally required of an upper-division student will not earn a passing grade, no matter how well the student performs in other areas of the course.

Prerequisite(s): AEM 250; and ECE 320 or ECE 225

Writing

**ME364 Vehicle Dynamics**
Hours 3

Dynamics of four-wheeled vehicles, including acceleration and braking performance, road loads, ride comfort, steady-state cornering, suspensions, steering systems, and rollover. Vehicle dynamics system modeling programs are introduced and used for detailed investigations of the effect of system design parameters on performance.

Prerequisite(s): AEM 264

**ME372 Dynamic Systems**
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Hours 3

An introduction to the modeling, analysis and control of dynamic systems. The course takes the student from initial modeling through analysis of the system response and finally into the control of the system. Specific systems include mechanical devices, electrical circuits, and electromechanical systems. Computing proficiency is required for a passing grade in this course.

Prerequisite(s): MATH 238 and AEM 264 and ME 349; and ECE 320 or ECE 225

Computer Science

**ME377 Noise Control**
Hours 3

Physical properties of noise; hearing and noise criteria measurement techniques; and noise-control fundamentals applied to practical problems are covered in this course. Both sound and vibration topics are discussed, including the spectral description of these phenomena. Applications of various estimation methods for characterizing room acoustics, such as reverberation time and room modes, are presented. Industrial applications are discussed throughout the course.

Prerequisite(s): MATH 238, and PH 106 or PH 126

**ME380 Engineering Leadership I**
Hours 1

Organizational leadership fundamentals for leaders of COE organizations regarding recruiting, motivating team members, managing resources and time, sponsor outreach, fundraising, scheduling, presentations, and budgeting. This is achieved through student led discussion, workshop service and project analysis. Intended that students follow up with Engineering Leadership II (ME 480).

**ME383 Modern Manufacturg Processes**
Hours 3

A survey of classical and modern manufacturing processes. Emphasis is on technical fundamentals and practical applications. Components include geometric and service attributes of manufactured products, metal casting processes, forming processes, machine processes, joining processes, and additive manufacturing.

Prerequisite(s): AEM 250, MTE 271 and (ENGR 161 or ENGR 171)

**ME406 Thermal Power Systems**
Hours 3

Study of thermal systems emphasizing large power generation systems. Topics include Rankine and gas turbine cycles, fossil fuels combustion, boiler characteristics, cogeneration, combined cycle plants, environmental effects of power generation, and alternative energy concepts.

Prerequisite(s): ME 305

**ME407 Heatg Ventilat Air-Condg**
Hours 3

Fundamentals and practice associated with heating, ventilating and air conditioning; study of heat and moisture flow in structures, energy consumption, human comfort and health; and design of practical systems.

Prerequisite(s): ME 309 and ME 305

**ME411 Computational Heat Transfer and Fluid Flow**
Hours 3

Computational techniques to solve conservation equations representing heat transfer, mass transfer, and fluid flow processes. Topics include discretization methods for multi-dimensional diffusion and convection problems, programming and numerical techniques, and pressure-correction algorithms. Use of computer software for practical applications is also covered.

Prerequisite(s): ME 309

**ME414 Principles of Combustion I**
Hours 3

Energy sources, combustion systems, fuels and emissions, combustion thermodynamics, chemical kinetics, 1D reactors, combustion phenomena (ignition, flashback, blow-off, deflagration, detonation, etc.), laminar and turbulent premixed and non-premixed flames, and heterogeneous combustion.

Prerequisite(s): ME 309

**ME416 Energy Conservtn & Manag**
Hours 3

Analysis of energy systems with focus on evaluating baseline energy usage and best practices for efficiency. Topics include overview of utility rate schedules and fuel sources and supplies, economic analysis, lighting systems, industrial energy systems, heating, ventilation, air-conditioning systems.

Prerequisite(s): ME 309 and ME 305 and ECE 320 or ECE 225

**ME417 Sustainable Energy**
Hours 3

Contemporary issues surrounding the challenge of providing energy for societal and economic development are examined. Depletion of fossil fuel resources and the impact of fossil fuel use on the environment and climate are considered. Alternative Sustainable sources of energy production are explored.

Prerequisite(s): ME 305

**ME418 Combustion Engines**
Hours 3

Theory, design, and performance of combustion engines; fuels, oxidants, and propellants; and combustion, dissociation, ionization, and engine emissions.

Prerequisite(s): ME 305

**ME421 Reliability and Maintainability Engineering**
Hours 3

This course is designed to introduce upper-level undergraduate engineering students to reliability and maintainability measures, models, and prediction methods. The course also covers preventive maintenance techniques and philosophies such as FMEA and Reliability Centered Maintenance.

Prerequisite(s): GES 255 or GES 400 or ME 349, or permission of the instructor

**ME424 Automotive Manufacturing**
Hours 3

This course is designed to introduce engineering students to automotive manufacturing processes, technologies, and systems. Topics include current status of automotive manufacturing as well as methods of material processing, material handling systems, production facilities and fundamentals of robotics and automation as they relate to automotive manufacturing.

Prerequisite(s): ME 383 (with grade of C or better)

**ME426 Internal Combustion Engines**
Hours 3

This course introduces how internal-combustion engines work, and links analysis and testing techniques used for their design and development to subjects presented within the mechanical engineering curriculum. Laboratory activities serve to reinforce and illustrate analysis application as well as provide visual reference to common internal-combustion engine components.

Prerequisite(s): ME 305

**ME430 Fuzzy Set Theory & Application**
Hours 3

The course covers the basic concepts in fuzzy set theory, fuzzy logic, and approximate reasoning. Relation between fuzzy set theory, probability theory, and possibility theory is discussed. Applications of fuzzy set theory in manufacturing systems are outlined.

Prerequisite(s): GES 255 OR GES 400/500 OR ME 349, or permission of the instructor

**ME440 Failure of Engineering Materials**
Hours 3

Understand how structural components fail and apply the proper techniques for a failure analysis investigation. Demonstrate the ability to identify and differentiate fractographic features of material failure including overload and progressive failures (ductile, brittle, fatigue, creep, corrosion, wear). Practical failure analysis project experience included.

Prerequisite(s): AEM 250 and AEM 251 and MTE 271 and ME 350 and ME 383

**ME448 Biomechanics of Human Movement**
Hours 3

An overview of the broad field and major challenges of movement bio mechanics; II. The principles of classical mechanics, anatomy, and physiology to describe, analyze, and assess human motion; and III. The engineering tools and the mathematical approaches applied to perform bio mechanical analysis of moving bodies.

Prerequisite(s): ME 349 Engineering Analysis; MATH 238 Applied Differential Equations 1; AEM 201 Statics; AEM 264 Dynamics

**ME450 Dynamic Machine Components**
Hours 3

This course covers the selection and application of machine elements in dynamic systems. Specific components covered include transmission elements (gears and pulleys), mechanisms (linkages and cams), shafting, bearing systems and prime movers.

Prerequisite(s): AEM 264 and ME 350

**ME452 Fundamentals of Automotive Systems**
Hours 3

Description of a generic vehicle development process. Full vehicle concepts. Performance and fuel efficiency calculations. Fundamentals of internal combustion engines, thermodynamic principles, vibrations. Transmission and drive train design.

Prerequisite(s): MATH 238

**ME454 Automotive Electrical and Electronic Systems**
Hours 3

Evolution of a classical automotive electrical point#to#point network into a modern electrical/electronic system with bus networking. Influence of E/E systems on the vehicle development process. Analog and digital control systems. Basic electronic components and sensors. Power management of the board network. Principles and behavior of batteries, alternators and starters. Deep dive into ESP#System (Electronic Stability Program) to understand the operating principles of its subsystems: Anti# lock Brake System, Traction Control System and Yaw Control System. Review of sensors and actuators used in ESP control. Principles of bus systems in automobiles. Detailed operation of the CAN, LIN and FlexRay bus system. Special topics including Electro Magnetic Compatibility. Knowledge of MATLAB and SIMULINK.

Prerequisite(s): ECE 225 or ECE 320

**ME456 Mechatronics**
Hours 3

This is the introductory course to the field of Mechatronics and Robotics. It covers fundamentals of electronics required for mechatronics systems, introduction to microcontroller programming and interfacing, data acquisition, sensing and actuation. The course is a mix of instructional theory and lab, coupled with an independent exploratory project.

Prerequisite(s): ME 360 and ME 372

**ME458 Modeling and Simulation of Automotive Systems**
Hours 3

Introduction to modeling and simulation of automotive systems with various components including internal combustion engine, transmission, battery, electric motor, and chassis dynamics. Energy efficiency and dynamic performances of conventional, hybrid electric, and full electric vehicles are covered.

Prerequisite(s): ME 349: Engineering Analysis ME 372: Dynamic Systems

**ME460 Energy Systems: Analysis and Measurement**
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Hours 4

Techniques of analysis and design of thermal systems including piping networks, heat exchangers, and pumping systems. Hands on experience with these systems through laboratory activities. Statistical design of experiments. Selection and use of basic thermal systems measurement instrumentation. Writing proficiency is required for a passing grade in this course. A student who does not write with the skill normally required of an upper-division student will not earn a passing grade, no matter how well the student performs in other areas of the course.

Prerequisite(s): ME 309 & ME 360 - each must have a minimum grade of C-.

Writing

**ME470 Mechanical Vibrations**
Hours 3

Formulation and solution of free and forced vibration problems for undamped and damped systems with single and multiple degrees of freedom. An introduction to modeling vibrations in continuous systems is also included. Superposition methods utilizing waveform decomposition, such as Fourier Series, are presented for use in both solution methods and system analysis. Experimental techniques of vibration measurement are also introduced.

Prerequisite(s): ME 372 and AEM 250

**ME471 Fundamentals Of Acoustics**
Hours 3

Fundamental physical principles underlying wave propagation and resonance in mechanical systems. The course introduces modeling, applications, and provides experience in acoustic and audio measurements and the associated instrumentation. The human auditory transduction mechanism is also studied along with physical parameters that describe how humans hear.

Prerequisite(s): MATH 238, and PH 106 or PH 126, and ECE 225 or ECE 320

**ME472 Introduction to Robotic Kinematics**
Hours 3

Teach the fundamental concepts in robot mechanics, planning and control, and enable the students to conduct basic kinematic and dynamic analysis for manipulator-type and mobile robots.

Prerequisite(s): ME 360 and ME 372

**ME475 Control Systems Analysis**
Hours 3

Classical feedback control system analysis, Laplace transform, transfer function, time response, proportional-integral-derivative control, root locus, frequency response, and computerized analysis. Also includes a brief introduction to modern control techniques.

Prerequisite(s): ME 349 and ME 372

**ME480 Engineering Leadership II**
Hours 2

Continues development of organizational leadership fundamentals initiated in ME 380 Engineering Leadership I regarding recruiting, motivating team members, managing resources and time, sponsor outreach, fundraising, scheduling, presentations, and budgeting among leaders working for COE organizations. This is achieved through student led discussion, workshop service and project analysis.

Prerequisite(s): ME 380

**ME484 Product Innovation**
Hours 3

This is an experiential, team-based learning course that allows students to develop ideas for new uses of patented technologies. Students use NASA technologies as the foundation for a new product idea and then work through the lean product development and customer discovery processes to test their ideas.

**ME489 Mechanical Engineering Design I**
Hours 3

Introduction to concepts and techniques of engineering design with supporting mathematical material. Guest lecturers present professional aspects of engineering. The Capstone Design Project is begun and carried on through ME 490 (ME 489 and ME 490 are taken in consecutive semesters).

Prerequisite(s): ME 305 and ME 309 and ME 350 and ME 351 and MATH 238

**ME490 Mechanical Engineering Design II**
Hours 3

In this course, student teams serve as consultants to a client. Emphasis is on conducting a professional design study and preparing written and oral presentations of the project.

Prerequisite(s): ME 489

**ME491 Special Problems**
Hours 1-6

This is a special topics lecture class or an assigned problem class. Credit is based on the amount of work undertaken.

**ME497 Mechanical Engineering Project**
Hours 1-3

An individual analytical, experimental or design project. Research on an assigned problem culminates in a required report.

**ME501 Mech Engr Analysis I**
Hours 3

This course is designed to provide the graduate students with fundamental concepts of advanced mathematical analysis of continuous and discrete mechanical engineering systems. The course includes intensive discussion of ordinary differential equations, Fourier analysis, and advanced vector calculus with applications to dynamic systems, heat transfer as well as fluid and solid mechanics.

**ME506 Found Thermal Power Gen**
Hours 3

Thermal power systems; components, process analysis and modeling, fuels, combustion, environmental aspects, and availability analysis in steam and gas turbine plants. Examination of recent trends such as cogeneration and combined cycles.

**ME509 Intermed Heat Transfer**
Hours 3

A first course in heat transfer at graduate level. Review of undergraduate treatment of conduction, convection, and radiation modes of energy transfer, with emphasis on theoretical concepts. Topics may include separation of variables solutions, superposition concepts, development of boundary layer equations, similarity solutions, spectral dependence of surface radiative properties, radiation exchange in diffuse, gray enclosures.

Prerequisite(s): ME 309 and AEM 311

**ME511 Computational Heat Transfer and Fluid Flow**
Hours 3

An introductory course providing computational background and experience to solve realistic heat transfer and fluid flow problems. Course will provide background on numerical techniques, and exposure to computer programming and commercial computational fluent dynamics (CFD) software.

**ME514 Principles of Combustion I**
Hours 3

Energy sources, combustion systems, fuels and emissions, combustion thermodynamics, chemical kinetics, 1D reactors, combustion phenomena (ignition, flashback, blow-off, deflagration, detonation, etc.), laminar and turbulent premixed and non-premixed flames, and heterogeneous combustion.

**ME516 Fnd Energy Conserv & Mgt**
Hours 3

Analysis and management of energy use in residential, commercial, and industrial applications, including lighting, heating and cooling, controls, and energy management systems. Topics include economics, auditing, energy management, and alternative energy sources.

**ME522 Reliability Maint & TPM**
Hours 3

*No description available*

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**ME526 Internal Combustion Engines**
Hours 3

This course introduces how internal-combustion engines work, and links analysis and testing techniques used for their design and development to subjects presented within the mechanical engineering curriculum. Laboratory activities serve to reinforce and illustrate analysis application as well as provide visual reference to common internal-combustion engine components.

Prerequisite(s): ME 305

**ME540 Failure of Engineering Materials**
Hours 3

Understand how structural components fail and apply the proper techniques for a failure analysis investigation. Demonstrate the ability to identify and differentiate fractographic features of material failure including overload and progressive failures (ductile, brittle, fatigue, creep, corrosion, wear). Practical failure analysis project experience included.

**ME548 Biomechanics of Human Movement**
Hours 3

An overview of the broad field and major challenges of movement bio mechanics; II. the principles of classical mechanics, anatomy, and physiology to describe, analyze, and assess human motion; and III. the engineering tools and the mathematical approaches applied to perform bio mechanical analysis of moving bodies.

**ME552 Fundamentals of Automotive Systems**
Hours 3

Description of a generic vehicle development process. Full vehicle concepts. Performance and fuel efficiency calculations. Fundamentals of internal combustion engines, thermodynamic principles, vibrations. Transmission and drive train design.

Prerequisite(s): MATH 238 Differential equations.

**ME556 Mechatronics**
Hours 3

This is the introductory course to the field of Mechatronics and Robotics. It covers fundamentals of electronics required for mechatronics systems, introduction to microcontroller programming and interfacing, data acquisition, sensing and actuation. The course is a mix of instructional theory and lab, coupled with an independent exploratory project.

**ME558 Modeling and Simulation of Automotive Systems**
Hours 3

Introduction to modeling and simulation of automotive systems with various components including internal combustion engine, transmission, battery, electric motor, and chassis dynamics. Energy efficiency and dynamic performances of conventional, hybrid electric, and full electric vehicles are covered.

Prerequisite(s): ME 349: Engineering Analysis ME 372: Dynamic Systems

**ME560 Thermal Fluid Measurement and Analysis**
Hours 3

Methods for acquisition and analysis of thermal systems-based measurements and actuator controls. Practical applications of various programming interfaces and embedded devices. Assignments focus on thermal-fluid measurement/actuator control topics applied to student's research topics. Assignment and lecture material will be supported by benchtop demonstrations of sensors and actuators in-class as appropriate.

**ME562 Intermediate Dynamics**
Hours 3

Dynamics of systems in moving coordinate frames; Lagrangian formulation and Hamilton's principle; stability and perturbation concepts for rigid body motion; motion of systems of rigid bodies in three dimensions.

**ME570 Mechanical Vibrations**
Hours 3

Formulation and solution of free and forced vibration problems for undamped and damped systems with single and multiple degrees of freedom. An introduction to modeling vibrations in continuous systems is also included. Superposition methods utilizing waveform decomposition, such as Fourier Series, are presented for use in both solution methods and system analysis. Experimental techniques of vibration measurement are also introduced.

**ME571 Fundamentals Of Acoustics**
Hours 3

Fundamental physical principles underlying wave propagation and resonance in mechanical systems. The course introduces modeling, applications, and provides experience in acoustic and audio measurements and the associated instrumentation. The human auditory transduction mechanism is also studied along with physical parameters that describe how humans hear.

**ME572 Introduction to Robotic Kinematics**
Hours 3

Teach the fundamental concepts in robot mechanics, planning and control, and enable the students to conduct basic kinematic and dynamic analysis for manipulator-type and mobile robots.

**ME575 Control Systems Analysis**
Hours 3

Classical feedback control system analysis, Laplace transform, transfer function, time response, proportional-integral-derivative control, root locus, frequency response, and computerized analysis. Also includes a brief introduction to modern control techniques.

**ME577 Advanced Linear Control**
Hours 3

Modern techniques for the analysis and design of linear control systems. Matrix formulation; multivariable control systems; state-variable concepts; discrete-time systems; optimization; and statistical design methods.

**ME591 Special Problems**
Hours 3

This course covers topics not currently covered by an existing course in the catalog and is usually associated with a faculty member's specialty area. Content varies by section and semester.

**ME594 Special Project**
Hours 2-6

Planning, executing, and presenting results of an individual project involving a research design, analysis, or similar undertaking.

**ME598 Non-Thesis Research**
Hours 1-3

*No description available*

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**ME599 Thesis Research**
Hours 1-12

This independent research course partially fulfills required master's-level research thesis hours toward the master's degree in Mechanical Engineering. The course is conducted under the guidance of the thesis advisor. Material covered will be of an advanced nature aimed at providing master's students with an understanding of the latest research and current developments within the field. Discussion and advisor guidance will be directed towards readings of research articles and development of research methodology, with the aim of producing an original research contribution that represents a novel development in the field, or a novel perspective on a pre-existing topic in the field. Variable hours.

**ME605 Classical Thermodynamics**
Hours 3

Classical macroscopic thermodynamic analysis of systems, pure substances, mixtures, and reacting systems.

**ME607 Conduction Heat Transfer**
Hours 3

Transient, multidimensional heat conduction in various geometries, and the mathematical and numerical means to analyze them.

**ME618 Princ Of Combustion II**
Hours 3

Parameters of confined combustion; evaporation of fuel, velocity of flames, detonation, and chamber design; dynamic effects; and measuring techniques. Assigned papers.

**ME670 Advanced Vibrations**
Hours 3

Covers advanced concepts in mechanical vibration analysis. Topics include introduction to variational approach and energy methods applied to motions of deformable body in three dimensions; vibrations of distributed-parameters systems including strings, bars, shafts, beams, membranes, and plates. Covers approximate methods, Rayleigh's Quotient, Rayleigh-Ritz method, method of functions expansion, Galerkin's and assumed mode methods, design and analysis of a variety of vibration-control systems, and recent advances in vibration of micro- and nano-scale systems.

Prerequisite(s): ME 470 or ME 570

**ME674 Nonlinear Control Systems**
Hours 3

Analysis of nonlinear systems. Nonlinear controller design techniques. State variables, phase plane analysis, describing functions, and Lyapunov stability theory.

Prerequisite(s): ME 475 OR ECE 475

**ME691 Special Problems**
Hours 1-6

*No description available*

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**ME694 Special Project**
Hours 2-6

Planning, executing, and presenting results of an individual project involving a research design, analysis, or similar undertaking.

**ME695 Graduate Seminar**
Hours 1

This is a first course in Graduate Research Seminar series offered by the Department of Mechanical Engineering. Students are exposed to a variety of lectures.

**ME696 Graduate Seminar**
Hours 1

This is a second course in Graduate Research Seminar series offered by the Department of Mechanical Engineering. Students are exposed to a variety of lectures.

Prerequisite(s): ME 695

**ME697 Graduate Seminar**
Hours 1

This is a third course in Graduate Research Seminar series offered by the Department of Mechanical Engineering. Students are exposed to a variety of lectures.

Prerequisite(s): ME 695 and ME 696

**ME699 Dissertation Research**
Hours 1-12

This independent research course partially fulfills required doctoral-level research dissertation hours toward the doctoral degree in Mechanical Engineering. The course is conducted under the guidance of the dissertation advisor. Material covered will be of an advanced nature aimed at providing doctoral students with an understanding of the latest research and current developments within the field. Discussion and advisor guidance will be directed towards readings of research articles and development of research methodology, with the aim of producing an original research contribution that represents a novel development in the field, or a novel perspective on a pre-existing topic in the field.