Mechanical Engineering (ME)

COURSES

ME 5000. PREPARATORY COURSE FOR MECHANICAL ENGINEERING. 0 Hours.
The course may be offered with multiple sections, wherein each section is paired with a corresponding undergraduate course being offered that semester. The purpose of the course is to allow students to take undergraduate courses in areas that may enhance their research knowledge and preparation for their graduate degree. Students can concurrently enroll in multiple sections. For each section of ME 5000, students must be concurrently enrolled in a section of either ME 5397 or ME 6397. Prerequisite: Consent of the Graduate Advisor.

ME 5010. AUTOMOTIVE ENGINEERING PRACTICUM. 0 Hours.
Practical design experience as full member of automotive design competition team. Prerequisite: Permission of Director for the Arnold E. Petsche Center for Automotive Engineering.

ME 5101. GRADUATE SEMINAR. 1 Hour.
The purpose is to acquaint graduate students with ongoing research at UTA, and outside in academia and industry. Seminars are given by graduate students of the department based on their ongoing research. Seminars are also given by external speakers from academia, industry and government.

ME 5191. PROJECT STUDIES IN MECHANICAL ENGINEERING. 1 Hour.
May be repeated for credit as topics change. Project work performed under a non-thesis degree will normally be accomplished under this course number, with prior approval of the Committee on Graduate Studies. May be graded pass/fail.

ME 5197. RESEARCH IN MECHANICAL ENGINEERING. 1 Hour.
Research in master's programs.

ME 5291. PROJECT STUDIES IN MECHANICAL ENGINEERING. 2 Hours.
May be repeated for credit as topics change. Work performed as a thesis substitute will normally be accomplished under this course number, with prior approval of the Committee on Graduate Studies. Maybe graded P/F.

ME 5297. RESEARCH IN MECHANICAL ENGINEERING. 2 Hours.
Research in master's programs.

ME 5302. INTRODUCTION TO BEARING DESIGN AND LUBRICATION. 3 Hours.
The course introduces 1) selection principles and design guidelines for various rolling element bearings, 2) theory of liquid and gas lubrication, 3) various novel fluid film bearings used in modern high speed turbomachinery and energy systems, and 4) fundamental principles of rotordynamics.

ME 5303. CLASSICAL METHODS OF CONTROL SYSTEMS ANALYSIS AND SYNTHESIS. 3 Hours.
Equip the student with familiarity of significant tools of the control engineer. Topics covered include controllers and their effect on system performance and stability, block diagram algebra, stability and analysis, system performance definition, root locus, frequency techniques, and state variable methods. Digital simulation tools for design and simulation of control systems. Demonstration of controller design and performance in the laboratory. Also offered as AE 5303. Credit will be granted only once.

ME 5305. DYNAMIC SYSTEMS MODELING. 3 Hours.
To equip the student with the capability of determining the necessary equations for distributed and lumped parameter modeling of mixed physical system types including mechanical, fluid, electrical, and thermal components. Models are formulated for computer simulation and analysis for systems with deterministic and stochastic inputs. Topics of random vibration and system identification are included. Offered as AE 5305 and ME 5305. Credit will be granted only once.

ME 5306. FLUID POWER CONTROL. 3 Hours.
Mathematical models for hydraulic and pneumatic control components and systems including hydraulic pumps, motors, and spool valves. The application of electrohydraulic and hydromechanical servomechanisms for position and velocity control are treated. Theory supported by laboratory demonstrations and experiments.

ME 5310. FINITE ELEMENT METHODS. 3 Hours.
Finite element method in the study of the static response of complex structures and of continua; applications to field problems; analytical methods emphasized, and digital computer application undertaken. Offered as AE 5310 and ME 5310. Credit will be granted only once.

ME 5311. STRUCTURAL DYNAMICS. 3 Hours.
Natural frequencies; forced response of complex structural systems studied through the use of the finite element method; computational aspects of these problems discussed, and digital computer applications undertaken. Offered as AE 5311 and ME 5311. Credit will be granted only once.

ME 5312. CONTINUUM MECHANICS. 3 Hours.
Study of the underlying physical and mathematical principles relating to the behavior of continuous media; interrelationships between fluid and solid mechanics. Offered as AE 5312 and ME 5312. Credit will be granted only once.

ME 5313. FLUID DYNAMICS. 3 Hours.
Basic conservation laws, flow kinematics, special forms of the governing equations, two-dimensional potential flows, surface waves and some exact solutions of viscous incompressible flows. Offered as AE 5313 and ME 5313. Credit will be granted only once.

ME 5315. FUNDAMENTALS OF COMPOSITES. 3 Hours.
This fundamental course will introduce students to mechanics of composites at various scales, including analysis, characterization, and manufacturing methods. Emphasis is on constitutive relations; mechanical and hygrothermal behavior; stress analysis; and simple applications. Offered as AE 5315 and ME 5315. Credit will be granted only once.

ME 5316. THERMAL CONDUCTION. 3 Hours.
Fundamental laws, initial and boundary conditions, basic equations for isotropic and anisotropic media, related physical problems and steady and transient temperature distributions in solid structures.

ME 5317. CONVECTION HEAT TRANSFER. 3 Hours.
Equations of motion of viscous fluids are reviewed and the energy equations are introduced. Exact and approximate solutions are made for forced convective problems with non-isothermal and unsteady boundaries. Free convection and combined free- and forced-convection problems are solved.

ME 5318. RADIATIVE HEAT TRANSFER. 3 Hours.
General equations of radiative transfer derived and solved for special problems, and the elements of atomic, molecular, and continuum radiation are introduced.

ME 5319. ADVANCED FINITE ELEMENT METHODS. 3 Hours.
Continuation of ME 5310. Modeling of large systems, composite and incompressible materials, substructuring, mesh generation, solids applications, nonlinear problems. Prerequisite: ME 5310 or equivalent.

ME 5320. DESIGN OPTIMIZATION. 3 Hours.
The purpose of this course is to present modern concepts of optimal design of structures. Basic ideas from optimization theory are developed with simple design examples. Analytical and numerical methods are developed and their applications discussed. Use of numerical simulation methods in the design process is described. Concepts of structural design sensitivity analysis and approximation methods will be discussed. The emphasis is made on the application of modern optimization techniques linked to the numerical methods of structural analysis, particularly, the finite element method. Prerequisite: AE 5310 or ME 5310.

ME 5321. ADVANCED CLASSICAL THERMODYNAMICS. 3 Hours.
Fundamentals of thermodynamics reviewed. Different treatments of principles studied, compared and formal relationships developed and applied to chemical, magnetic, electric and elastic systems.

ME 5322. ADVANCED STRUCTURAL DYNAMICS. 3 Hours.
Normal mode method for undamped and proportionally damped systems, component mode synthesis, generally damped systems, complex modes, effect of design modification on system response. Prerequisite: ME 5311 or equivalent.

ME 5323. ENGINEERING RESEARCH METHODS. 3 Hours.
This hands-on course will teach the tools that are essential for conducting graduate research, with an aim to prepare the students for project-based graduate research. The course will be focused on the integration of engineering concepts to complete course projects that imitate mini research projects. Prerequisite: Undergraduate education in engineering or science.

ME 5324. POWER PLANT ENGINEERING. 3 Hours.
Fundamental thermodynamics and heat transfer principles behind design and optimization of power generation systems with significant emphasis on component and system design. This class will cover a number of power plant types, including coal/gas fired, hydroelectric, nuclear, and solar. Concepts learnt in this class prepare students for an engineering career in power plants, oil, gas and related industries.

ME 5325. COMBUSTION. 3 Hours.
Fundamental treatment of problems involving simultaneous occurrence of chemical reaction and transfer of heat, mass and momentum. Topics include kinetically controlled combustion phenomena; diffusion flames in liquid fuel combustion; combustion of solids; combustion of gaseous fuel jets; flames in premixed gasses. Offered as AE 5325 and ME 5325. Credit will be granted only once.

ME 5326. MANUFACTURING PROCESSES AND SYSTEMS. 3 Hours.
Survey and modeling of manufacturing, assembly, surface treatment, automation, and integration processes. Prerequisite: Graduate standing.

ME 5327. DESIGN FOR MANUFACTURING. 3 Hours.
The interaction between design and manufacturing stressed in terms of the design process, customer-focused quality, design specifications versus process capability and tolerances, and redesign for producibility. Topics include material and manufacturing process selection, tolerancing, quality function deployment (QFD), design for assembly (DFA), quality control techniques, reliability, and robust design. Prerequisite: ME 5326.

ME 5328. METAL ADDITIVE MANUFACTURING. 3 Hours.
This course will provide students with essential knowledge and technical skills for metal additive manufacturing (AM), providing a solid foundation for a future career in the field. Primary areas of focus include: metal AM processes and their capabilities, process fundamentals, part design and analysis, build preparation and machine set-up, fabrication and post-processing, inspection and monitoring, microstructure analysis and mechanical testing, and process optimization.

ME 5329. ADDITIVE MANUFACTURING. 3 Hours.
The range of technologies and processes, both physical and digital, used to translate virtual solid model data into physical models using additive layering methods. Emphasis is given to application of these technologies to manufacture end use components and assemblies but rapid prototyping is also discussed. Metal, polymer, ceramic, and composite material applications of additive manufacturing are included. Discussion includes advantages and limitations of additive methods with respect to subtractive methods and to each other. Principles of design for additive manufacturing are covered along with discussion of applications. Students complete a project to design and build an engineering component or assembly for additive manufacturing. Offered as AE 5329 and ME 5329. Credit will be granted only once. Prerequisite: Graduate standing.

ME 5331. ANALYTIC METHODS IN ENGINEERING. 3 Hours.
Introduction to advanced analytic methods in engineering. Methods include multivariable calculus and field theory, Fourier series, Fourier and Laplace Transforms. Offered as AE 5331 and ME 5331. Credit will be granted only once. Prerequisite: Undergraduate degree in engineering, physics, or mathematics.

ME 5332. ENGINEERING ANALYSIS. 3 Hours.
Introduction to partial differential equations and complex variable theory with application to modeling of physical systems. Offered as AE 5332 and ME 5332. Credit will be granted only once.

ME 5333. THERMAL PHENOMENA IN MICROSYSTEMS. 3 Hours.
Introduction to experimental methods for microscale thermal transport, including experimental measurement techniques, design of experiments, data acquisition and analysis tools. Significant emphasis on carrying out mini-projects on related topics. Course learning outcomes are directly relevant for engineering jobs in semiconductors, energy conversion and other related industries. Offered as AE 5333 and ME 5333. Credit will be granted only once.

ME 5335. OPTIMAL CONTROL OF DYNAMIC SYSTEMS. 3 Hours.
Linear and nonlinear optimization methods; optimal control; continuous time Ricatti equation; bang-bang control; singular arcs; differential inclusions; collocation techniques; design of optimal dynamic system trajectories. Offered as AE 5335 and ME 5335. Credit will be granted only once.

ME 5336. OPTIMAL ESTIMATION OF DYNAMIC SYSTEMS. 3 Hours.
Kalman filter design and implementation. Optimal filtering for discrete-time and continuous-time dynamical systems with noise. Wiener filtering. State-space determination. Offered as EE 6327, AE 5336 and ME 5336. Credit will be granted only once. Prerequisite: introductory systems or identification course is desirable. Also offered as AE 5336 and EE 6327. Credit will be granted only once.

ME 5337. INTRODUCTION TO ROBOTICS. 3 Hours.
An overview of industrial robots and applications to traditional and emerging applications. Coordinate systems and homogeneous transformations, kinematics of manipulators; motion characteristics and trajectories; dynamics and control of manipulators; actuation and design issues. Programming of industrial robotic manipulators in the laboratory. Offered as AE 5337 and ME 5337. Credit will be granted only once.

ME 5338. ANALYTICAL & COMPUTATIONAL DYNAMICS. 3 Hours.
The course focuses on developing the equations of motion for dynamic systems composed of multiple, connected and unconnected, rigid bodies using Kane's method and the Lagrangian approach. The resulting model is used to simulate and visualize the predicted motion. Topics include: kinematics, Euler parameters, kinematic constraints, virtual work, the calculus of variations, energy, momentum, contact, impact, and checking functions. Offered as AE 5338 and ME 5338. Credit will be granted only once.

ME 5339. INTERMEDIATE MECHANICS OF MATERIALS. 3 Hours.
This fundamental mechanics course covers the concepts of deriving stress formulas from deformation and the stress-strain relationship, stress and failure analysis, 2D elasticity, energy methods, and elastic stability. Offered as AE 5339 and ME 5339. Credit will be granted only once.

ME 5340. AUTOMOTIVE ENGINEERING. 3 Hours.
Introduction to automotive engine types and performance, drive train modeling and vehicle loading characteristics, fueling requirements, fuel injection systems, tire characteristics and modeling, suspension characteristics and handling, braking systems and requirements. Course taught through lecture, student presentations and student design projects.

ME 5341. CONTROL SYSTEM COMPONENTS. 3 Hours.
The components and hardware used in electronic, hydraulic, and pneumatic control systems; techniques of amplification, computation, compensation, actuation, and sensing; modeling of multiport systems as well as servo systems analysis. Pulse modulated systems. Offered as AE 5341 and ME 5341. Credit will be granted only once. Prerequisite:Undergraduate introductory control course in Mechanical Engineering or equivalent or ME 5303 or equivalent.

ME 5342. GAS DYNAMICS. 3 Hours.
Review of fundamental compressible flow theory, method of characteristics for perfect gases, the Rankine-Hugoniot conditions, linearized flow theory. Offered as AE 5342 and ME 5342. Credit will be granted only once. Prerequisite: MAE 3303 or equivalent.

ME 5344. VISCOUS FLOWS. 3 Hours.
Navier-Stokes equations and Prandtl's boundary layer approximations; laminar and turbulent boundary layers including internal and external flows.

ME 5345. NUMERICAL HEAT TRANSFER AND FLUID FLOW. 3 Hours.
Introduction to numerical solutions for problems in heat transfer and fluid flow by the finite-volume method. The focus will be on numerical aspects pertaining to incompressible fluids. It provides the background training towards the use of commercial software. Offered as AE 5345 and ME 5345. Credit will be granted only once.

ME 5347. HEAT EXCHANGER DESIGN. 3 Hours.
Design procedures, system evaluations and design parameters in heat exchangers. Heat exchanger configurations; student design projects.

ME 5349. POLYMER SCIENCE AND ENGINEERING. 3 Hours.
This course provides a broad introduction to polymer science, technology, and use in engineering design. Topics covered are: polymer chemistry (major synthetic polymerization routes); Polymer physics (solution and melt behavior, solid-state morphology and properties); polymer engineering (melt processing, recycling methods); and polymer applications (automotive, aerospace, composites, 3D printing).

ME 5350. COMPUTER AIDED DESIGN AND MANUFACTURING. 3 Hours.
Study of detailed computer aided tools within the framework of designing and manufacturing processes of real-world products. Topics covered are mathematics of geometric modeling, process of defining geometric elements with constraints and relations, concurrent engineering in design including modularization of products, reverse engineering with surface reconstruction, kinematic chain analysis for machine design, and simulation of manufacturing processes along with some aspects of digital manufacturing and its role in direct and additive manufacturing.

ME 5352. FUNDAMENTALS IN ELECTRONIC PACKAGING. 3 Hours.
An introductory treatment of electronic packaging, from single chip to multichip, including materials, electrical design, thermal design, mechanical design, package modeling and simulation, processing considerations, reliability, and testing.

ME 5353. COMPUTATIONAL TECHNIQUES FOR ELECTRONIC PACKAGING. 3 Hours.
Characterization of the thermo/mechanical reliability of microelectronics devices using commercial computational heat transfer codes (Icepack, Flotherm, and ANSYS). Industry related problems ranging from first level packages through system level packages analyzed. Formulate and model contemporary problems using commercial CFD codes.

ME 5358. RACECAR ENGINEERING. 3 Hours.
This course intended for Formula SAE team members and other interested students to develop new systems or analyze concepts for the Formula SAE or Formula Electric racecar and related equipment. The students will form teams and perform research and development on projects related to automotive or racecar engineering.

ME 5359. APPLIED AUTOMOTIVE ENGINEERING. 3 Hours.
The purpose of this course is to gain practical experience in the design and fabrication of parts or systems for automotive applications. The student must write a proposal, give a public oral presentation, and prepare a formal final report. The student must have attained full team member status in a student design competition team. Prerequisites: permission of Director of the Arnold E. Petsche Center for Automotive Engineering.

ME 5362. INTRODUCTION TO MICRO AND NANOFLUIDICS. 3 Hours.
As going down to micro scales, the basic hypothesis in the macro scale fluid mechanics may not be applicable in such scales. The objectives of this course are: to identify dominant forces and their effects in micro scale fluid systems that are different from those in the macro scales; to understand the fundamentals of micro fluidic phenomena; to discuss various microfluidic applications in research and commercial levels; and to explore new possible microfluidic applications in the emerging fields. Topics include overview of microfluidics, scaling laws, violation limit of the Navier-Stokes equations, surface force, surface tension, electrowetting, electrokinetics, dielectrophoresis, and soft lithography. Prerequisite: MAE 2314 and MAE 3310 or equivalents.

ME 5363. INTRODUCTION TO ROTORCRAFT ANALYSIS. 3 Hours.
History of rotorcraft. Behavior of the rotor blade in hover and forward flight. Rotor configurations, dynamic coupling with the fuselage, elastic and aeroelastic effects. Offered as AE 5363 and ME 5363. Credit will be granted only once.

ME 5364. INTRODUCTION TO AERODYNAMICS OF ROTORCRAFT. 3 Hours.
Practical aerodynamics of rotors and other components of rotorcraft. Introduction to performance, handling qualities, and general flight mechanics related to rotorcraft design, test, and certification requirements. Emphasis is on rotorcraft mission capabilities as defined by the customer. Offered as AE 5364 and ME 5364. Credit will be granted only once.

ME 5365. INTRODUCTION TO HELICOPTER AND TILTROTOR SIMULATION. 3 Hours.
Dynamic and aerodynamic modeling of rotorcraft elements using vector mechanics, linear algebra, calculus and numerical methods. Special emphasis on rotors, aerodynamic interference, proper axis system representation, model assembly methods and trimming. Offered as AE 5365 and ME 5365. Credit will be granted only once.

ME 5366. FUEL CELLS AND APPLICATIONS. 3 Hours.
The course introduces: Principles and thermodynamics applied to fuel cell-based power generation systems; materials and manufacturing methods of two common fuel cells and their stacks; modeling, analysis, and design of fuel cells and various reformers; and design issue of balance of plants such as steam management systems.

ME 5374. NONLINEAR SYSTEMS ANALYSIS AND CONTROLS. 3 Hours.
Nonlinear systems; phase plane analysis; Poincare-Bendixon theorems; nonlinear system stability; limit cycles and oscillations; center manifold theorem, Lyapunov methods in control; variable structure control; feedback linearization; backstepping techniques. Offered as AE 5374 and ME 5374. Credit will be granted only once.

ME 5378. INTRODUCTION TO UNMANNED VEHICLE SYSTEMS. 3 Hours.
Introduction to UVS (Unmanned Vehicle Systems) such as UAS (Unmanned Aircraft Systems), UGS (Unmanned Ground System) and UMS (Unmanned Maritime System), their history, missions, capabilities, types, configurations, subsystems, and the disciplines needed for UVS development and operation. UVS missions could include student competitions sponsored by various technical organizations. This course is team-taught by engineering faculty. Offered as AE 5378 and ME 5378. Credit will be granted only once.

ME 5379. UNMANNED VEHICLE SYSTEM DEVELOPMENT. 3 Hours.
Introduction to the technologies needed to create an UVS (Unmanned Vehicle System). Integration of these technologies (embodied as a set of sensors, actuators, computing and mobility platform sub-systems) into a functioning UVS through team work. UVS could be designed to compete in a student competition sponsored by various technical organizations or to support a specific mission or function defined by the instructors. This course is team-taught by engineering faculty. Offered as AE 5379 and ME 5379. Credit will be granted only once. Prerequisite: B or better in MAE 4378 or AE 5378 or ME 5378 and admission to the UVS certificate program.

ME 5380. DESIGN OF DIGITAL CONTROL SYSTEMS. 3 Hours.
Difference equations, z- and w- transforms, discrete TF (Transfer Function). Discrete equivalence (DE) to continuous TF. Aliasing & Nyquist sampling theorem. Design by DE, root locus in z- plane & Youla parameterization. Discrete state- space model, minimality after sampling, pole placement, Moore-Kimura method, linear quadratic regulator, asymptotic observer. Computer simulation and/or laboratory implementation. Offered as EE 5324, AE 5380 and ME 5380. Credit will be granted only once. Prerequisite: undergraduate level controls course or equivalent. Also offered as AE 5380, EE 5324. Credit will be granted only once.

ME 5381. BOUNDARY LAYERS. 3 Hours.
An introductory course on boundary layers. The coverage emphasizes the physical understanding and the mathematical foundations of boundary layers, including applications. Topics covered include laminar and turbulent incompressible and compressible boundary layers, and an introduction to boundary layer transition. Offered as AE 5381 and ME 5381. Credit will be granted only once.

ME 5382. RESEARCH TRENDS IN RENEWABLE ENERGY TECHNOLOGIES. 3 Hours.
This course is offered to graduate and senior level undergraduate students with engineering and science background to introduce them to micro/nano research and development for energy conversion and storage. The course will cover topics such as Scaling laws, MEMS fabrication, Nanomaterial synthesis, Electrochemical energy storage/conversion (Batteries, Fuel Cells & Supercapacitors), Solar energy (photovoltaics and solar thermal energy), Energy harvesting and Solar water splitting and electrocatalysis.

ME 5386. WIND & OCEAN CURRENT ENERGY HARVESTING FUNDAMENTALS. 3 Hours.
A broad senior/graduate first course in wind/wave/ocean current energy harvesting systems, focused on fundamentals, and serving as the basis for subsequent MAE specialized follow-on graduate course offerings focused on structures (conventional and composite), aero/hydro-mechanical response and control, and tailoring and smart material actuation, respectively, as well as for non-MAE, specialized graduate courses. (also taught as AE 5386).

ME 5390. SPECIAL TOPICS IN MECHANICAL ENGINEERING. 3 Hours.
To provide formal instruction in special topics pertinent to Mechanical Engineering from semester to semester depending on the availability of faculty. May be repeated provided topics differ.

ME 5391. ADVANCED STUDIES IN MECHANICAL ENGINEERING. 3 Hours.
May be repeated for credit as topics change. Project work performed under a non-thesis degree will normally be accomplished under this course number, with prior approval of the Committee on Graduate Studies.

ME 5397. RESEARCH IN MECHANICAL ENGINEERING. 3 Hours.
Research in master's programs.

ME 5398. THESIS. 3 Hours.
Thesis.

ME 5698. THESIS. 6 Hours.
Thesis Prerequisite: GRAD ME thesis major.

ME 5998. THESIS. 9 Hours.
Thesis Prerequisite: GRAD ME thesis major.

ME 6196. MECHANICAL ENGINEERING INTERNSHIP. 1 Hour.
For students participating in internship programs. May be repeated for credit. Requires prior approval of ME Graduate Advisor.

ME 6197. RESEARCH IN MECHANICAL ENGINEERING. 1 Hour.
May be repeated for credit.

ME 6297. RESEARCH IN MECHANICAL ENGINEERING. 2 Hours.
May be repeated for credit.

ME 6299. DISSERTATION. 2 Hours.
Prerequisite: Admission to candidacy for the Doctoral of Philosophy degree.

ME 6304. ADVANCED MECHANICS OF MATERIALS. 3 Hours.
This graduate level course will cover the calculation of stresses and strains in a body that experiences hyperelastic, viscoelastic and plastic deformation. Offered as AE 6304 and ME 6304. Credit will be granted only once. Prerequisite: AE 5339, ME 5339, or instructor consent.

ME 6310. ADVANCED FINITE ELEMENT METHODS. 3 Hours.
Modeling of large systems, composite and incompressible materials, substructuring, mesh generation, solids applications, nonlinear problems. Offered as AE 6310 and ME 6310. Credit will be granted only once. Prerequisite: AE 5310, ME 5310, or instructor consent.

ME 6311. ADVANCED STRUCTURAL DYNAMICS. 3 Hours.
Normal mode method for undamped and proportionally damped systems, component mode synthesis, generally damped systems, complex modes, effect of design modification on system response. Offered as AE 6311 and ME 6311. Credit will be granted only once. Prerequisite: AE 5311, ME 5311, or instructor consent.

ME 6314. FRACTURE MECHANICS. 3 Hours.
Linear elastic fracture mechanics, energy of fracture, mixed mode crack propagation, fatigue crack growth, numerical methods for stress intensity factor determination, damage tolerance and durability design. Offered as AE 6314 and ME 6314. Credit will be granted only once. Prerequisite: AE 5339, ME 5339, or instructor consent.

ME 6315. ADVANCED COMPOSITES. 3 Hours.
This course introduces students to advanced mechanics of composites at various scales, including analysis and characterization methods. Emphasis is on advanced methods for material characterization; nonlinear constitutive relations; structural and microstructural analysis; and advanced materials and structures applications. Offered as AE 6315 and ME 6315. Credit will be granted only once. Prerequisite: AE 5315, ME 5315, or instructor consent.

ME 6337. ADVANCED ROBOTICS. 3 Hours.
Advanced robotic design concepts considering structural statics, dynamics and control strategies for both rigid and flexible manipulators will be studied using optimization techniques and analytical approaches and introduction to micro- and mobile robotic devices. Study of emerging applications of robotics will be explored. Digital simulation of robotic devices and programming and demonstration of robotic devices in the laboratory. Prerequisites: AE 5337 or ME 5337 or equivalent.

ME 6344. HEAT TRANSFER IN TURBULENT FLOW. 3 Hours.
Introduction to heat transfer in turbulent boundary layers including internal and external flows, turbulence structure, the Reynolds analogy, van Driest hypothesis, high and low Prandtl number two equation model, effects of surface roughness on heat transfer. Also offered as AE 6344. Credit will be granted only once.

ME 6397. RESEARCH IN MECHANICAL ENGINEERING. 3 Hours.
May be repeated for credit.

ME 6399. DISSERTATION. 3 Hours.
May be repeated for credit.

ME 6697. RESEARCH IN MECHANICAL ENGINEERING. 6 Hours.
May be repeated for credit.

ME 6699. DISSERTATION. 6 Hours.
Prerequisite: Admission to candidacy for the Doctor of Philosophy degree.

ME 6997. RESEARCH IN MECHANICAL ENGINEERING. 9 Hours.
May be repeated for credit.

ME 6999. DISSERTATION. 9 Hours.
Admission to candidacy for the Doctor of Philosophy degree.

ME 7399. DOCTORAL DEGREE COMPLETION. 3 Hours.
This course may be taken during the semester in which a student expects to complete all requirements for the doctoral degree and graduate. Enrolling in this course meets minimum enrollment requirements for graduation, for holding fellowships awarded by The Office of Graduate Studies and for full-time GTA or GRA positions. Students should verify that enrollment in this course meets other applicable enrollment requirements. To remain eligible in their final semester of study for grants, loans or other forms of financial aid administered by the Financial Aid Office must enroll in a minimum of 5 hours as required by the Office of Financial Aid. Other funding sources may also require more than 3-hours of enrollment. Additional hours may also be required to meet to requirements set by immigration law or by the policies of the student's degree program. Students should contact the Financial Aid Office, other sources of funding, Office of International Education and/or their graduate advisor to verify enrollment requirements before registering for this course. This course may only be taken twice. Students who do not complete all graduation requirements while enrolled in this course must enroll in a minimum of 6 dissertation hours (6699 or 6999) in their graduation term. Graded P/F/R.