

# Mechanical Engineering Courses

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## Courses

### **MECH 5010. Graduate Seminar.**

Graduate Seminar To provide a common meeting framework for students and external guests to present research findings and talks on topics relevant to mechanical engineering studies. Every full time mechanical engineering graduate students is required to enroll in this class each semester.

**Department:** Mechanical Engineering

**0 Credit Hours**

**9 Total Contact Hours**

0 Lab Hours

0 Lecture Hours

9 Other Hours

### **MECH 5301. Mathl Methods for Mech Eng.**

Mathematical Methods for Mechanical Engineers (3-0). The primary objective of this class is to give a grounding in some basic mathematical analysis methods that are most relevant to mechanical engineers. Topics include linear algebra and vector spaces, tensorial calculus, ordinary and partial differential equations.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

### **MECH 5302. Solid Mechanics I.**

Solid Mechanics I (3-0). An introduction to continuum mechanics, elasticity, stress, strain and constitutive models for solid mechanics problems.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

### **MECH 5303. Heat Transfer I.**

Heat Transfer I (3-0). Introduction to heat conduction and convection; steady state and transient solutions, analytical and numerical methods.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

### **MECH 5305. Comp. Fluid Dynamics.**

Computational Fluid Dynamics (3-0). Flow models and governing equations, mathematical behavior of partial differential equation, discretization technique: finite difference and finite volume, basics of numerics: algorithms for solving systems of linear algebraic equations, numerical stability, heat conduction, convection and diffusion, calculation of the flowfield: SIMPLE and SIMPLER algorithm, grids and transformation, post processing.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

### **MECH 5306. Fluid Dynamics.**

Fluid Dynamics (3-0). Introduction to the dynamics of continuum compressible and incompressible flows; basic laws of continuum fluids; Navier-Stokes equations; solution of simple idealized flows; potential flow; turbulence introduction.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5310. Thermodynamics.**

Thermodynamics (3-0). Applications of general thermodynamic relations; study and applications of time-dependent energy relationships; analysis of power, refrigeration, cryogenic and direct energy conversion systems.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5311. Adv Finite Element Analysis.**

Advanced Finite Element Analysis (3-0). This class will give an introduction to theory and application of advanced nonlinear finite element analysis.

Topics covered include Eulerian and Lagrangian grids, explicit and implicit schemes, solution methods, large deformations and nonlinear materials, and contact.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5312. Solid Mechanics II.**

Solid Mechanics II (3-0). Advanced topics in solid mechanics; inelastic material response; continuum mechanics; fracture mechanics; computational mechanics; finite elasticity; micro-mechanics. Prerequisite: MECH 5302.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5313. Mech of Composite Materials.**

Mechanics of Composite Materials (3-0). Analysis, design and applications of laminated and fiber reinforced composites. Micro- and macro-mechanical analysis of elastic constants, failure modes and environmental degradation.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5314. Continuum Mechanics.**

Continuum Mechanics To provide a common meeting framework for students and external guests to present research findings and talks on topics relevant to mechanical engineering studies. Every full time mechanical engineering graduate student is required to enroll in this class each semester.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5318. Analytical Dynamics.**

Analytical Dynamics (3-0). Advanced concepts in dynamics; Newtonian dynamics of particles and systems of particles; Dynamics of systems of rigid bodies and elastically deformable bodies; Lagrange's and Hamilton's equations of motion; Variational Principles.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5328. Fracture Mechanics.**

Fracture Mechanics Overview of linear elastic fracture mechanics as well as small scale plastic fracture mechanics; near tip fields; stress intensive factors, crack energetics and energy release rate; basic of computational fracture mechanics; J-integral. Prerequisites: MECH 5302.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5334. Space Systems Design.**

Space Mission Designs and Requirements. Orbital Mechanics. Propulsion. Space Environment. Structural Design and Thermal Control. Power and Communication Systems.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5335. Aerospace Propulsion.**

Fundamentals of airbreathing and rocket propulsion. Parametric Cycle Analysis of ideal and real engines. Engine Performance Analysis. Turbomachinery. Inlet, Nozzles, and Combustion System.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5336. Aerospace Structures.**

Advanced mechanics of materials analysis of spacecraft and aircraft structural components: elasticity; torsion and bending of beams, analysis and design of thin-walled beams; failure modes; elastic buckling; in-plane stresses in monocoque and semi-monocoque pressure vessels.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5337. Aero Dynamics and Controls.**

Aero Dynamics and Controls (Dynamics and Control of Aerospace Vehicles) (3-0). Flight mechanics, flight dynamics, systems and control theories. Controller Design. System design considerations.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5351. Intro to 3D Eng & Additive Mfg.**

Introduction to 3D Engineering and Additive Manufacturing Fundamentals of 3D Engineering (3DE) and Additive Manufacturing (AM) across a diverse spectrum of technologies and application areas are introduced, including design principles and computer aided- design (CAD), reverse engineering, analysis relevant to 3DE/AM, and 3D printing/ additive manufacturing and other advanced manufacturing technologies. Upon completion of the course, the student should be capable of making informed decisions about 3DE and AM design and process selection, and understand fundamental materials science behind 3DE and AM performance limitations. This course requires departmental approval.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5352. Dsg for 3D Eng & Additive Man.**

Design for 3D Engineering and Additive Manufacturing Design fundamentals of 3D Engineering (3DE) and Additive Manufacturing (AM) are presented, including economics of 3DE and AM technologies with respect for design and process selection. Upon completion of the course, the student should be capable of applying engineering tools such as CAD, FEA, and CFD to allow students to take advantage of 3DE and AM design freedom for performance optimization within technology performance and materials selection constraints. This course requires departmental approval.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5353. Adv 3D Eng & Additive Manufact.**

Advanced 3D Engineering and Additive Manufacturing Advanced 3D Engineering (3DE) and Additive Manufacturing (AM) topics are covered and applied to the state-of-the art in design, analysis, process of selection, materials, manufacturing, and final part performance with particular emphasis on new design principles available through 3DE and AM. This course requires departmental approval.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5354. Design Studio I.**

Design Studio I Design Studio I includes hands-on applications of 3D Engineering and Additive Manufacturing to include 3D design and fabrication across process categories to demonstrate performance characteristics, available materials, and process advantages and limitations. This course requires departmental approval.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5355. Design Studio II.**

Design Studio II Design Studio II includes advanced hands-on projects that demonstrate the new paradigm in design and fabrication afforded through 3D Engineering and Additive Manufacturing. This course requires departmental approval.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5390. Special Topics Mechanical Engr.**

Special Topics in Mechanical Engineering (3-0) Advanced topics of contemporary interest in mechanical engineering. May be repeated for credit when topic varies. Prerequisite: Department approval.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 5391. Individual Studies.**

Individual Studies (0-0-3). Individual studies credit for Masters level graduate students on specific topics and problems conducted under the direct supervision of a faculty member. A maximum of 3 credit hours may be applied towards the MS degree.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

0 Lecture Hours

3 Other Hours

**MECH 5396. Graduate Projects.**

Graduate Projects (0-0-3). Individual research, design, or analysis on advanced engineering problems conducted under faculty supervision. This may not be taken by MS thesis students and may only be taken once by non-thesis students.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

0 Lecture Hours

3 Other Hours

**MECH 5397. Graduate Projects.**

Graduate Projects (0-0-3). Individual research, design, or analysis on advanced engineering problems conducted under faculty supervision. This may not be taken by MS thesis students and may only be taken once by non-thesis students.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

0 Lecture Hours

3 Other Hours

**Prerequisite(s):** (MECH 5396 w/P or better)

**MECH 5398. Thesis.**

Thesis (0-0-3)

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

0 Lecture Hours

3 Other Hours

**MECH 5399. Thesis.**

Thesis (0-0-3) Prerequisite: MECH 3598.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

0 Lecture Hours

3 Other Hours

**Prerequisite(s):** (MECH 5398 w/P or better)

**MECH 6304. Heat Transfer II.**

Heat Transfer II Advanced topics in heat conduction, convection and radiation; Turbulent effects free convection, boundary layers.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**Prerequisite(s):** (MECH 5303 w/C or better)

**MECH 6306. Princ of Experiment & Eng Dev.**

Principles of Experimental and Engineering Development Various topics related to how transfer engineering research advances into products and to industry. Proposal writing and strategies to be competitive in proposal writing, business plans, technology roadmaps, SBIR and STTR programs.

Prerequisites: Departmental Approval.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 6307. Eng Regulation and Policy.**

Engineering Regulation and Policy An overview on how various regulatory policies affect product development and engineering research as well as how such regulations and policies are drafted and who are the driving constituents behind the policies. This class is intended to give the students a perspective on policy and regulation in the context of the development of engineering research and intellectual property. Prerequisites: Departmental approval.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 6308. Prod Dev in Entrepren Ventures.**

Product Development in Entrepreneurial Ventures A survey course on some of the basics of developing products and transitioning research to the marketplace. There is focus on topics such as intellectual property strategy, business plans, the venture capital method and alternatives, product concept testing, as well as negotiation and leadership vision. Prerequisites: Departmental approval

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 6311. Adv Finite Element Analysis.**

Advanced Finite Element Analysis This class will give an introduction to theory and application of advanced nonlinear finite element analysis. Topics covered include Eulerian and Lagrangian grids, explicit and implicit schemes, solution methods, large deformations and nonlinear materials, and contact.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 6312. Solid Mechanics II.**

Solid Mechanics II Advanced topics in solid mechanics; inelastic material response; continuum mechanics; fracture mechanics; computational mechanics; finite elasticity; micro-mechanics.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 6323. Micromechanics.**

Micromechanics Basic theories, analytical techniques, and mathematical foundations of micromechanics, dislocations, and cohesive fracture models, Eshelby's eigenstrain theory, theoretical composite material micromechanics and homogenization with periodic structures. Prerequisites: MECH 5302.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 6328. Fracture Mechanics.**

Fracture Mechanics Overview of linear elastic fracture mechanics as well as small scale plastic fracture mechanics; near tip fields; stress intensive factors, crack energetics and energy release rate; basic of computational fracture mechanics; J-integral.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**Prerequisite(s):** (MECH 2302 w/C or better)

**MECH 6343. Advanced Manufacturing(3DPrin).**

Advanced Manufacturing Basic mechanics of various manufacturing processes. Metal forming, composite manufacturing techniques, mechanics and processing of additive manufacturing. Prerequisites: MECH 5302

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 6363. Turbomachinery.**

Turbomachinery Application of basics of fluid dynamics, mass transportation and heat transfer to various turbomachinery systems. Prerequisites: MECH 5306 and MECH 5310.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 6364. Turbulence I.**

Turbulence I Background on Turbulence: Description of turbulence, Kinematics of fluid motion, Reynolds averaged Navier-Stokes (RANS) equations, Scaling of turbulent flows (free shear layers and boundary layers). Turbulence Modeling: Hierarchy of turbulence simulations, Direct numerical simulation (DNS) , Large-eddy simulation (LES) approaches. Prerequisites: MECH 5306.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 6390. Spec Topics in Mechanical Eng.**

Special Topics in Mechanical Engineering Advanced topics in Mechanical Engineering suitable for doctoral level students.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

3 Lecture Hours

0 Other Hours

**MECH 6396. Doctoral Research.**

Doctoral Research Individual research, design or analysis on advanced phases of engineering problems conducted under the direct supervision of a faculty member.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

0 Lecture Hours

3 Other Hours

**MECH 6398. Dissertation I.**

Dissertation I Initial work on the dissertation. Departmental approval.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

0 Lecture Hours

3 Other Hours

**MECH 6399. Dissertation II.**

Dissertation II Continuous enrollment required while work on the thesis continues. Prerequisites: Departmental approval.

**Department:** Mechanical Engineering

**3 Credit Hours**

**3 Total Contact Hours**

0 Lab Hours

0 Lecture Hours

3 Other Hours

**MECH 6696. Doctoral Research.**

Doctoral Research Advanced topics in mechanical engineering suitable for doctoral level students.

**Department:** Mechanical Engineering

**6 Credit Hours**

**6 Total Contact Hours**

0 Lab Hours

0 Lecture Hours

6 Other Hours

**MECH 6996. Doctoral Research.**

Doctoral Research Advanced topics in mechanical engineering suitable for doctoral level students.

**Department:** Mechanical Engineering

**9 Credit Hours**

**9 Total Contact Hours**

0 Lab Hours

0 Lecture Hours

9 Other Hours