

## **Mechanical Eng. - Engrg. Mech.**

### **MEEM 5110 - Continuum Mechanics/Elasticity**

Covers development of Cartesian tensors and indicial notation applied to vector analysis; analysis of stress, principal stresses, invariants, strain tensors, material derivatives, and continuity equations; basic conservation laws and constitutive relationships; the theory of elasticity, including 2-D problems in plane stress/strain, stress functions, and 3-D problems with polar symmetry.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Pre-Requisite(s):** MEEM 2150 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

### **MEEM 5120 - Plasticity and Viscoplasticity**

Plastic stress-strain laws, yield criteria, flow rules, work hardening, flexure and torsion of bars, boundary-value problems, thick cylinders, spheres, discs, general 3-D, residual stresses, limit analysis, plane strain, slip line theory.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 5110

### **MEEM 5150 - Advanced Mechanics of Matls**

A critical study of the basic concepts of stress, strain, and constitutive laws of solids, the physical significance of principle stresses, stress deviator and octahedral stress. Covers failure theories; two-dimensional elasticity theory; mechanics of sub-micron structures; torsion of prismatic bars, thick pressure vessels; special topics in beam theory; elements of elastic stability.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall, Spring

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Pre-Requisite(s):** MEEM 2150 and MEEM 5110

### **MEEM 5160 - Experimental Stress Analysis**

Review of elastic stress-strain relationships. Covers theory and use of resistive strain gages, strain gage circuits, rosette analysis, static and dynamic strain measurement; discusses other current strain measuring techniques; introduces photoelasticity, Moire, and other optical techniques.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-2)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Pre-Requisite(s):** MEEM 2150

**MEEM 5170 - Finite Element and Variational Methods in Engineering**

Variational concepts and Euler-Lagrange equations and the application of these concepts in formulating boundary value problems and approximate methods, including finite-element method. Development of finite element methodology for problems in engineering.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**MEEM 5175 - Failure of Materials in Mechanical Design - Theory and Design**

Identifies the modes of mechanical failure that are essential to prediction and prevention of mechanical failure. Discusses theories of failure in detail. Treats the topic of fatigue failure extensively and brittle fracture, impact and buckling failures at some length. A research/design project will be required. Cannot receive credit for both MEEM4170 and MEEM5175.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

**MEEM 5180 - Mechanics of Composite Matls**

Introduces engineering properties and advantages of fibrous composites, the governing equations of mechanics of anisotropic, laminated materials. Develops micromechanics methods for predicting the elastic properties of the composite and classical lamination theory, including hygrothermal effects, and applies them to stress and failure analysis of composite structures.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**MEEM 5185 - Advanced Engineering Biomechanics**

Engineering mechanics applied to the human body in health and disease on injury, which includes mechanics of human biological materials and engineering design in musculo- skeletal system. Also studies on mechanics of posture (occupational biomechanics) and locomotion (sports biomechanics) using mathematical models of the human body. No credit for both MEEM4180 and MEEM5185.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 2150 and MEEM 2700

**MEEM 5200 - Advanced Thermodynamics**

A study of the principles of thermodynamics, including fundamental concepts and introduction of the analytical treatments of the first, second and combined first and second laws of thermodynamics. Topics include irreversibility, availability (exergy), thermodynamic relations, mixtures, chemical reactions, and chemical equilibrium.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall, Spring

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Pre-Requisite(s):** MEEM 2200

**MEEM 5205D - Comp Methods in Thermal Sci (Distance Program)**

Introduces computational methods used to solve thermodynamic, fluid mechanic, and heat transfer problems. Discusses theoretical and practical aspects. Modern computational tools are used to reinforce principles and introduce advanced topics in thermodynamics, fluid mechanics, and heat transfer.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand

**Pre-Requisite(s):** MEEM 3230

**MEEM 5210 - Advanced Fluid Mechanics**

Develops control volume forms of balance laws governing fluid motion and applies to problems involving rockets, pumps, sprinklers, etc. Derives and studies differential forms of governing equations for incompressible viscous flows. Some analytical solutions are obtained and students are exposed to rationale behind computational solution in conjunction with CFD software demonstration. Also covers qualitative aspects of lift and drag, loss of stability of laminar flows, turbulence, and vortex shedding.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 3210

**MEEM 5230 - Advanced Heat Transfer**

Advanced topics on conduction, convection, radiation, and heat exchangers are covered. Emphasis is on problem formulation, and exact solutions, with some coverage of empirical results and computational techniques.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Spring

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Pre-Requisite(s):** MEEM 3230

**MEEM 5240 - Comp Fluid Dynamics for Engg**

Introduces finite-difference and finite-volume methods used in solving fluid dynamics and heat transfer problems. Covers numerical grid generation, turbulence modeling, and application to some selected problems.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Spring - Offered alternate years beginning with the 2001-2002 academic year

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**MEEM 5250 - Internal Combustion Engines II**

Advanced topics in internal combustion engines with emphasis on CI operation, modeling of engines, modeling of combustion processes, tribology, second law applications, and other topics of current interest.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall - Offered alternate years beginning with the 2001-2002 academic year

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 4220 and MEEM 5200

**MEEM 5270 - Advanced Combustion**

The objective is to understand basic combustion processes through detailed analysis. Introduces both analytical and modern experimental methods. Emphasizes liquid fuel combustion, flame propagation, and critical phenomena of ignition and extinction.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall - Offered alternate years beginning with the 2002-2003 academic year

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

**Pre-Requisite(s):** MEEM 4240

**MEEM 5280 - Phase-Change & Two-Phase Flows**

Considers two-phase flow patterns for air-water, condensing, and boiling flows in the context of interface conditions (surface tension, etc.) and interfacial instabilities that lead to interfacial waves, droplet formation, etc. The course emphasizes development of model equations. Relevant experimental data leading to pressure drop correlations, interfacial shear model, etc., are discussed. The model equations and empirical correlations are used to estimate solutions of problems.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 3230

**MEEM 5401 - Design for Reliability**

Emphasizes the importance of reliability in design, covering basic concepts of series, parallel, standby and mixed systems. Uses conditional probability and multimode functions as methods for problem solution. Considers derating and reliability testing.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 3501

**MEEM 5404D - Mechanism Syn/Dynamic Modeling (Distance Program)**

Student apply kinematic synthesis techniques in design and analysis of mechanical systems. They develop synthesis software to link to dynamic analysis packages such as ADAMS, I-DEAS, Unigraphics, etc. They investigate influences of process variation on system output and learn methods to minimize the variation influences.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall, Spring

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 3502(C)

**MEEM 5405D - Intro to the Finite Element Method (Distance Program)**

Introduces the use of the finite element method in stress analysis and heat transfer. Emphasizes the modeling assumptions associated with different elements and uses the computer to solve many different types of stress analysis problems, including thermal stress analysis and introductory nonlinear analysis.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 3502 and (MA 2320 or MA 2321 or MA 2330) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

**MEEM 5408 - Design Automation**

Students learn fundamental theories and techniques used in mechanical CAD software development. Useful to all students using CAD software in their research and students specializing in design. Basic software engineering, math topics, geometry, solid modeling, design knowledge, design manipulation, and internet will be covered.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-4-0)

**Semesters Offered:** Fall - Offered alternate years beginning with the 2004-2005 academic year

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**MEEM 5443 - Kinematics**

Students apply kinematic synthesis techniques in the design and analysis of mechanical systems and special purpose cams. They develop synthesis software to link to commercial dynamic packages, optimizing simple mechanisms and mechanical systems.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 3502

**MEEM 5602D - Process and Product Design and Improvement**

Introduces value-engineering tools for product development and total quality management. Topics include systems engineering fundamentals, quality function deployment, experimental design, robust engineering, failure mode and effects analysis, and engineering problem-solving techniques.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Campus(s): Extended University Programs

**MEEM 5605D - Metal Forming Processes (Distance Program)**

Covers analytical and experimental study of metal forming processes, such as forging, extrusion, rolling, bending, stretch forming, and deep drawing as well as progressive die design for sheet metal stamping and design of dies for bulk forming.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 2500 and MEEM 2150

**MEEM 5610 - Advanced Machining Processes**

Covers mechanics of 2-D and 3-D cutting and their extension to commonly used processes such as turning, boring, milling, and drilling. Topics include force modeling, surface generation, heat transfer, tool life and dynamics.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Spring

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Pre-Requisite(s):** MEEM 2500

**MEEM 5615 - Advanced Metal Forming**

Introduces fundamentals of plasticity theory and applies to the analysis of deformation processes.

Processes considered are forging, extrusion, wire drawing, bending, deep drawing, and stretch forming.

Emphasizes sheet metal formability.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Pre-Requisite(s):** MEEM 3502 or MEEM 2150

**MEEM 5625 - Precision Manuf and Metrology**

Presents theory and practice involved in the manufacturing and measuring of precision components.

Topics include precision machining processes, precision machine/mechanism design, and dimensional metrology. Addresses current manufacturing challenges in the bearings, optics, and microelectronics industries.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-2)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Pre-Requisite(s):** MEEM 3502 and MEEM 3700

**MEEM 5640 - Micromanufacturing Processes**

Introduces the processes and equipment for fabricating microsystems and the methods for measuring component size and system performance. Fabrication processes include microscale milling, drilling, diamond machining, and lithography. Measurement methods include interferometry and scanning electron microscopy. No credit for both MEEM4640 MEEM5640.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-2)

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 3502(C)

**MEEM 5645 - Numerical Analy Manuf Proc**

Nonlinear FEM and BEM analyses, modeling of bulk forming processes, sheet forming processes, machining processes, casting processes, grinding of ceramics.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 2500

**MEEM 5650 - Advanced Quality Engineering**

Stresses the concepts and methods for quality and productivity improvement. Topics include principles of Shewhart, Deming, Taguchi; meaning of quality: control charts for variables, individuals, and attributes; process capability analysis; variation of assemblies; Monte Carlo simulation, multi-variate situations; and computer-based workshops. No credit for both MEEM4650 and MEEM5650.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Pre-Requisite(s):** MA 3710

**MEEM 5653 - Life-cycle Engineering**

Familiarizes students with the principles and techniques of life-cycle engineering. These techniques include design reviews, re-engineering, cost/benefit analysis, value engineering and design for "X." Upon completion, students should be adept at weighing the costs and benefits of product design decisions as they apply to a product from concept to retirement. Credit may not be received for both MEEM 4653D and MEEM 5653.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following College(s): College of Engineering

**Pre-Requisite(s):** MEEM 4900

**MEEM 5655 - Introduction to Lean Manufacturing**

Lean manufacturing is emerging globally as a paradigm by which business units must function to be globally competitive. Quality, cost, and delivery have become critical measures that impact profits and, in turn, the success of an organization. Significant improvements in all these three measures come from the continuous elimination of waste, or non-value added activities, in manufacturing. Numerous tools are available for the elimination of waste and making businesses lean. This course is intended to familiarize students with this new philosophy of lean manufacturing and arm them with a basic toolset that enables the identification, measurement, and elimination of non-value added activities.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Spring - Offered alternate years beginning with the 2007-2008 academic year

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): School of Business & Economics, College of Engineering

**MEEM 5660 - Data Based Modeling & Control**

System modeling and analysis from observed data for computer-aided design and manufacturing, providing differential equation models. Computer routines for modeling, forecasting with accuracy assessment and minimum mean-squared error control. Underlying system analysis, including stability and feedback interpretation, periodic and exponential trends. Uses illustrative applications to real-life data, including team projects.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**MEEM 5670 - Experimental Design in Engg**

Review of basic statistical concepts. Models for testing significance of one or many factors. Reducing experimental effort by incomplete blocks, and Latin squares. Factorial and fractional factorial designs. Response surface analysis for optimal response.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall, Summer

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**MEEM 5680 - Optimization I**

Provides introductory concepts to optimization methods and theory. Covers the fundamentals of optimization, which is central to any problem involving engineering decision making. Provides the tools to select the best alternative for specific objectives.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall, Spring

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**MEEM 5685 - Environmentally Responsible Design and Manufacturing**

Examines impact of engineering and, in particular, design/manufacturing decisions on the environment. Topics include sustainability; energy/material flows; risk assessment, life cycles, manufacturing process waste streams, product design issues, including disassembly/post-use product handling; techniques for pollution prevention. Requires course project. Credit may not be received for both MEEM4685 and MEEM5685.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Spring - Offered alternate years beginning with the 2001-2002 academic year

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**MEEM 5700 - Dynamic Meas/Signal Analysis**

Assessment of measurement system requirements: transducers, conditioners, and displays of dynamic measurands. Time-, frequency-, probabilistic-, and correlative-domain approaches to dynamic signal analysis: sampled data, discrete Fourier transforms, digital filtering, estimation errors, system identification, calibration, recording. Introduction to wavelet analysis. All concepts reinforced in laboratory and simulation exercises.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-3)

**Semesters Offered:** Fall, Spring

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MA 4520

**MEEM 5701 - Intermediate Dynamics**

Intermediate study of several topics in engineering dynamics, including three-dimensional kinematics and kinetics, generalized coordinates, Lagrange's equation, and Hamilton's principle. Uses computer-aided dynamic simulation tools for analyzing dynamic systems.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Pre-Requisite(s):** MEEM 2700

**MEEM 5702 - Analytical Vibroacoustics**

First in a series of two courses on vibro-acoustics to provide a unified approach to study noise and vibration. Emphasizes interaction between sound waves and structures. Presents advanced vibration concepts with computational tools. Discusses wave-modal duality.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 3700

**MEEM 5703 - Exp Methods Vibro-Acoustics**

Covers operating data measurement and analysis, including multisource ODS. Includes signature analysis and order tracking; modal theory, modal scaling. FRF estimators; multiple input excitation techniques; parameter estimation methods; sound measurements and acoustic intensity; sound quality; field data acquisition, DAT; binaural recording and playback with equalization.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-3)

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 5702 and MEEM 4701

**MEEM 5705 - Introduction to Robotics and Mechatronics**

Cross-discipline system integration of sensors, actuators, and microprocessors to achieve high-level design requirements, including robotic systems. A variety of sensor and actuation types are introduced, from both a practical and a mathematical perspective. Embedded microprocessor applications are developed using the C programming language. A final project is required including analysis, design, and experimental demonstration. Cannot receive credit for both MEEM4705 and MEEM5705.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-3)

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 4700

**MEEM 5710D - NVH and Sound Quality (Distance Program)**

Noise Vibration and Harshness (NVH) is an important design consideration in the automotive, appliance, and machine tool industry. This course presents the fundamental concepts of noise and vibration measurement, modeling, and control. Lectures are supported with hands-on testing and analysis.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-2)

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 3700

**MEEM 5715 - Linear Systems Theory and Design**

Overview of linear algebra, Modern Control; state-space based design of linear systems, observability, controllability, pole placement, observer design, stability theory of linear time-varying systems, Lyapunov stability, optimal control, Linear Quadratic regulator, Kalman filter, Introduction to robust control.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall, Spring - Offered alternate years beginning with the 2005-2006 academic year

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 4700 or EE 4261 or MA 4330

**MEEM 5990 - Special Topics**

Study of selected subjects related to mechanical engineering or engineering mechanics.

**Credits:** variable to 6.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of department required; Must be enrolled in one of the following Level(s): Graduate

**MEEM 5999 - Graduate Research**

Research/investigation on a topic related to mechanical engineering or engineering mechanics leading to the submission of a thesis or report in partial fulfillment of the requirements for the master's degree.

**Credits:** variable to 15.0; Repeatable to a Max of 30; Graded Pass/Fail Only

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Eng-Eng Mechanics, Engineering Mechanics, Mechanical Engineering

**MEEM 6000 - Graduate Seminar**

Presentations/seminars on issues related to mechanical engineering and engineering mechanics. May include invited speakers from industry, government labs, and academe.

**Credits:** 1.0; Repeatable to a Max of 2

**Lec-Rec-Lab:** (0-1-0)

**Semesters Offered:** Fall, Spring

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**MEEM 6120 - Hi Strain Rate Behav of Matl**

Covers stress-strain response of high strain rates, constitutive models, microstructural changes, wave propagation. Uses experimental methods to obtain dynamic response, dynamic fracture, adiabatic shear banding.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand - Offered alternate years beginning with the 2001-2002 academic year

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 2150

**MEEM 6130 - Engineering Fracture Mechanics**

Development of the stress and deformation fields present near the tips of cracks. Uses elasticity solutions, plasticity corrections, and numerical methods in modeling these fields. Introduces fracture criteria and explains the various parameters used to develop these criteria.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand - Offered alternate years beginning with the 2001-2002 academic year

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 5110

**MEEM 6230 - Conduction**

Fundamental aspects of conductive heat transfer applied to steady-state and transient conditions. Studies multidimensional conduction problems with exact and approximate solutions techniques.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 5230

**MEEM 6240 - Convective Heat Transfer**

An introduction to flow and boundary layer theory for forced and natural convection heat and mass transfer. Includes derivation and application of the equations for conservation of mass, energy, and momentum; dimensional analysis and correlation of experimental results.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 5230

**MEEM 6250 - Radiative Heat Transfer**

Fundamentals of thermal radiation for black, gray, nongray, diffuse, and specular surfaces. Includes radiation combined with conduction and convection at boundaries; properties for radiation in absorbing, emitting, and scattering media; and the engineering treatment of gas radiation in enclosures.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 5230

**MEEM 6401 - Engg Design Optimization**

Covers mathematical optimization methods useful for engineering design optimization. Includes classical methods as well as new techniques. Emphasizes practical applications and the selection of optimization methods for the solution of specific problems in design.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**MEEM 6670 - Data Dependent Systems**

Modeling of systems from multiple series of observed data. Includes interpretation and characteristics of vector difference-equation models; impulse response functions and modal analysis; spectrum analysis of the contribution of various system components to the measured responses; application to process control and design.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 4660 or MEEM 5660

**MEEM 6702 - Nonlinear Sys Analy & Control**

Studies nonlinear systems from perspective of analysis/control system design. Explores fundamental properties of nonlinear differential equations in addition to describing functions, phase plane analysis, stability/instability theorems. Develops and applies control system design approaches for nonlinear systems, including feedback linearization, quantitative feedback theory, sliding mode control, and backstepping.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**MEEM 6703 - Advanced Vibrations**

Free and forced vibration of continuous systems with applications to strings, shafts, beams, plates and membranes. Problems formulated using Hamilton's principle and Lagrange's equations. Approximate methods of solution include the Rayleigh-Ritz method and Galerkin's method.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** MEEM 3700

**MEEM 6705 - Advanced Dynamics**

Systematic study of principles of mechanics from a modern perspective. Includes rates of change of position and orientation; angular velocity and acceleration; linear velocity and acceleration; generalized coordinates and velocities; properties of distributed mass; generalized active and inertia forces for holonomic and nonholonomic systems; potential energy, kinetic energy, and virtual work.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**MEEM 6990 - Special Topics**

Study of selected subjects related to mechanical engineering or engineering mechanics.

**Credits:** variable to 6.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of department required; Must be enrolled in one of the following Level(s): Graduate

**MEEEM 6999 - Doctoral Research**

Research/investigation on a topic related to mechanical engineering or engineering mechanics leading to the submission of a dissertation in partial fulfillment of the requirements for the PhD degree.

**Credits:** variable to 15.0; Repeatable to a Max of 90; Graded Pass/Fail Only

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**Graduate Course Descriptions Effective Fall 2007**

[https://www.banweb.mtu.edu/pls/owa/stu\\_ctg\\_utils.p\\_online\\_all\\_courses\\_gr](https://www.banweb.mtu.edu/pls/owa/stu_ctg_utils.p_online_all_courses_gr)

For more information, contact

Office of Student Records and Registration

Michigan Technological University

1400 Townsend Drive

Houghton, Michigan 49931-1295

906/487-2319

Fax: 906/487-3343

Email: [stuosrr@mtu.edu](mailto:stuosrr@mtu.edu)