MEMA - MECHANICS AND MATERIALS

MEMA 601 Theory of Elasticity

Credits 3. 3 Lecture Hours. Analysis of stress and strain in two and three dimensions, equilibrium and compatibility equations, strain energy methods; torsion of noncircular sections; flexure; axially symmetric problems. **Prerequisite:** Mechanics of Materials, Advanced Calc Different Equations. **Cross Listing:** AERO 605 and MEEN 603.

MEMA 602 Continuum Mechanics

Credits 3. 3 Lecture Hours. Development of field equations for analysis of continua (solids as well as fluids); conservation laws; kinematics, constitutive behavior of solids and fluids; applications to aerospace engineering problems involving solids and fluids. **Prerequisite:** Graduate classification. **Cross Listing:** AERO 603 and MEEN 608.

MEMA 606 Multifunctional Materials

Credits 3. 3 Lecture Hours. In-depth analysis of multifunctional materials and composites, and their novel applications. **Prerequisites:** MEMA 602/AERO 603, MSEN 601. **Cross Listing:** AERO 606 and MSEN 606.

MEMA 608 Nanomechanics

Credits 3. 3 Lecture Hours. Application of mechanics concepts to nano-scale behavior of materials; review of continuum mechanics; extensions to generalized continua; nonlocal elasticity; nano-scale plasticity; focus on multi-scale modeling - dislocation dynamics; quasi-continuum method; molecular dynamics with introductions to quantum mechanics and statistical mechanics. **Prerequisite:** AERO 603. **Cross Listing:** AERO 608 and MSEN 608.

MEMA 611 Fundamentals of Engineering Fracture Mechanics

Credits 3. 3 Lecture Hours. Understanding of the failure of structures containing cracks with emphasis on mechanics; linear elastic fracture mechanics, complex potentials of Muskhelishvili and Westergaard, J-integral, energy release rate, R-curve analysis, crack opening displacement, plane strain fracture toughness testing, fatigue crack propagation, fracture criteria, fracture of composite materials. **Prerequisite:** AERO 603.

MEMA 613/MSEN 610 Principles of Composite Materials

Credits 3. 3 Lecture Hours. Classification and characteristics of composite materials; micromechanical and macromechanical behavior of composite laminate; macromechanical behavior of laminates using classical laminate theory; interlaminar stresses and failure modes; structural design concepts, testing and manufacturing techniques. **Prerequisite:** Graduate classification; MEMA 602, or approval of instructor. **Cross Listing:** MSEN 610/MEMA 613.

MEMA 616 Damage and Failure in Composite Materials

Credits 3. 3 Lecture Hours. Mechanisms and models related to damage and failure in composite materials subjected to mechanical loads. **Prerequisite:** Courses in composite materials, elasticity.

MEMA 625/AERO 617 Micromechanics

Credits 3. 3 Lecture Hours. Eigenstrains; inclusions, and inhomogeneities; Eshelby's solution for an ellipsoidal inclusion; Eshelby's equivalent inclusion method; effective elastic properties of composites; composite spheres and cylinders models; bounds on effective moduli; Hashin-Shtrikman bounds; applications to fiber, whisker and particulate reinforced composites; introduction to micromechanics of inelastic composites and solids with damage. **Prerequisite:** MEMA 602. **Cross Listing:** AERO 617/MEMA 625.

MEMA 626/AERO 618 Mechanics of Active Materials

Credits 3. 3 Lecture Hours. Introduction to coupled field theories: constitutive response of materials with thermal and electromagnetic coupling; microstructural changes due to phase transformations; shape memory alloys; piezoelectric and magnetostrictive materials; active polymers and solutions; micromechanics of active composites. **Prerequisite:** MEMA 602. **Cross Listing:** AERO 618/MEMA 626.

MEMA 641 Plasticity Theory

Credits 3. 3 Lecture Hours. Theory of plastic yield and flow of two and three-dimensional bodies; classical plasticity theories, unified viscoplastic theories, numerical considerations; applications and comparisons of theory to experiment. **Prerequisite:** MEMA 602.

MEMA 646 Introduction to the Finite Element Method

Credits 3. 3 Lecture Hours. Weak or variational formulation of differential equations governing one- and two-dimensional problems of engineering; finite element model development and analysis of standard problems of solid mechanics (bars, beams and plane elasticity), heat transfer and fluid mechanics; time-dependent problems; computer implementation and use of simple finite element codes in solving engineering problems. **Prerequisite:** Senior or graduate classification.

MEMA 647 Theory of Finite Element Analysis

Credits 3. 3 Lecture Hours. Finite elements models of a continuum; virtual work principle; plane stress and plane strain finite element models; bending of plates; axisymmetric problems; three-dimensional stress analysis; isoparametric formulations; finite element computer programs to solve typical structural problems. **Prerequisite:** Graduate classification or approval of instructor.

MEMA 648 Nonlinear Finite Element Methods in Structural Mechanics

Credits 3. 3 Lecture Hours. Tensor definitions of stress and strain, finite strain, geometric and material nonlinearities; development of nonlinear finite element equations from virtual work; total and updated Lagrangian formulations; solution methods for nonlinear equations; computational considerations; applications using existing computer programs. **Prerequisite:** MEMA 647 or equivalent.

MEMA 649/AERO 649 Generalized Finite Element Methods

Credits 3. 3 Lecture Hours. Systemic introduction to the theory and practice of generalized finite element (FE) methods, including GFEM, the hp-cloud method, particle methods and various meshless methods with similar character; precise formulation of the methods are presented; known theoretical results for convergence; important issues related to implementation, issues of numerical integration. **Prerequisite:** Graduate student status. **Cross Listing:** AERO 649/MEMA 649.

MEMA 670/MSEN 670 Computational Materials Science and Engineering

Credits 3. 3 Lecture Hours. Modern methods of computational modeling and simulation of materials properties and phenomena, including synthesis, characterization, and processing of materials, structures and devices; quantum, classical, and statistical mechanical methods, including semi-empirical atomic and molecular-scale simulations, and other modeling techniques using macroscopic input. **Prerequisites:** Approval of instructor; graduate classification. **Cross Listing:** MSEN 670/MEMA 670.

MEMA 689 Special Topics in...

Credits 1 to 4. 1 to 4 Lecture Hours. Selected topics in an identified area of mechanics and materials. May be repeated for credit. **Prerequisite:** Approval of instructor.