# 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 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.