

**Aerospace and Mechanical Engineering**  
**Graduate Course Offerings**  
**Fall 2003 (updated 9/2/03)**

**ENG AM 501                      Dynamic System Theory                      Dupont                      TR 2-4**

Prereq: familiarity with differential equations and matrices at the level of ENG AM404 or CAS MA 242, or consent of instructor. Introduction to analytical concepts and examples of dynamic systems and control. Mathematical description and state-space formulation of dynamic systems: modeling, controllability, and observability. Eigenvector and transform analysis of linear systems including canonical forms. Performance specifications. State feedback: pole placement and linear quadratic regulator. Introduction to MIMO design and system identification using computer tools and laboratory experiments. Meets with ENG SC501.

**ENG AM 513                      Compressible Aerodynamics                      Udelson                      MW 2-4**

Prereq: ENG EK 304 & EK 400, and either ENG AM420 or AM422. Aerodynamics and thermodynamics of compressible fluid flow. Laval nozzles, Prandtl-Meyer flow, normal and oblique shock waves. Linearized theory. Application to external and internal flow problems such as airfoils.

**ENG AM 515                      Vibration of Complex Mechanical Systems                      Pierce                      MW 10-12**

Prereq: (CASMA226 & CASPY313 & ENGEK302 & ENGEK307 & ENGAM400 & (ENGAM307 OR ENGAM308)) Introductory course in mechanical vibrations for graduate students and for undergraduate students with substantial mastery of core undergraduate subjects in mechanics and mathematics. Course includes an elementary introduction to applicable concepts in linear algebra. Potential and kinetic energy functions of single- and multidegree of freedom systems. Matrix formulations of forced vibrations of linear systems. Natural frequencies, resonance, and forced vibration response. Natural modes and mode shapes. Rayleigh's principle. Rayleigh's dissipation function, transient and forced responses of damped vibrations. Random excitation of vibrations. Impedance matrix. O'Hara-Cunniff theorem, modal masses, modal analysis. Vibrations of simple continuous systems such as strings, beams, rods, and torsional shafts. This course cannot be taken for credit in addition to ENG AM 441.

**ENG AM 521                      Continuum Mechanics                      Oberai                      MW 8-10**

Objective: This course provides a unified development of the mathematical description for modeling a continuum. It will be useful for any student planning to study topics in solid and fluid mechanics such as elasticity, inelastic material modeling, fluid mechanics and rheology. There are no prerequisites for this course. Basic concepts: Introduction to vector and tensor algebra and calculus. Basic kinematics of continuum deformation. Stress, strain, and strain rate. Conservation of mass and balance of linear and angular momentum. Conservation of energy and thermodynamics. Governing equations for deformation of an arbitrary continuum body. Closing the equations through constitutive modeling. Constitutive models: General theory of constitutive modeling. Applications to elastic, viscoelastic and elastoplastic solids and Newtonian and non-Newtonian fluids. Project: Each student will develop or implement (numerically) material models for special materials: 1. Biological materials (tissues). 2. Polymers and polymeric fluid flows. 3. Slush and mush. There is no prescribed text for the course. Every student will be handed out a set of notes prepared by Prof. Oscar Gonzalez and Andrew Stewart. Several reference books will be recommended.

**ENG AM 708****Waves in Fluids****Howe****TR 6-8**

Prereq: ENg EK 510 or equivalent. Analytical methods are developed for studying the propagation and diffraction of waves in uniform and inhomogeneous fluid media. Illustrative applications are made to sound waves, gravity waves, waves in random media, evanescent waves.

**ENG AM 723****Waves in Random Media****Carey****MW 4-6**

This is a special topics course in the sound transmission, scattering and radiation from random media. The topics covered in this course have a direct bearing on acoustic imaging systems ranging from seismic exploration, sea floor imaging, oceanic acoustic arrays and the problems encountered in medical ultrasonic. The course requires a working knowledge of differential and integral calculus. The course will develop the inhomogeneous wave equation with emphasis on the physical sources of sound and scatters of sound. Physical Acoustic quantities concerning wave motion, momentum and energy will be treated in both simple and tensor forms, Monopole, dipole, and quadrupole sources of sound will be treated along with both deterministic and random source distributions. Scattering from planes, spheres and cylinders as well as the radiation from pistons in each will be covered with concrete examples. Bubbly liquids and turbulence will be treated with the Born approximations to illustrate the importance that bubble scattering has on enhance radiation and scattering. The problem will be extended to that of fog droplets in air. Multiple scattering will be discussed and the problem of a compact cloud of scatters will be discussed in terms of resonance phenomena. Finally the problem of sound scattering from a randomly rough surface will be treated with the Helmholtz-Kirchoff formulation.

FOR COURSES IN OTHER DEPARTMENTS PLEASE CHECK THE STUDENT LINK UNDER  
“ACADEMICS.”