

**Aerospace and Mechanical Engineering**  
**Graduate Course Offerings**  
**Fall 2005 (3/23/05)**

- ENG AM 501                      Dynamic System Theory                      Dupont                      TR 2-4**  
Prereq: familiarity with differential equations and matrices at the level of ENG AM 404 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 505                      Engineering Analysis                      Sullivan                      TR 10-12**  
Prereq: ENG AM 400 or equivalent. Mathematical methods in aerospace and mechanical engineering; vectors and tensors; partial differential equations of heat and mass transfer, wave motion and potential theory, classification of second order PDEs; eigenfunction expansions, method of characteristics, Fourier and Laplace transforms; complex variable theory, residue integration, conformal mapping; Green's functions, integral equations, variational methods; perturbation methods for non-linear differential equations.
- 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 8-10**  
Prereq: (CAS MA 226 & CAS PY 313 & ENG EK 302 & ENG EK 307 & ENG AM 400 & (ENG AM 307 OR ENG AM 308)) 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 520                      Intro to Acoustics                      Cleveland                      MW 2-4**  
Prereq: ENG EK 302, Ek 303, EK 304, and AM 400. Introduction to wave propagation and sound. General concepts such as quantitative measure of sound, plane waves, and acoustic energy density and intensity. Derivation of wave equation. Sound radiation from vibrating bodies. Basic ray-acoustic concepts: reflection, refraction, diffraction and scattering of acoustic waves. Other topics may include flow-induced sound, Helmholtz resonators, sound transmission through ducts and mufflers, room acoustics, and absorption and attenuation of sound waves in fluids.
- ENG AM 521/BE 521                      Continuum Mechanics                      Damiano                      TR 2-4**  
Prereq: (ENGEK424 & ENGAM400 & ENGBE436) and graduate standing or consent of instructor. Foundations of the classical theories of continuum mechanics: elasticity and fluid mechanics. A rigorous mathematical approach to kinematics, stress analysis, balance laws (mass, momentum, and energy), entropy inequality, and constitutive equations using vectors and tensors.
- ENG AM 707                      Finite Element Analysis                      Oberai                      MW 4-6**  
Prereq: ENG AM 404 and either AM 580 or AM 542. An introduction to the finite element method with emphasis on fundamental concepts. Variational equations, Galerkin's method. Finite element

applications to linear elliptic boundary value problems in structures, solid and fluid mechanics, and heat transfer. Optimality, convergence, function spaces and energy norms. Isoparametric elements. Mixed methods, penalty methods, selective reduced integration; applications may include Kirchoff plate theory, incompressible elasticity, Stokes flow. Thick and thin beams, plates, and shells. Implementation: element data structures, numerical integration, assembly of equations, element routines, solvers. Advanced topics may include: dynamic analysis, stabilized methods, eigenvalue problems, hybrid analytical methods.

**ENG AM 708**

**Waves in Fluids**

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**TR 6-8**

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

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