THE DEPARTMENT OF AEROANUTICS AND ASTRONAUTICS

AA 480 SYSTEMS DYNAMICS

SPRING QUARTER

CLASS SCHEDULE: 3 credits**,** Three 50 minute lectures per week.

COORDINATOR: Adam Bruckner, Professor of Aeronautics and Astronautics

TEXTBOOK: Theory of Vibrations and Applications, Thompson, W. T., Prentice Hall, 1988.

SUPPLEMENTAL MATERIALS: Introduction to Dynamics and Control, Meirovich, Wiley, 1985.
Elements of Vibration Analysis, Meirovich, McGraw-Hill, 1986.

CATALOG DATA: SYSTEMS DYNAMICS, Selected Elective
Equations of motion and solutions for selected problems; natural frequencies and mode shapes; response of systems to applied loads. Prerequisite: AA 312 or senior standing.

PREREQUISITES BY TOPIC:

1) Introduction to vibration analysis (AA 312)
2) Matrix analysis methods desirable

OUTCOMES:

1. Can analyze the vibration characteristics in real world systems using concepts such as damping, frequencies, mode shapes, and isolation.
2. Can go into the laboratory, take dynamic data of a structure, convert it into frequency domain data, and interpret the results in terms of frequencies, damping, and mode shapes.
3. Can model a complex dynamic system.
4. Can apply concepts of systems dynamics to a current, advanced dynamic systems problems.

RELATIONSHIP TO STUDENT OUTCOMES:

a) An ability to apply knowledge of mathematics, science, and engineering
c) An ability to design a system, component, or process to meet desired needs.
e) An ability to identify, formulate, and solve engineering problems

TOPICS:

1) Review of multi-degree-of-freedom discrete mass systems, Eigenvalues, Eigenvectors
2) Matrix equation form of coupled equation sets, matrix iteration, orthogonality of natural modes
3) Dependent variable transformation, modal matrix, uncoupling of equations
4) Modal analysis of forced vibrations, general solutions, expansion theorem
5) Effect of various forms of damping, analysis techniques
6) Continuous systems; Eigenvalues and Eigenvectors for simple beams, rods and strings; orthogonality of modes
7) Approximate methods for predicting natural frequencies and modes

(Eigenvalues and vectors), Rayleigh, Ritz, Galerkin, matrix iteration, matrix integration

8) Forced and damped motions of continuous systems, response dependent forcing and damping functions, stability of response
9) Introduction to flutter analysis
10) Modeling of non-deterministic forcing functions and vibration response