EGM 5421: Structural Dynamics

Mechanical & Aerospace Engineering Department
University of Florida

Professor: Nagaraj K. Arakere, Office: NEB 139, Tel: 392-0856,Email: nagaraj@ufl.edu

Textbook: Structural Dynamics-An introduction to computer methods, by Roy R. Craig, Jr.
John Wiley & Sons Inc. ISBN 0-471-04499-7
Other References:
Fundamentals of Vibrations, L. Meirovitch, McGrawhill
Dynamics of Structures, Chopra, Prentice Hall

Scope: The course emphasizes applications of structural dynamics in mechanical engineering, aerospace engineering and engineering mechanics. Topics addressed will include: mathematical modeling of structures and experimental verification of mathematical models; introduction to numerical techniques for computing natural frequencies and mode shapes and for computing transient response; introduction to the use of finite elements in structural dynamics analysis; applications of complex frequency response representations for the response of single and multiple degree-of-freedom systems; a detailed exposition of the mode-superposition method for computing dynamic response; and introduction to component mode synthesis.

Topics Covered:

1. Single-Degree-of-Freedom (SDOF) Systems
   A brief introduction to modeling, free vibration response, forced vibration response to harmonic and general dynamic excitation, and frequency domain analysis is covered.
2. Vibration of Continuous Systems
   a. Hamilton's principle, axial and transverse vibration of beams, Rayleigh's method
3. Mathematical models for Multiple-Degree-of-Freedom (MDOF) Systems
   a. Application of Newton's laws and Lagrange's equations to lumped-parameter and continuous models.
   b. Constrained coordinates and Lagrange multipliers
4. Vibration of undamped 2-DOF systems: Free and forced response.
5. Free vibration of MDOF systems: Modal Analysis
6. Numerical Evaluation of Modes and Frequencies of MDOF systems
7. Dynamic response of MDOF systems: Mode-Superposition Method
   a. Mode-displacement solution for response of undamped MDOF systems
   b. Mode-acceleration solution for response of undamped MDOF systems
   c. Mode-superposition solutions for certain viscous-damped systems
   d. Mode-superposition for undamped systems with rigid-body modes
8. Finite element modeling of structures
9. Direct integration methods for dynamic response
10. Component mode synthesis
    a. Component modes for constrained components
    b. System synthesis for undamped free vibration
    c. Component modes for unconstrained components
    d. Residual flexibility; residual component modes

Homework: Several homework problems will be assigned involving practical applications in structural dynamics of aerospace structures, machinery vibration, and rotor dynamics. Homework problems will require the use of MATLAB or MATHCAD programs.

Grading Policy:

Homework	30 %
Mid-Term Test	30 %
Final Exam	40 %