MAE 130C / SE 101C (4 units)
Mechanics III: Vibrations

Class/Laboratory Schedule: four hours of lecture, eight hours outside preparation.
12 hours/week total

Course Coordinator(s): Vlado Lubarda

Textbooks/Materials:
1. S.S. Rao: Mechanical Vibrations, 4th ed., Prentice Hall, 2010
2. W.T. Thomson and M.D. Dahleh, Theory of Vibrations with Applications, 5th ed., Prentice Hall, 1997
3. L. Meirovitch, Fundamentals of Vibrations, Waveland press, Incorporated, 2010

Catalog Description: Free and forced vibrations of undamped and damped single degree of freedom systems. Harmonically excited vibrations and vibrations under general loading conditions. Vibrating systems with two or more degrees of freedom. Modal analysis with application to realistic engineering problems. Introduction to vibration of continuous systems.

Prerequisites: Grades of C- or better in Math 20F and MAE 130B or SE 101B.

- ■ Required Course
- □ Technical Elective Course
- □ Other: _____

Performance Criteria:

Objective 1
1.1 Students will demonstrate an understanding of linear vibration theory and the basic formulations for n degree-of-freedom and continuous systems.

Objective 2
2.1 Students will demonstrate the ability to formulate the equations of motion for multi degree-of-freedom systems.
2.2 Students will demonstrate an ability to calculate the normal modes of a system.
2.3 Students will demonstrate that they can determine and apply the appropriate solution method to calculate the response of the system.

Objective 3
3.1 Students will demonstrate an understanding of Lagrange's equations as applied to free vibrations of single and multi- degree-of-freedom systems without dissipation.
3.2 Students will demonstrate an ability to apply Lagrange's equations to forced vibrations of dissipative systems.

Course Objectives:
(Numbers in parentheses refer to ME and AE Program Outcomes)

Objective 1: To teach students the basic principles underlying the vibration of mechanical and structural systems (1a, 5e).
Objective 2: To train students to identify, formulate and solve engineering problems in vibrations (1a, 5e).
Objective 3: To introduce students to the concepts and applications of Lagrange's equations (1a, 5e).

Course Topics:

1. One degree-of-freedom transient and steady state response
2. Applications to vibration isolation and measurement
3. Response to impact and impulse excitation
4. Two degree-of-freedom undamped systems: beat frequencies, static and dynamic coupling, free vibration, and normal modes
5. Properties of n degree-of-freedom systems: matrix formulation, eigenvalues and eigenvectors, modal matrix, and reduction to normal coordinates
6. Free and forced vibration of n degree-of-freedom systems
7. Lagrange's Equations
8. Vibration of continuous systems

Prepared by: D. Benson, February 2000
Revised: V. Lubarda and H. Murakami, April 2008 via Teaching Work Group meeting
Reviewed: TWG, June 2010
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Reviewed: TWG, August 2012