Mechanical Engineering and Mechanics

MEM 423 Mechanics of Vibrations

Fall 2006/Spring 2007

| Designation: | Elective | | |
|--|---|--|--|
| Catalog Description: | Reviews Laplace transforms, linear algebra, and modeling of basic mechanical systems; covers modeling and analysis of multi DOF systems with and without viscous and Coulomb damping; introduces modes, nodes and mode shapes of discrete and continuos systems. | | |
| Prerequisites: | Systems I (tDec 221), Systems II (tDec 222) | | |
| Textbook(s) and other required material: | | | |

1 extbook(s) and other required material:

Required: <u>Mechanical Vibrations</u>, S.S.Rao, 4th edition, Prentice Hall, ISBN 0-13-048987-5 MatLab software

Course Objectives:

- 1. Generate models of multi DOF mechanical systems.
- 2. Determine and characterize system responses.
- 3. Use Equivalent elements for simplification.
- 4. Employ Lagrangean method for model development.
- 5. Determine frequencies, modes, and mode shapes.
- 6. Generate models of continuous systems.
- 7. Analyse the fundamental frequencies and normal modes.
- 8. Use Matla software to verify theoretical analyses.

Topics:

- 1. Review of Laplace transforms and linear algebra.
- 2. Modeling of multi DOF systems.
- 3. Effect of viscous and Coulomb damping.
- 4. Lagrange's approach to modeling.
- 5. Determination of frequencies and mode shapes.
- 6. Modeling of continuous sytems.
- 7. Vibration control

Class Schedule: 4 hours/week lecture (4 credits)

Contribution to Professional Component:

Contributes toward the 1 ¹/₂ year of engineering topics appropriate to developing the ability to work in the area of mechanical vibrations. Prepares students for classes in finite element methods and system design.

Relationship to Program Outcomes:

| Outcomes a - k | Content | Explanation | Evidence |
|--|---------|--|---|
| a. An ability to apply knowledge of mathematics, science and engineering | 2 | This course requires the students to understand the dynamics of mechanical systems with emphasis on vibrations. The students learn how to apply and synthesize their knowledge of mathematics, science, and engineering. | Homework, Exams, Design Project |
| b. An ability to design and conduct experiments as well as to analyze and interpret data | 0 | N/A | N/A |
| c. An ability to design a system, component or process to meet desired needs | 1 | The assigned home work problems and exams require selection or design of components to improve the response of a system. | Final report for the design project and home works |
| d. An ability to function on multidisciplinary teams | 2 | The second exam and the final report require team work. | Final report and second exam. |
| e. An ability to identify, formulate and solve engineering problems | 2 | This course emphasizes converting a mechanical system into a mathematical model to analyze and improve the vibratory response of the system. | Homework, exams, design project |
| f. An understanding of professional and ethical responsibility | 0 | N/A | N/A |
| g. An ability to communicate effectively | 1 | The final project and the second exam require written reports. | Final report and second exam |
| h. The broad education necessary to understand the impact of engineering solutions in a global/societal context | 0 | N/A | N/A |
| i. A recognition of the need for and ar ability to engage in lifelong learning | 0 | NA | N/A |
| j. A knowledge of contemporary issues | 0 | NA | N/A |
| k. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice | 2 | Students are required to understand and use the current software tools for the analysis of vibrational systems. The recommended tool is MatLab. | Homework; Final report for the design project |

Prepared by:

Dr. Ajmal Yousuff, 15 November 2006