MECHANICAL ENGINEERING PROGRAM

ABET COURSE SYLLABUS

ME 453 - Mechanical Vibration (3 credits): Required Course

Course Description (2008-2010 Catalog):

Free and forced response of single-and-multi-degree-of-freedom, lumped parameter systems. Fourier series and Fourier and Laplace transforms. Introduction to vibration of continuous systems and applications.

Prerequisite Course: ME 242, ME 330

Prerequisite by Topic:

- **Dynamics**
- **Analysis of Dynamic Systems**

Textbook: Engineering Principles of Mechanical Vibration, Reynolds, Trafford Publishing

Other Reference Material: N/A

Course Coordinator: Douglas Reynolds, Professor

Course Learning Outcomes:

(a) Have a clear understanding of the different mechanical elements that comprise the mass, spring, and damping elements of simple vibration systems.
(b) Know how to develop the equations of motion associated with one- and two-degree-of-freedom vibration systems using Newton's method, d'Alembert's principle, energy method, and Lagrange's equation.
(c) Know how to solve the equations of motion for one-degree-of-freedom systems for initial conditions and for harmonic and complex periodic excitation; know how to solve the equations of motion for two-degree-of-freedom systems to determine the system resonance frequencies and corresponding vibration mode shapes and to determine the system responses to harmonic excitation.
(d) Understand basic concepts associated with harmonic response functions, vibration transmissibility, and analytical modal analysis. Understand basic concepts associated with system resonances and how they can cause problems in and/or the failures of mechanical systems. Know how simple vibration tests can be used to identify the values of the mass, spring, and damping elements of simple mechanical systems and to determine if vibration resonances exist in mechanical systems.

Relationship of Course to Mechanical Engineering Program Outcomes:

Educational Objective 1: Provide mechanical engineering graduates with technical capabilities.					**Educational Objective 2:** Prepare the mechanical engineering graduates to have effective workplace skills.				**Educational Objective 3:** Instilling a sense of responsibility as a professional member of society.			
1.a	**1.b**	**1.c**	**1.d**	**1.e**	**2.a**	**2.b**	**2.c**	**2.d**	**3.a**	**3.b**	**3.c**	**3.d**
H		**L**	**H**	**H**				**M**			**L**	

(L)ow (M)edium (H)igh

Topics Covered:

1. Complex vectors
2. Addition of harmonic signals
3. Complex periodic signals
4. Degrees of freedom
5. Mass elements
6. Spring elements
7. Vibration isolators
8. Damping elements
9. Equations of Motion - Newton's method, d'Alembert's principle, energy method
10. Vibration criteria
11. Problem solving procedures
12. Equations of motion - one-degree-of-freedom systems
13. Free vibration with no damping
14. Free vibration with viscous damping
15. Free vibration with structural damping
16. Harmonic excitation - forced response of a system without damping
17. Harmonic excitation - forced response of a system with viscous damping
18. Harmonic excitation - forced response of a system with structural damping
19. Vibration transmissibility - without damping, with viscous and structural damping
20. Vibrating system with a moving base
21. Critical speed of a rotating disk on a shaft
22. Equations of motion - two-degree-of-freedom systems
23. Free vibration without damping - resonance frequencies and modal vectors
24. Coordinate coupling
25. Harmonic excitation - forced vibration
26. Tuned absorbers
27. Machine mounted on a flexible structure

Laboratory Projects: None

Class/Laboratory Schedule: 75 minute lecture two sessions per week

Assessment of Student Progress toward Course Objectives:

Two written exams, weekly quizes, home work, and final exam

Class/Laboratory Schedule: MW 1:00-2:15 pm (Fall Symester)

Contribution of Course for meeting Professional Component:

(a) Mathematics and basic sciences:	3 credit
(b) Engineering Topics (Design/Science):	0 credit
(c) General Education:	0 credit
(d) Others:	0 credits

Prepared by:	**Date:**
Douglas Reynolds	December 16, 2009