

King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT
ME 482: Mechanical Vibrations

Catalogue Description: (3-0-3)

Free and forced vibration; Applications to systems with one, two, and multi-degree of freedom; Viscous, hysteretic and Coulomb damping; Response to general periodic excitations; Transient vibration and the phase method; Principal and coupled coordinate; Dynamic vibration absorbers; Energy methods and Rayleigh's principle; Vibration measurement instruments.

Status in Curriculum (Required or Elective): Elective (offered Fall & Spring)

Prerequisites: ME201

Co-requisites: None

Prerequisites by Topics:

- Kinematics of rigid body (ME201)
- Kinetics of rigid body and Newton's second law (ME201)
- Kinetics of rigid body and Energy Methods (ME201)
- Kinetics of rigid body and Momentum Principle (ME201)

Textbook: Mechanical Vibration, William J. Palm, Wiley, 2007.

References:

- 1) **Fundamental of Mechanical Vibrations**, S. G. Kelly, McGraw Hill, 2nd Ed., 2000.
- 2) **Theory of Vibration with Applications**, W. T. Thomson, Prentice Hall, 5th Ed., 1999.
- 3) **Mechanical Vibrations**, S. Rao, Mechanical Vibrations, Prentice Hall, 4th Ed., 2004.
- 4) **Engineering Vibration**, J. Inman, Prentice Hall, 3rd Ed., 2008

Coordinator: Dr. Hassen Ouakad, Assistant Professor of Mechanical Engineering

Goals: (general objectives)

This course is intended to cover the basic concepts of the vibration phenomenon and its significance in mechanical systems. The course stresses the practical considerations in controlling vibration by designing appropriate vibration absorbers and isolators. Some vibration analysis techniques, including vibration measurements are presented.

Course Outline (Lecture Topics):

1. Introduction to Mechanical Vibration (3 hours)
2. Models with One Degree of Freedom (6 hours)
3. Free Response with a Single Degree of Freedom (6 hours)
4. Harmonic Response with a Single Degree of Freedom (6 hours)
5. General Forced Response (6 hours)
6. Two-Degrees-of-Freedom System (6 hours)
7. Vibration Suppression and control (6 hours)
8. Matrix Method for Multi-Degree of Freedom Systems (3 hours)
9. Vibration measurements and Testing (3 hours)

Design Activities/Projects:

Coursework including Term Projects for analyzing the mechanical vibrations of several types of mechanical systems using numerical software such as MATLAB are assigned.

Computer Usage:

Students are encouraged to solve some assigned Homework Problems using the available engineering software, such as MATLAB, and MATHEMATICA.

Laboratory: None

Assessment Tools:

- i- Two Mid-Term Examinations
- ii- Homework Assignments
- iii- Quizzes
- iv- Term Projects

v- Final Exam

Course Learning Outcomes:

- I- Students shall be able to draw a free-body and kinetic diagrams for dynamic configurations.
- II- Students shall be able to formulate the dynamic equations of motion of problems in vibrations using Newton's second law, Lagrange's equations and any influence coefficients.
- III- Students shall have the ability to obtain the solutions to vibration problems for single- and multi-degree-of freedom systems. This includes the determination of natural frequencies and mode shapes and the evaluation of time response of systems under free and forced, damped and un-damped conditions.
- IV- Students shall become familiar with the design of vibration isolators and to select the appropriate parameters for the vibration absorbers.
- V- Students shall be able to investigate the whirling problem of a rotating flexible shaft when designing a simple rotor-shaft system.
- VI- Students shall demonstrate a basic understanding of the vibration measuring techniques, as well as different instrumentations for measuring and recording vibration signals.
- VII- Students shall acquire team work skills through homework and term projects.
- VIII- Students shall submit a complete term-project report.

Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>
Course-to-Student outcome mapping	I, II, III,		IV	VII	II, III, VIII						IV, V, VI, VIII
Emphasis*	S		M		L						

*L: Little/None, M: Moderate, S: Strong

Status of Continuous Improvement review of this Course:

Reviewed by: -----

Date reviewed: -----

Prepared by: Dr. Hassen Ouakad

Date prepared: March 01, 2015