King Saud University
College of Engineering

Department of Mechanical Engineering
Course Syllabus (ABET Format)

ME 464 Mechanical Vibrations

Catalog Description

ME 464 Mechanical Vibrations. Review of single degree of freedom systems; response spectrum, multi-degree of freedom systems , modal analysis, vibration absorbers and isolators, whirling of shafts ; basics of modal testing and rotating machinery fault diagnosis.

Credits 3

Prerequisites by Course

ME 362 (system dynamics)

Prerequisites by Topic

1. Dynamics.
2. Vibration of single-degree-of-freedom systems.
3. Ordinary differential equations.
4. Basics of Linear Algebra.

Textbook

S. S. Rao, Mechanical Vibrations, fourth edition, Pearson Prentice Hall.

References

1. R. T. Thomson, Theory of Vibrations with Applications, Addison-Wesley.
2. D. J. Inman, Engineering Vibration, Prentice-Hall.
3. R. F. Steidel, An Introduction to Mechanical Vibrations, Wiley.

Course Topics

1. Study of vibrations: overview.
2. Response to a general forcing function of single-degree-of-freedom systems.
3. Response spectrum.
4. Two-degree-of-freedom systems: free vibration analysis; harmonically forced vibration.
5. Dynamic vibration absorbers.
6. Isolators for shock and harmonic loading.
7. Multi-degree-of-freedom systems: influence coefficients; generalized coordinates and forces; Lagrange's equations; solution of the eigenvalue problem; transient free vibration; forced vibration (modal analysis).
8. Whirling of rotating shafts.
9. Introduction to experimental modal analysis.
10. Diagnosis of faults in rotating machines.

Class/Laboratory Schedule:

1. Class: 3 per week; 50 minutes each.
2. Tutorial: 1 per week; 50 minute.
3. Lab illustrations and demo experiments

Evaluation Method:

1. Homework assignments.
2. Term project.
3. Quizzes and midterm exams.
4. Final exam.

(*for more details, please see the attached course assessment table*)

Computer Use:

Programming language such as Fortran, software package such as MATLAB.

Science/Design Contents:

2/1

Course Objectives:

(Entries in brackets are links to program educational objectives.)

1. To present the fundamentals and applications of vibration theory. [A]
2. Students will demonstrate the ability to model and analyze free and forced vibration of multi-degree of freedom systems. [A]
3. Students will be able to apply vibration principles for the design of engineering systems and devices. [A, C]
4. Students will demonstrate the ability to use experimental as well as theoretical vibration analysis for system parameter identification and vibration trouble shooting. [A, C]
5. Enhance a team work spirit and report writing. [B]

Course Outcomes:

(Entries in brackets are links to program learning outcomes.)

1. Students will be able to draw a free-body and kinetic diagrams for dynamic configurations. [a]
2. Students will be able to formulate the dynamic equations of motion of problems in vibrations using Newton's second law, Lagrange's equations and influence coefficients. [a, e]
3. Students will have the ability to obtain the solutions to vibration problems that contain two- 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 conditions. [a, e]
4. Students shall become familiar with the design of vibration isolators for harmonic and shock loading. [k, c]
5. Students will be able to select the appropriate parameters for the vibration absorbers. [k, c]
6. Students will be able to investigate the whirling problem of a rotating flexible shaft when designing a simple rotor-shaft system. [k]
7. Students will be able to perform small scale modal testing and verify 2 DOF mathematical models by comparing the natural frequencies and mode shapes of the system. [a, b]

8. Students will be able to identify major faults in rotating machinery components using vibration signal analysis. [a, b]
9. Students will acquire team work skills through homework and term projects. [d]
10. Students will submit a complete term-project report. [e, k]
11. Students will conduct an oral presentation for their project including intensive discussions with the instructors of the course. [g]

Prepared by

Dr. Ahmed A. Khdeir and Dr. Khalid A. Alsaif

Date of Preparation

Feb. 6, 2006

Table : Course Assessment table

Assessment Method	**Number/Type**				**Instructor Assessed**	**TA/Grader Assessed**	**Peer/Self Assessed**
Homework	4 homework assignments				✓		
Mid Terms/Final Exams	2 mid term; 1 final exam				✓		
Quizzes	3 quizzes				✓		
Individual Projects	1-2 wks	3-4 wks	1/2 sem	Full sem			
Team Projects	1-2 wks	3-4 wks	1/2 sem	Full sem ✓	✓		
Lab Assignments							
Computer Assignments							
Computer Tools Used	FORTRAN, MATLAB				✓		
Oral Presentations	one				✓		
Written Reports	one				✓		
Other							