SYLLABUS

ME 460 Mechanical Vibrations

4 Credit Hours

Instructor:

Class time and location:

Office Hours:

Catalog Data:

Modeling and analysis of single and multi-degree of freedom systems under free and forced vibration and impact, Lagrangian and matrix formulations, energy methods, and introduction to random vibrations. Prerequisite: ME 360, Corequisite: ME 460L

Text:

D.J. Inman. Engineering Vibration, 3rd Ed., Prentice Hall, 2008.

References:

Objectives:

Learn modeling and analysis of single and multi-degree of freedom systems under free and forced vibration and impact, Lagrangian and matrix formulations, energy methods, and introduction to random vibrations. Prerequisite: ME 360, Corequisite: ME 460L

Pre-Requisites:

Differential equations, modeling of single and multiple degree of freedom dynamic systems (Newton's law and conservation of energy), transient response, harmonic response, Laplace transforms, linear algebra, kinetic energy of rigid bodies, kinematics, vector dynamics.

Homework:

Approximately 90 vibration problems are assigned as homework.

Design Project:

Exam Policy:

Give Exams.

Grading:

Homework 10%
Labs 25%
Exams 65%
All labs must be completed to receive a grade in the class.

Grading Scale:

A course average within each of the following ranges will guarantee you *at least* the corresponding letter grade: A: 90-100, B: 80-90, C: 70-80, D: 60-70, F: <60.

Attendance Policy:

Attendance in lab is required

Cheating Policy: Refer to the university policy or the instructor can add his or her own criteria.

Laboratory:
See the course coordinator for labs. There are 4 experimental labs, and 4 computational labs. Successful completion of labs is required for a passing grade.

Topics Covered in Course:

Topic	Time Spent	A-K Outcomes Covered
Resonance	.5 class	A, E
Free response	.5 class	A, E
Forced response	2 classes	A, E
Mode Shapes	3 class	A, E
Natural frequencies	2 classes	A, E
MDOF Forced Response	2 classes	A, E
Hysteresis	2 classes	A, E
Lagrange's equations	2 classes	A, E
Design of Vibration Absorbers	1.5 classes	A, E
Design of Isolation Systems	1 class	A, E
Critical speeds of whirling disks	1.5	A, E
Exams	2 classes	

Outcome:
Upon completion of this course, the student will be able to:

	ABET Outcome	Assessment Method
Derive Governing Equations of MDOF Mechanical Systems	A, E	Exam
Find mode shapes and natural frequencies of MDOF systems	A, E	Exam
Find forced response of MDOF systems to harmonic forces.	A, E	Exam
Find forced response of MDOF systems to impulse forces.	A, E	Exam
Find forced response of MDOF systems to general forces.	A, E	Exam
Design of vibration absorbers	A, E	Exam
Design of isolation systems	A, E	Exam
Design vibration avoidance	A, E	Exam
Determine critical speed of spinning shafts/disks	A, E	Exam
Stiffness, damping and mass identification	A, E	Exam

Time Spent on Program Outcomes:

	A-K Outcome	**Time Spent In Class (Hrs) (Lecture, Exam)**	**Time Spent Outside of Class (Hrs) (HW, Project)**
A	An ability to apply knowledge of mathematics, science, and engineering	24	48
B	An ability to design and conduct experiments, and analyze and interpret data	2	5
C	An ability to design a system, component, or process to meet desired needs	2	4
D	An ability to function on multi-disciplinary teams	-	-
E	An ability to identify, formulate, and solve engineering problems	12	24
F	An understanding of professional and ethical responsibility	-	-
G	An ability to communicate effectively	-	-
H	The broad education necessary to understand the impact of engineering solutions in a global and societal context	-	-
I	A recognition of the need for, and an ability to engage in life-long learning	-	-
J	A knowledge of contemporary issues	-	-
K	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	-	-

Student Survey of Topics Covered:

After having completed this course, on a scale from (1) to (5), please rate how well this course has helped you to perform the following course outcomes (**1 = Very dissatisfied**, **5 = Very satisfied**)

1. Derive Governing Equations of MDOF Mechanical Systems
2. Design vibration absorbers
3. Identify key system parameters (m, c, k, zeta, ω_n) from Frequency Response Functions
4. Identify key system parameters (m, c, k, zeta, ω_n) from Free Response
5. Find the response of a system (x(t)) given a harmonic excitation and the governing linear differential equation
6. Find the response of a system (x(t)) given a harmonic excitation and the Frequency Response Function
7. Find the Fourier Coefficients of a function repeating in time.
8. Find the response of a system to an arbitrary excitation using the convolution integral.
9. Find the response of a system to an arbitrary excitation using numerical integration
10. Find mode shapes and natural frequencies of MDOF systems
11. Find forced response of MDOF systems to harmonic forces.
12. Find forced response of MDOF systems to impulse forces.
13. Find forced response of MDOF systems to general forces.
14. Design of vibration absorbers
15. Design of isolation systems
16. Design vibration avoidance
17. Critical speed of rotating shafts/disks