ENGR 4440/5440: VIBRATIONS

University of Detroit Mercy
Term II, 2009-2010

Course Description: A study of the oscillation of mechanical systems. The course considers free and forced vibrations of one and two degree of freedom systems. The concepts of rotating and reciprocating unbalance, vibration isolation and transmissibility and frequency response are introduced. Matrix methods are applied.

Prerequisites: MTH 3720, Differential Equations
ENGR 3130, Dynamics

Instructor: Dr. Rick Hill, Assistant Professor
Department of Mechanical Engineering
Room E274
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Class meetings: TR 6:40-7:55 pm, Room E134

Office hours: T 5:00-6:30pm, R 11:00-12:00pm, 5:00-6:30pm,
others by appointment

Course homepage: http://knowledge.udmercy.edu

Required text:
Inman, D.J., *Engineering Vibration*. 3rd Ed., Pearson Prentice Hall, 2007.

Class Elements: Homework - Problem sets will be assigned approximately weekly over the course of the semester.

Quizzes - In-class quizzes will be given every one to two weeks. Quizzes cannot be made-up if you miss class.

Exams - Two midterms will be given during the semester in addition to a cumulative final.

Class Policies: Late work - Homework must be turned in at the beginning of class. Late homework is not accepted.

Emergencies - Your lowest homework and quiz score will be dropped, thereby allowing for emergencies. If there are further extenuating circumstances, they can be discussed on a case by case basis.

Exams - Exams will in general be closed book and closed note. You may be allowed an equation sheet. Make-up exams will only be given if prior arrangements have been made with me.

Regrades - If you feel a mistake has been made in the grading of an assignment or exam, you have one week from the date of its return to submit the item for a regrade.

Academic Integrity - Any suspected cheating will be dealt with according to the College policy - see the Engineering Science Student Handbook. In the case of homework, working together is encouraged, but you must write your own solutions that reflect your own understanding of the material.

Grading:

Homework	15%
Quizzes	5%
Midterm Exams	50% (25 % each)
Final exam	30%

Grade Scale:

Percentage	93-100	90-92	87-89	83-86	80-82	77-79	70-76	60-69	< 60
Grade	A	A-	B+	B	B-	C+	C	D	F

Course Topics:

1. Free periodic motion
2. Damping and damped free vibration
3. Response to harmonic excitation
4. General forced motion (response to arbitrary inputs)
5. Multiple degree of freedom systems

6. Matrix methods for the analysis of discrete systems
7. Vibration isolation and absorption

Course Outcomes: After successful completion of this course, students will be able to:

1. Calculate the natural frequency of un-damped single degree of freedom system. (Outcomes a and k)
2. Analyze and predict the free, steady-state periodic motion of an un-damped single degree of freedom system. (Outcomes a and k)
3. Analyze and predict the forced, steady-state periodic motion of an un-damped single degree of freedom system. (Outcomes a and k)
4. Model the effect of the different types of damping on vibration. (Outcomes a and k)
5. Calculate the natural frequency of damped single degree of freedom system. (Outcomes a and k)
6. Analyze and predict the forced, steady-state periodic motion of a damped single degree of freedom system. (Outcomes a and k)
7. Analyze forced vibration caused by rotating unbalanced forces. (Outcomes a and k)
8. Analyze forced vibration caused by harmonic ground motion. (Outcomes a and k)
9. Calculate the transmitted forces due to vibration. (Outcomes a and k)
10. Choose system parameters for specific vibration isolation. (Outcomes a and k)
11. Calculate the natural frequencies and determine the mode shapes of un-damped two degree of freedom system. (Outcomes a and k)
12. Analyze and predict the free, steady-state periodic motion of an un-damped two degree of freedom system. (Outcomes a and k)
13. Analyze and predict the forced, steady-state periodic motion of an un-damped two degree of freedom system. (Outcomes a and k)
14. Employ matrix methods in the analysis of multi-degree of freedom systems. (Outcomes a and k)
15. Calculate the transmission of force and motion in two-degree of freedom systems. (Outcomes a and k)