ENME 360 – VIBRATIONS

Spring 2017, Mechanical Engineering, UMBC

COURSE DESCRIPTION: Vibration engineering is a branch of mechanical engineering that deals with oscillatory motions of mechanical systems from machine parts to structures. Sometimes vibrations are desired as in the case of a vibrating string in a music instrument; monitoring the health of a structure; and harvesting vibrational energy. Many times vibrations are unwanted as in the case of an unbalanced rotating machine. The main purpose of this course is to introduce students to the modeling and analysis techniques for single- and multiple-degree-of-freedom vibratory systems. The basic concepts and formulations learned will be used for designing vibratory systems to achieve desired response specifications.

TEXTBOOK:

- Engineering Vibration, 4th Edition, by Daniel J. Inman, Pearson, 2014.

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CLASS SCHEDULE: Tue and Thu 5:30 PM to 6:45 PM (ITE #104)

GRADING:

In-class quiz	5%
Exam I	20%
Exam II	25%
Final Exam	30%
Homework	20%

The grading will follow the usual weighted scoring: A (weighted sum 90.0%~); B (75.0~89.9%); C (65.0~74.9%); D (55.0~64.9%); and F (~54.9%).

COURSE POLICIES:

1. Neatness and clarity count in homework problems. Do not hand in pages ripped out of spiral notebooks. Make sure all computer printouts are no larger than standard sized paper (8-1/2 x 11in.)
2. All homework must represent your own work. Consultation with other members of the class is allowed, but all work must represent an individual effort. For example the design of a computer program may be done in consultation with someone else, however the actual coding of the program must be an individual effort. The exception this policy is in the case of take home tests. All aspects of the test must be done individually.
3. Homework and reports turned in late will receive a 25% per day penalty starting immediately after the time that the assignment is due.

TENTATIVE COURSE TOPICS:

Topic	Sections	Date
• Introduction	1.1	Jan 31~
• Free vibration of single-degree-of-freedom (SDOF) systems		
○ Undamped free vibration	1.2	
○ Damped free vibration	1.3	
○ Modeling and energy method	1.4	
○ Stiffness	1.5	
○ Damping – logarithmic decrement	1.6	
○ Design problems	1.7	~Feb 16
• Harmonic response of SDOF systems		
○ Harmonically excited undamped vibration	2.1	Feb 21~
○ Harmonically excited damped vibration	2.2	
○ Alternative representations	2.3	
○ Base excitation, vibration isolation	2.4	
○ Rotating unbalance	2.5	~Mar 14
• Response of SDOF systems to general excitation		
○ Impulse response function	3.1	Mar 16[*†]~
○ Response to general excitation	3.2	
• Response of SDOF systems to periodic excitation		
○ Fourier analysis	3.3	
○ Steady-state response to periodic excitation	3.3	~Apr 18
• Multiple-degree-of-freedom (MDOF) systems		
○ Undamped natural frequencies and modes	4.1, 4.2	Apr 20~
○ Orthogonality of modes, modal analysis	4.2	
○ Modal analysis - damped systems & forced response	4.5, 4.6	
○ Lagrange's equations	4.7	
○ Dynamic vibration absorber	5.3	
○ Optimization	5.5	~May 16

[*] Spring break 3/19~26

[†] Dr. Lee attends SPIE SS/NDE conference (3/25~29, class replaced by Midterm I on 3/28)

IMPORTANT DATES:

HW 1	**Due Feb 14**
HW 2	**Due Feb 28**
HW 3	**Due Mar 14**
Midterm I	**Mar 28**
HW 4	**Due Apr 11**
Midterm II	**Apr 25**
HW 5	**Due May 9**
Final	**TBD (May 23?)**

First Day of Classes:	Monday, January 30
Spring Break:	Sunday, March 19-Sunday, March 26
Last Day of Classes:	Tuesday, May 16
Final Exams:	Thursday, May 18-Wednesday, May 24

Prepared by Dr. Soobum Lee, Dec 19, 2016.
Revised, Jan 30, 2017.