WEST VIRGINIA UNIVERSITY INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING
COURSE POLICY & SYLLABUS

Spring 2015

COURSE: MAE 340 – Vibrations

PREREQUISITES: MAE 242 – Dynamics & MATH 261: Differential Equations

WEB PAGE: community.wvu.edu/~bpb011/MAE340

TEXT: D.J. Inman, *Engineering Vibration*, 4th Edition, Prentice-Hall, 2013

REFERENCES:
1. R.K. Vierck, *Vibration Analysis*, Crowell, 1979.
2. R.F. Steidel, *An Intro. to Mechanical Vibrations*, 3rd Ed., Wiley, 1989.
3. S.S. Rao, *Mechanical Vibrations*, 3rd Edition, Addison-Wesley, 1995.
4. W. Weaver, S.P. Timoshenko, D.H. Young, *Vibration Problems in Eng.*, 5th Ed., 1990.

INSTRUCTOR: Dr. Bernhard Bettig
Office: E-301
Phone: 304-442-3289
Email: bpbettig@mail.wvu.edu
Office Hours: MF 10:00-12; 2-3:30; TWR 11-12; and by appointment

A. Course Objectives

i. To understand the fundamentals of Vibration Theory
ii. To be able to mathematically model real-world mechanical vibration problems
iii. To use computer software programs to investigate and understand vibration problems.

B. Learning Outcomes

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

i. apply Newton's equation of motion and energy methods to model basic vibrating mechanical systems
ii. model reciprocating and oscillatory motions of mechanical systems
iii. model undamped and damped mechanical systems and structures
iv. model free and harmonically forced vibrations
v. model single- and multi-degree of freedom systems
vi. perform and verify computer simulations employing time integration and modal analysis of discrete vibrating systems.

This course contributes to the assessment of the following program (student) outcomes:

a. an ability to apply knowledge of mathematics, science and engineering
e. an ability to identify, formulate, and solve engineering problems

C. Assessment

Assessment for this course consists of homework assignments, tests and a final comprehensive exam as described below.

1. ATTENDANCE

Due to the nature of the material covered in this course, regular attendance is highly recommended. However, I will neither call the roll nor maintain a record of your attendance. In case you miss a class, it is your responsibility to keep up with the class work and be informed of all announcements in class such as homework assignments, tests, etc. Also, please bring a calculator for solving practice problems together in class.

2. HOMEWORK

Trying to solve actual engineering problems is essential to learning and understanding engineering concepts. Homework will be assigned from the text after completing the discussion of each independent topic. Homework is due the class period after it has been assigned unless another due date is announced. Late homework will not be accepted, except for documented personal emergencies. The instructor will normally return the graded homework within a week. Some of the homework assignments may require the use of MATLAB or Mathcad and you are expected to be familiar with these software packages. Some of the homework may require the use of SolidWorks Simulation and you will be given instructions on using it. You are encouraged to consult with and seek assistance from your friends in completing your homework assignments. However, the homework must be completed entirely with your own efforts. I reserve the right to assign a grade of zero (0) for all participants who are involved in any kind of cheating/copying, or submitting, what appears to be, a duplicate copy of someone else's work. To encourage learning without fear of making mistakes, the homework will be graded purely on effort. As well:

- Each problem must have clearly identified sections: Given, Find, Solution.
- The units must be clear for every numeric value.
- All computations must first show equations symbolically and then with numeric values, without any rearrangement of variables.
- Submitted work must be neat. Use a ruler and underline or put boxes around answers.
- Convince me you have the correct answer!

4. EXAMS

I am planning on giving two class exams and a final exam as shown in the syllabus below. The class exams will be announced in advance and the final exam will be given according to the school schedule. They will be closed-book, closed-notes exams with formula sheet(s). You are allowed to use a one-page, self-written formula sheet for reference for each class test and all accumulated formula sheets for the final exam. The formula sheets may contain anything you consider useful in a test such as equations, figures, formulas, procedures, etc. However, they may not contain any solved problems or numerical answers. Anyone found violating this rule will be given a zero grade for the exam.

5. GRADING

Your final grade will be computed based on the following deliverables and grading scale.

Course Deliverables	
Homework	10%
2 Midterm Exams (30 each)	60%
Final Exam	30%
Course Total	100%

Grading Scale	
A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	< 60%

D. Syllabus

The course will tentatively follow the outline in the following table.

Week	**Lecture Topics**	**Text**	**Homework**
1 (1/12)	Introduction to Free Vibration	1.1	1.11, 16, 22, 23, 19 + extra, 20, 22 extra, 24
2 (1/19)	Harmonic Motion	1.2	1.27, 36, 40
3 (1/26)	Viscous Damping	1.3	1.53, 58, 60
4 (2/2)	Modeling and Energy Methods Stiffness	1.4 1.5	1.69, 70 1.82, 88
5 (2/9)	Measurement Design Considerations **Test 1 (2/11)**	1.6 1.7	1.94, 95 1.102
6 (2/16)	Stability Numerical Simulation of the Time Response Coulomb Friction and the Pendulum	1.8 1.9 1.10	1.112 1.125
7 (2/23)	Harmonic Excitation of Undamped Systems Harmonic Excitation of Damped Systems	2.1 2.2	2.6, 8, 15 2.30, 31
8 (3/2)	Base Excitation Rotating Unbalance Measurement	2.4 2.5 2.6	2.52, 53 2.63 2.71
9 (3/9)	Other forms of Damping Numerical Simulation and Design	2.7 2.8	2.73
10 (3/16)	Nonlinear Response Properties **Test 2 (3/18)** Two-Degree-of-Freedom Systems (Undamped)	2.9 4.1	 4.1, 2, 3, 4
11 (3/30)	MDOF System Response – Direct Method	Notes	4.77 + extra
12 (4/6)	Modal Analysis	4.2-6	4.13 + extra
13 (4/13)	Acceptable Levels of Vibration Vibration Isolation **Test 3 (4/15)**	5.1 5.2	

14 (4/20)	Vibration Absorbers* Damping in Vibration Absorption*	5.3 5.4	
15 (4/27)	Discussion of selected sections from Chapter 3 and practical problems from other Chapters.* Review		
16 (5/4)	Final Exam (5/4 at 1:00 pm)		

* content is time-permitting

Inclusivity

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Disability Services (304.981.6210). For more information on West Virginia University's Diversity, Equity, and Inclusion initiatives, please see http://diversity.wvu.edu.

Academic Integrity

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code http://studentlife.wvu.edu/office_of_student_conduct/student_conduct_code. Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me *before* the assignment is due to discuss the matter.