ME 6210 – MECHANICAL VIBRATIONS

INSTRUCTOR

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WEBSITE

Website: www.secs.oakland.edu/~gu/

You need to use Edge, Chrome or Safari to view and download the course materials.

OFFICE HOURS

Tue. and Thur., 3:00 PM ~ 5:30 PM, or by appointment

COURSE DESCRIPTION

Linear free and forced response of one and multiple degree of freedom systems. Equations of motion of discrete systems. Free vibration eigenvalues and eigenvectors. Applications to engineering systems including vibration isolation, rotating imbalance, vibration absorbers and balancing of rotating machinery.

Project required. Offered fall.

Comments: Formerly ME 522.

TEXT/REFERENCE

1. ***Engineering Vibration***, 4th edn., by D. J. Inman, 2014, Prentice Hall, ISBN-10: 0132871696 • ISBN-13: 9780132871693.
2. ***Theory of Vibration with Applications***, 5th edn., by W. T. Thomson and M. D. Dahleh, 1998, Prentice Hall. ISBN-10: 013651068X • ISBN-13: 9780136510680.
3. ***Mechanical Vibrations***, 5th edn., by S. S. Rao, Pearson, 2011. ISBN-13: 9780132128193.

Lectures will be primarily based on the texts listed above. Some class notes, in particular software related case studies, will be posted online.

SOFTWARE / LAB / ACCESSING COMPUTERS

The computer software available for use includes the following:

Code	Type	Usage
MATLAB	Programming	Examples and HW assignment Download and execute vtbud.m in MATLAB
ANSYS APDL ANSYS Workbench	pre- & post-processors and finite element solver	Modeling and solving mechanical vibration problems

All programs are PC-based and are installed in PCs in Rm. EC 466. Aside from all theoretical aspects of the course, numerical examples using MATLAB, ANSYS APDL as well as ANSYS Workbench will be covered. Instruction on the use ANSYS APDL/Workbench will be given. Matrix operation tools and differential equations solvers found in MATLAB and MS Excel will also be used in solving vibration applications. The 24/7 general computing lab at EC560 has PCs with the same configuration of ME software packages.

You will be using your UserID for accessing the computers in the labs. Follow the instruction in the website below to apply for an SECS computer account.

http://elara.secs.oakland.edu/SECSNetworkLogins/request.aspx

HOMEWORK

There will be approximately eight homework assignments to be given in the semester. Each HW is an individual work. Due date of the homework will be announced as the homework is given. Homework will be collected and checked. Late homework will be accepted, but a 10% per day penalty will be imposed. Some homework assignments are to be done using software packages. You need to prepare some flash drives for storing the files. Homework assignments and other materials will be posted online.

PROJECT

The term project is to be assigned in the first week of February. The project is to be done by individual. No collaboration or files sharing is allowed. In the project you may be asked to read a journal paper and to

numerically experiment the theory presented in the article. The numerical analysis is to be performed using Microsoft Excel, ANSYS (APDL/Workbench) and a symbolic solver such as MATLAB. Discussion about the paper will be given in the class. Due date of this assignment is Thursday, April 12, 2018. No late project report will be accepted.

EXAMINATIONS

There will be three open-book/open-notes exams scheduled below. NO make-up examinations will be provided. If you have any conflict, contact the instructor as soon as possible so that the exams can be re-scheduled.

Exam	Date
Exam 1	Feb. 08, 2018 (Tue.) (5:30P – 7:17P)
Exam 2	Mar. 22, 2018 (Thur.) (5:30P – 7:17P)
Exam 3	Apr. 19, 2018 (Thur.) (7:00P – 10:00P)

The exams normally consist of problems similar to examples shown in the class, and homework problems. They may include creating and completing computer files as well as essay problems. You must have a USB drive ready for taking the exams.

GRADING

Your final course grade will be a weighted average of the following components.

Component	Percentage
Homework	15 %
Exams	70 %
Project	15 %

Homework assignments and exams may weigh differently. Your course grades may be posted online by the last four digits of your GID (can be viewed using the click sequence COURSES : ME6210 : LOG : 1). If so desired, you need to email your consent to Dr. R. Gu (gu@oakland.edu) with the subject that reads: "ME6210 - I Wish to Have My Course Grades Posted Online".

COURSE CONTENT

1. Free Vibration
   Equations of Motion & Natural Frequency, Energy Method, Viscously Damped Vibration, Logarithmic Decrement, Experimental Measurement of Damping Coefficient, Coulomb Damping
2. Harmonic Excitation
   Forced Harmonic Vibration, Unbalanced Load, Support Motion, Vibration Isolation, Energy Dissipation, Structural Damping, Vibration Instruments
3. Forced and Transient Response
   Arbitrary Excitation, Laplace Transform, Response Spectrum
4. Multi-Degree-of-Freedom Systems
   Normal Mode Vibration, Coordinate Coupling, Forced Harmonic Vibration, Vibration Absorber, Flexibility and Stiffness Matrices, Eigenvalue Problems, Forced Vibration, Modal Analysis, Viscously Damped Systems
5. Continuous Systems
   Vibration of a String, Vibration of Rods/Bars, Torsional Vibration, Bending Vibration of a Beam
6. Finite Element Method
   Bar Element, Beam Element, Mass Matrices, Applications using Workbench
7. Testing and Experimental Modal Analysis

CONDUCT CODE

Discussion between teams is encouraged. There should not be, however, collaboration of any form between teams. Persons suspicious of cheating or plagiarism will be brought to the attention of the Academic Conduct Committee (ACC) for investigation. If found guilty; they will be given a 0.0 for the final course grade in addition to the possible sanction imposed by ACC. You are urged to review the Academic Conduct Policy contained in your University Catalogs.