MECH 364: Mechanical Vibrations

(September, 2011)

Prerequisites: MECH 221, MECH 260; a sound working knowledge in kinematics, solid mechanics, differential equations, complex numbers, and matrix algebra is essential for this course.

Course Objectives: i) *Develop* lumped parameter models of mechanical systems; ii) *Formulate* equations of motion using free-body-diagrams and energy methods; iii) *Solve* for vibration response; iv) *Design* counter-vibration measures: absorbers, isolators, and system modification; v) *Understand* working principles of vibration measurement devices.

Course Outline: Read the sections indicated below from the course text book– Mechanical Vibrations by S.S. Rao (5th or 4th Edition)– before each lecture. Lectures: Tu & Th 8-9.30 am (CEME 1202); Tutorial: W 12-1 pm (CEME 1202); Lab: 2 members per group (ICICS X039); Lab times: TBA.

No	Topic	Read	Do	Objectives
1	**Introduction to Vibrations**	1.1−1.6	A1	i
2	**Single-Degree-of-Freedom Systems**			
2.1	Formulation of Equations of Motion	2.1; 2.2.1; 2.2.3;	A2	ii
2.2	Equivalent Systems	1.7; 1.8	A2	ii
2.3	Undamped SDOF response	1.10; 2.2; 3.3	A3	iii
2.4	Viscously Damped SDOF response	2.6;3.4	A3	iii
2.5	Vibration Isolation	9.10	A4	iv
2.6	Forced Vibration: General Excitation	4.2−4.5	A5	iii
3	**Vibration Measuring Instruments**	10.4; 10.5		v
4	**Spectral Analysis**	Class Notes	A6	v
4.1	Introduction to Fourier Series & Fourier Transform			
4.2	MATLAB Implementation			
4.3	Frequency Response Functions and Coupled Systems			ii
5	**Multi-Degree-of-Freedom Systems**			
5.1	Formulation of Matrix Equations of Motion; Coupling and Principal Co-Ordinates	5.1−5.6 6.1−6.8		i–ii
5.2	Eigenvalue Problems & Orthogonality Conditions	6.9−6.10		iii
5.3	Free and Forced Vibration Response	6.13−6.15		iii
5.4	Vibration Absorbers	9.11	A7	iv
6*	**Continuous Systems**			ii–iii
6.1	String Vibrations; Normal Modes and Orthogonality	8.1−8.2	A8	

Assignments (A1−A8) will be issued periodically on VISTA; solutions will appear a week after. Do the assignments on your own to fill gaps in your knowledge. Ignore this advice at your own risk!

Grading: Homework (5%); 3 'Midterm' exams (15%); Laboratory Report (10%); Final (70%). **You must secure at least 50% overall and at least 50% in the final to pass the course. If you score below 50% in the final exam, your final exam mark will be your course mark.**

Exam Dates: **28th Sep. (MT1); 26th Oct. (MT2); 23rd Nov. (MT3); TBA (Final)**

Contacts: Dr.Srikanth (Instructor) srikanth@mech.ubc.ca; CEME 2061
Graeham Douglas (TA for course related questions): graeham.douglas@gmail.com; CEME1054
Masih Hanif (TA for lab): masih.hanif@gmail.com; X015-CS/ICICS Building

All course related material (notes, announcements, e-mails) will be on VISTA.

Course Policies

1. **Tutorial attendance is compulsory.** Tutorial problems are posted every Friday on VISTA. We will solve these problems together on the following Wednesday.

2. **Course Load**: This is a 4 credit course and the course load is heavier compared to a normal 3 credit course. It integrates concepts from Dynamics & Solid Mechanics. Students find this material challenging and rewarding. **A 3-5 hours of study per week spent on this course outside the lectures, labs, and tutorials will keep you up to speed.** Please do not leave things to the last moment.

3. **Assignments**: Regular assignments will be posted on VISTA. Solve assignment problems on your own to determine your understanding of the lecture material. Solutions will be posted on VISTA, approximately a week after the assignments are issued.

4. **Homework**: One home-work problem per week will be posted on every Wednesday; your hand-written answers should be submitted before the following Wednesday in the tutorial. **Late submissions are not allowed under any circumstances**. Solving homework and assignment problems will help you prepare for the midterm and final examinations. **Marked homeworks can be picked up from CEME 1054, approximately a week after you submit them.**

5. **Labs**: Please come prepared: read the handout carefully and complete the pre-lab exercise. *You will be given a short quiz in the lab, the mark of which will count toward the pre-lab.* The report should be submitted within two weeks (including holidays, weekends) in the tutorial. **Late submissions will incur mark deduction ($\sim$ 5%).** Grading scheme for the lab reports is posted on VISTA along with the lab handout. *Follow the report guidelines in the handout and ensure that your report addresses all points in the grading scheme.*

6. **'Midterm' exams**: Three exams will be held in the tutorial times on the dates announced (see page 1). **These dates are final and non-negotiable.** The exams are closed-book ; **your hand-written formula sheet (letter paper, both sides)** is allowed. The exam is of 45 minutes duration and will comprise one question (20 marks).

7. **Who should I contact?** Graeham Douglas is the TA responsible for your lecture/tutorial related queries. Masih Hanif is the TA responsible for labs. Please send them your questions related to the course matter by email. See page 1 for email addresses.

8. **Office hours**: Thursday 10AM–11 AM. Please send me your questions related to the course matter by email to arrange individual appointment. See previous page for email addresses.

9. **Enjoy learning**: I am here to help you learn. Let me know if you face any difficulties. Make most of the learning opportunities given to you and enjoy what you study. All the very best to you!