MECH 463: Mechanical Vibrations

(September, 2013)

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; vi) *Apply* computational tools (MATLAB and MSC-ADAMS) in vibration analysis and design.

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 8-9.30am in DMP 310; Tutorial (3 members per group): W 12-1pm in CEME 1202 & Fr 2-3 pm in ESB 2012; Lab (2 members per group): ICICS X039, 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 Coordinates	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 CONNECT; solutions will appear a week after. Do the assignments on your own to test your course knowledge. Ignore this advice at your own risk!

Grading: Homework (5%); Tutorials (5%); ADAMS (5%); 3 'Midterm' exams (15%); Laboratory Report (10%); Final (60%). **You must secure at least 50% overall and at least 50% in the final to pass. If you score below 50% in the final exam, your final exam mark will be your course mark.**

Exam Dates: **26th Sep. (MT1); 31st Oct. (MT2); 19th Nov. (MT3); TBA (Final)**

Contacts: Dr.Srikanth (Instructor) srikanth@mech.ubc.ca; CEME 2061. TA information on the reverse.

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

Course Information and Policies

TA Information

Name	Office hours	Contact
Masih Hanif (Lab)	TBA	masih.hanif@gmail.com, ph: 604-822-3147
Banda Logawa (Tutorials)	CIRS 2160, 1-4pm (M) & 3:30-5pm (Tue).	logawa_b@yahoo.com, ph: 778-989-4777.
Louis Moskven (Tutorials)	CEME 1054, TBA	lmoskven@gmail.com, ph: 604-822-2817
Manav (Lab)	CEME 1054, TBA	manav.iitk@hotmail.com, ph: 604-822-2817
Ahmad Panah (ADAMS)	8am-6pm (M–F)	ahmadpa20@gmail.com, ph: 604-222-5613,
Reza Zanganeh (Tutorials)	ICICS X227, 4pm-7pm (M–F).	r.zangeneh87@gmail.com, ph: 778-708-1717.

1. **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.
2. **Tutorial attendance is compulsory.** Tutorial problems are posted every Friday on CONNECT. We will solve these problems together, **in groups**, on the following Wednesday and Friday in the tutorials. **Please sign up via CONNECT in groups of 3.** Your group will solve the tutorial problems and submit the solution to the TA allocated for marking and feedback.
3. **Assignments**: Regular assignments will be posted on CONNECT. Solve assignment problems on your own to determine your understanding of the lecture material. Solutions will be posted on CONNECT, 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 3pm on the following Wednesday in CEME 1054. **Late submissions are not allowed under any circumstances**. Solving homework and assignment problems will help you prepare for the midterm and final examinations. **Marked homework 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 ($\sim$ 2%).** Grading scheme for the lab reports is posted on CONNECT 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. **ADAMS**: Tutorials on using ADAMS will be conducted in the PACE LAB in ICICS Building. Please sign up for these sessions on CONNECT.
7. **'Midterm' exams**: Three exams will be held in the lecture 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) with parts.
8. **Office hours**: **Open doors policy**. Please email to arrange individual appointments. 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!