MECH 364: Mechanical Vibrations

Module 0

COURSE INFORMATION

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Department of Mechanical Engineering
The University of British Columbia
Vancouver V6T 1Z4 CANADA
LEARNING OBJECTIVES

1) **Develop** a *systematic* approach to study small oscillations of mechanical systems
   1) Determine accelerations
   2) Sketch Free Body Diagrams
   3) Apply equation of motion/equilibrium to describe systems in *mathematical* terms

2) **Deduce** the response of these systems to transient and harmonic disturbances
   1) Impulse response
   2) Frequency response
   3) Convolution

3) **Analyse** systems with more than one degree of freedom

4) **Design** vibration isolators and vibration absorbers

5) **Understand** working principles of vibration measurement devices and **Interpret** measurements.

   Emphasis is on **concepts and synthesis of ideas**.
COURSE STRUCTURE

Module 1  
Introduction & Review

Module 2  
Fundamentals of vibration

Module 3  
SDOF: Free Vibration

Module 4  
SDOF: Forced Vibration & Resonance

Module 5  
Energy Methods & Frequency Domain

Module 6  
MDOF Systems: Coupling, Orthogonality

Module 7  
Design & Special Topics

Module 8  
Vibration Measurement

Module 9  
Continuous Systems

Modules 1 and 2 are preparatory material intended for UBC students.

Modules 1-7 will be covered in that sequence. The remaining two modules will be covered depending on the pace of the course.
## ROAD MAP

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<td>01 December 2009</td>
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- **Mid-term Examination I**: 7th October 2009, In Tutorial
- **Mid-term Examination II**: 4th November 2009, In Tutorial

*Graded scripts must be collected by each student from me in my office: Rusty Hut 107.*

- Homework/Assignment problems posted regularly on VISTA will not be marked. Solutions will be posted on VISTA after the tutorial. **YOU MUST SOLVE THESE PROBLEMS ON YOUR OWN OR IN GROUPS TO ENSURE THAT YOU MASTERED THE MATERIAL COVERED. ATTEND TUTORIALS TO SEE ADDITIONAL PROBLEMS.**
## GRADING

<table>
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<td>Midterm 2</td>
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*Passing mark (50%) in the final exam is mandatory to pass the course. I Will Consider Your Final Exam Performance to INCREASE Your Grade. I want to ensure that you learned overall.

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**NO FORMULA SHEET! MAKE YOUR OWN IN ONE SHEET (BOTH SIDES). ATTACH IT. MARKED SCRIPTS TO BE COLLECTED FROM ME DIRECTLY**

Module 0    MECH 364: MECHANICAL VIBRATIONS; SECTION 101; 2009
COURSE DELIVERY

MECH 364 is posted on VISTA:
http://www.vista.ubc.ca
Notes, Assignments, Labs, Calendar, Announcements, Discussion groups, WWW links ...

Lectures / Tutorials / Labs:
Lecture: Tues & Thursday
8:00-9:30 AM
MCLD 254

Tutorial: Wednesday
12:00-13:00
Woodward IRC3

Lab: Monday
11:00-17:00 (X060A)
Lab is located in the basement of ICICS (opposite to PACE labs). Contact Imad (TA2).
OUTSIDE CLASS

1) OFFICE HOURS
   Tues & Thurs: 1-2 pm in RH 107 (Rusty Hut)

2) INDIVIDUAL APPOINTMENT: srikanth@mech.ubc.ca

3) MECH 364-FAQ list on VISTA: A document listing common questions from students.

4) Teaching Assistants:

   **Ali Vakil (Problems)**
   Office: 313, Pulp and Paper Centre.
   Email: ali.vakil@gmail.com
   Office Hours: Mon 16:30 – 18:30

   **Imad Abou Yusef (Lab help)**
   Office: 311, Pulp and Paper Centre
   Email: imad3@interchange.ubc.ca

5) SOLVE PROBLEMS ON YOUR OWN FIRST AND LIST YOUR DIFFICULTY AREAS BEFORE APPROACHING TA/ME/YOUR FRIEND.

"Engineering problems are under-defined, there are many solutions, good, bad and indifferent. The art is to arrive at a good solution. This is a creative activity, involving imagination, intuition and deliberate choice."
- Ove Arup
Lecture Notes

You are expected to fully master the material presented in lecture notes. You will be examined on this. In addition, supplementary material will be posted as and when required. This material, though not examined, may be useful to develop your own perspective on vibrations. I encourage you to make notes of your own.

Suggested Reading

Catalogue numbers from I.K. BARBER LEARNING CENTRE are in **bold** where available.


“Feynman Lectures on Physics: Volume 1.” Richard P. Feynman, Robert B. Leighton, Matthew Sands, Addison-Wesley, **QC23 F47 1963 V.1 C.3**. Read chapters 21–24 for an easy-to-understand physicist’s view of vibrations.

“Vibration Problems in Engineering.” This is a classic book by Timoshenko, updated with modern techniques.

“Mechanical Vibrations.” J.P. Den Hartog, **TA355.D4**. *A Bible for vibration engineers*.


“Vibration Testing: Theory and Practice.” Kenneth G. McConnell and Paulo S. Varoto, Wiley; 2 edition. A good source for vibration testing engineers about measurement and interpretation of vibration data. Shows how to obtain meaningful experimental results via the proper use of modern instrumentation, vibration exciters, and signal-processing equipment, with particular emphasis on how different types of signals are processed with a frequency analyzer.

*Imagination is more important than knowledge— Albert Einstein*
HOW TO SUCCEED IN MECH 364?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Attend and Understand Lectures &amp; Tutorials</td>
<td>30%</td>
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<tr>
<td>APPLY the concepts to problems ON YOUR OWN</td>
<td>50%</td>
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<td>Friends/TA/Me to clarify doubts</td>
<td>20%</td>
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1) LEARN BY DOING problems yourself. What is obvious to your friend may not be obvious to you. ATTEND tutorial.

2) DO NOT BE AFRAID to seek help from me or TA however trivial your doubt may be.

3) BE PROFESSIONAL. Respect YOUR fellow student’s time in lectures and tutorials.

4) TELL ME your difficulties with the course. I cannot fix an unknown problem.

5) ENJOY the course. It is not all about grades. The joy of discovering things and the art of learning will stay with you for a life time.

ALL THE BEST!