Course Syllabus

Mechanical Vibration, MECH 4340, Fall 2015
Hours: Tuesday & Thursday: 4:00pm-5:15pm
Class Credits: 3 Credits
Room: JO 3.516

Instructor: Majid Minary
Email: majid.minary@utdallas.edu
Office: ECSN 3.212
Office Hours: Tuesdays 2:30-4 PM.
Teaching Assistant: Mahmoud Baniasadi
Email: mxb130430@utdallas.edu
Office Hours: Monday 9:45-10:45AM, Thursday 11am-1pm.

Prerequisites: ENGR 2300 and MATH 2420 and ENGR 3341 and MECH 2330.

Course Description: This course covers harmonic and periodic motion including both damped and undamped free and forced vibration, single- and multi-degree-of-freedom systems and matrix techniques suitable for computer simulations.

Topics:

- Introduction to Vibrations
- Free vibration of single-degree-of-freedom systems
- Harmonically excited vibration
- Vibration under general forcing conditions
- Vibration of two-degree-of-freedom systems

Student Learning Objectives/Outcomes:

1. Model real and physical dynamic systems in terms of mathematical models.
2. Apply principles of mechanical vibrations such as Newton's second law, and the principle of conservation of energy to the mathematical models to obtain their governing equations of motion.
3. Solve the obtained equations of motion to understand behavior of oscillatory systems to various excitations such as harmonic excitation, and impulse excitation.
4. Develop basic numerical simulation skills using MATLAB to simulate the dynamic and oscillatory response of physical models.

Textbook

Mechanical Vibrations, Singiresu S. Rao, Prentice Hall; 5th Edition (2011)

Suggested Course Materials

1. Engineering Vibration, Daniel J. Inman, 3rd Edition 2007, Prentice Hall
2. Schaum's Outline of Mechanical Vibrations, S. Graham Kelly , McGraw-Hill; 1 edition (April 1, 1996)
3. Theory of Vibration with Applications, William T. Thomson, Prentice Hall; 5 edition (August 17, 1997)
4. Mechanical Vibrations, J.P. Den Hartog, Crastre Press (November 4, 2008)
5. Fundamentals of Vibrations, Leonard Meirovitch, Waveland Pr Inc.; 1 edition (July 1, 2010)

Grading Policy

- Homework (20%)
- Mid-term I (15%)
- Mid-term II (15%)
- Final (40%)
- Quiz (10%)

* Late homework will not be accepted, except for unusual circumstances, which should be comminuted with the instructor ***before*** the due date.

Use of cell phones in class is not allowed.
UT Dallas Syllabus Policies and Procedures
The information contained in the following link constitutes the University's policies and procedures segment of the course syllabus. Please go to http://go.utdallas.edu/syllabus-policies for these policies.

The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.

Mechanical Vibration, MECH 4340
Instructor: Majid Minary
Learning Objectives

Chapter 1: **Introduction to vibrations**
After learning this chapter students should be able to do the following:

- Indicate the importance of study of mechanical vibrations.
- State the steps involved in vibration analysis.
- Name the three important elements of every mechanical vibration system.
- Know the definitions of the periodic and harmonic motion.
- Obtain the equation of motion for various dynamic systems.

Chapter 2: **Free vibration of single-degree-of-freedom systems**

After learning this chapter students should be able to do the following:

- Derive the equation of motion of a single-degree-of-freedom system using different methods such as Newton's second law, D'Alembert's principle, and the principle of conservation of energy.
- Obtain the natural frequency and damped frequency for the single-degree-of-freedom system
- Solve the equation of motion for the different types of initial conditions.
- Solve the equation of motion for different values of viscous damping.

Chapter 3: **Harmonically excited vibration**

After learning this chapter students should be able to do the following:

- Obtain the response of the undamped single-degree-freedom system to harmonic excitations.
- Define the resonance and beating phenomena.
- Obtain the response of the damped single-degree-freedom system to harmonic excitations.
- Distinguish between transient and steady state solutions.
- Define the quality factor of the vibrations.
- Solve the equations of motion for two important cases of rotating unbalance and base-excitations.
- Obtain the frequency response of the systems using Laplace transformation.

Chapter 4: **Vibration under general forcing conditions**

After learning this chapter students should be able to do the following:

- Obtain response of the single-degree-of-freedom system to arbitrary forces using convolution integral.
- Find the response of the system to impulse, step, and ramp forces using Laplace transform.

Chapter 5: **Vibration of two-degree-of-freedom systems:**

After learning this chapter students should be able to do the following:

- Formulate the equations of motion of two-degree-of-freedom systems.
- Identify the mass, stiffness and damping matrices from the equations of motion.
- Obtain the mode shapes and natural frequencies of the system.
- Obtain the free vibration and force vibration solution for two-degree-of-freedom systems.
- Perform coordinate decoupling and obtain the principal coordinates.

MATALB programming: In each chapter students will use numerical codes based on MATLAB to plot response function for various excitations and initial conditions.