MECH4750 Mechanical Vibration

Course Code: MECH4750	**Course Title:** Mechanical Vibration
Required Course Or Elective Course: elective	**Terms Offered (Credits):** Fall 23-24 (3 credits)
Faculty In Charge: Zhengbao YANG	**Pre/Co-Requisites:** N/A
Course Structure: Lecture: 2 days per week, 1.5 hours per lecture	
Textbook/Required Material: Lecture notes, Reference textbook: S.S. Rao, Mechanical Vibration, 5/e, Prentice Hall, 2011.	
Bulletin Course Description: Single-degree-of freedom vibration, multiple-degree-of-freedom vibration, beam theory, energy method, passive control, active control, Programming, MATLAB, Finite Element Analysis, energy harvesting, sensors, smart materials, and structures.	
Course Topics: 1. Fundamentals of vibration 2. Single-degree-of-freedom vibration 3. Harmonically excited vibration 4. Multiple-degree-of-freedom vibration 5. Modal analysis and beam theory 6. Mid-term exam 7. Passive and active control 8. MATLAB programming 9. Finite element method 10. Smart Sensors 11. Energy harvesting 12. Final presentation 13. Revision week/Lab	
Course Objectives: (correlated program objectives)	1. To equip the students with fundamental vibration theories and vibration control technologies that are commonly used in mechanical, civil, electrical, and aerospace engineering (P-O1) 2. To introduce various damping mechanisms and frequency response function in mechanical systems (P-O3). 3. To provide students with the skill of identification of system vibration characteristics, the response of free vibration and forced vibration, using analytical methods and numerical methods, especially finite element method (P-O1, P-O3) 4. To introduce the design of various vibration control methods, based on specified vibration constraints and/or international standards (P-O1, P-O3). 5. To introduce experimental methods to determine vibration characteristics for vibration control and condition-based maintenance in mechanical and aerospace engineering (P-O1, P-O2, P-O3) 6. To learn the cutting-edge knowledge on sensors and transducers (P-O1, P- O2, P-O3)
Course Outcomes: (correlated course objectives and program outcomes)	A. Ability to derive system equations [1,3] (POC1). B. Ability to modify, in a design scenario, the system parameters to

	alter vibration response [2,4,5] (POC1, POC3). C. Ability to determine natural frequencies and vibration shape(s) [3,5] (POC1, POC3). D. Ability to measure vibration characteristics and infer model parameters from the measured data [5] (POC1, POC2, POC3). E. Ability to apply modern computational techniques (i.e. Matlab and ANSYS to vibration analysis) [3] (POC3, POC6). F. Ability to design practical vibration control systems for mechanical systems in mechanical and aerospace engineering [4,5] (POC4, POC5, POC6)
Assessment Tools: (correlated course outcomes)	Quiz/Assignment 20% [A-F] Mid-term exam 40% [A-E] Course project 40% [A-E]

BEng in Mechanical Engineering (4-year program)

Program Objectives:

P-O1. Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments,

P-O2. Have an international outlook with clear perspectives on the Pearl river Delta and Greater China,

P-O3. Be able to research, design, develop, test, evaluate and implement engineering solutions to problems that are of complexity encountered in professional practice and leadership,

P-O4. Clearly Consider the ethical implications and societal impacts of engineering solutions,

P-O5. Continuously improve through lifelong learning.

Program Outcomes:

POC1. ability to identify and formulate problems in multidisciplinary environment with an understanding of engineering issues and constraints;

POC2. ability to design and conduct experiments as well as analyze and interpret data;

POC3. ability to apply knowledge of mathematics, science, and engineering for problem solving in mechanical engineering and related sectors or for further education in a research career;

POC4. ability to develop specification and to design system, component, or process to meet needs;

POC5. ability to understand the manufacturability, maintainability, and recyclability of engineering system and components;

POC6. ability to use modern engineering tools, techniques, and skills in engineering practice;

POC7. ability to communicate effectively;

POC8. ability to function in multi-disciplinary teams and provide leadership;

POC9. broadly educated with an understanding of the impact of engineering solutions on issues such as economics, business, politics, environment, health and safety, sustainability, and societal context;

POC10. clear understanding of professional and ethical responsibilities;

POC11. recognition of the need for life-long learning and continuing education;

POC12. international outlook with knowledge of contemporary issues.