Vibration, Control and Programming

MECH3750

3 Credits

Pre-requisites: MECH 2020

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Office Hours: Monday 1-3 pm, or by email appointments

Course Description

Master the essential principles of vibration that drive innovation in the mechanical, civil, and aerospace industries. This course takes you from the fundamentals of simple vibrations to the complex analysis of multi-degree-of-freedom structures and beams. You will learn to command powerful engineering software like MATLAB and Finite Element Analysis (FEA) to model and solve real-world challenges. Our approach is hands-on and practical. You will transform theory into practice through engaging lectures, interactive labs, and collaborative projects. This method builds teamwork and innovation, giving you a distinct advantage for your final year design project, internships, and job interviews. Assessments are straightforward, balancing exams with creative project work to ensure you learn deeply without unnecessary stress. Graduates from this course are highly sought after for rewarding careers in aerospace, automotive, and civil engineering, etc., where expertise in time-varying systems drives innovation and efficiency.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

ILO1: Ability to derive 1DoF system equations.

ILO2: Ability to modify, in a design scenario, the system parameters such as stiffness, mass and damping ratio to alter vibration response

ILO3: Ability to determine natural frequencies and vibration shape(s)

ILO4: Ability to apply modern computational techniques (i.e., Matlab and ANSYS for basic vibration analysis)

ILO5: Ability to select and use sensors and actuators

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Quiz/Assignment	20%	Week 1-12
Mid-term exam	40%	Week 7
Course project	40%	Week 12

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Quiz/Assignment	ILO1, ILO2, ILO3, ILO4, ILO5	This task assesses students' ability to catch up with the lecture materials and encourages students to use learnt knowledge to analyze engineering problems.
Mid-term exam	ILO1, ILO2, ILO3.	This task is to assess students' overall learning outcomes.
Course project	ILO1, ILO2, ILO3, ILO4, ILO5.	This task is designed to motivate students to use knowledge and skills to solve real-world engineering problems and at the same time practice their teamwork spirit and communication skills.

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of subject matter, expertise in problem-solving, and significant creativity in thinking. Exhibits a high capacity for scholarship and collaboration, going beyond core requirements to achieve learning goals.]
B	Good Performance	Shows good knowledge and understanding of the main subject matter, competence in problem-solving, and the ability to analyze and evaluate issues. Displays high motivation to learn and the ability to work effectively with others.
C	Satisfactory Performance	Possesses adequate knowledge of core subject matter, competence in dealing with familiar problems, and some capacity for analysis and critical thinking. Shows persistence and effort to achieve broadly defined learning goals.
D	Marginal Pass	Has threshold knowledge of core subject matter, potential to achieve key professional skills, and the ability to make basic judgments. Benefits from the course and has the potential to develop in the discipline.
F	Fail	Demonstrates insufficient understanding of the subject matter and lacks the necessary problem-solving skills. Shows limited ability to think critically or analytically and exhibits minimal effort towards achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline.

Course AI Policy

The use of Generative AI in project is permitted with proper acknowledgement and will NOT be contributed to the students' work.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated in class within two weeks of submission. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Late submission Policy

To ensure fairness for students who submit assignments on time, a penalty for late submission is listed as follows:

- Late submission within 12 hours, 25% penalty will be applied.
- Late submission between 12 to 24 hours, 50% penalty will be applied.
- Late submission for more than 24 hours will not be accepted.

Required Texts and Materials

S.S. Rao, Mechanical Vibration, 5/e, Prentice Hall, 2011.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.