

PME 534400 Structural Dynamics | 結構動力學

Spring 2024

Instructor:

Dr. Meng-Hsuan (Mark) Tien | 田孟軒 助理教授

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Lectures: Wednesday 3, 4, noon (10:10-12:50) in Engineering Building I – 210

Office Hours: Appointment by email

Textbook: Lecture notes from the instructor

References: D. Wagg and S. Neild, *Nonlinear Vibration with Control*, Springer

L. Meirovitch, *Fundamentals of Vibrations*, McGraw Hill

L. Humar, *Dynamics of Structures*, CRC Press

Course Descriptions:

The understanding of dynamics and vibrations of structural systems is critical to design, analysis, and diagnosis of a variety of engineering systems. This course will cover the fundamental modeling approaches for structures and the methodology for analyzing their structural dynamics. Both analytical and numerical tools for analyzing the linear and nonlinear structures will be introduced. The specific course learning objectives are:

- Linear vibration theory: vibrations of single DOF oscillators and multi-DOF oscillators; modal analysis; reduced-order modeling.
- Nonlinear dynamics: nonlinear vibration phenomena; approximate analytical methods.
- Numerical tools for solving structural dynamics problems.

Course Objectives:

1. Introduce fundamental theories about analysis of structural dynamics.
2. Develop skills using MATLAB to perform analyses.
3. Develop ability to read technical papers and understand current research trends.

Exams:

An Exam will be given in the semester to test your familiarity of lecture materials.

Project:

Projects will be chosen by the students with approval from the Professor to explore additional advanced topics related to structural dynamics. The students are expected to (a) read technical papers and perform analyses, (b) prepare a presentation to summarize and defend the result, and (c) write a technical report.

Grades:

The course grade will be determined as follows :

	Exam	40 %
Project	Written report	30 %
	Presentation	30 %

Minimum grades will be determined based on the suggested university grade scale, the course will be curved if necessary to improve the average:

Grade	Percentage	Grade	Percentage	Grade	Percentage	Grade	Percentage
A+ (4.3)	90 – 100	B+ (3.3)	77 – 79	C+ (2.3)	67 – 69	D (1.0)	50 – 59
A (4.0)	85 – 89	B (3.0)	73 – 76	C (2.0)	63 – 66	F (0)	1 – 49
A- (3.7)	80 – 84	B- (2.7)	70 – 72	C- (1.7)	60 – 62	X (0)	0

Note: You have one week from the time any homework, quiz or exam grade is posted to discuss with me any change in score after that **the score will not be changed**.

Course Outline:

1. Introduction of structural dynamics
2. Formulation of the equations of motion
3. Linear vibrations
 - a. Analytical and numerical methods for solving single DOF system
 - b. Analytical and numerical methods for solving multiple DOF system
 - c. Modal analysis
 - d. Reduced order modeling
4. Nonlinear dynamics and vibrations
 - a. Nonlinear vibration phenomena
 - b. Numerical tools for analyzing nonlinear dynamics
 - c. Approximate analytical methods for analyzing nonlinear vibrations