

CIVIL-467

Advanced Structural Dynamics

De la Llera Martin Juan Carlos

Cursus	Sem.	Type
Civil Engineering	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	During the semester
Workload	90h
Weeks	14
Hours	3 weekly
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

This course covers theoretical and practical aspects of the dynamic response of linear and nonlinear structural systems in continuous and discrete time. First and second order system dynamics are used. Applications will be focused on the passive vibration control of structures.

Content

General formulation of the dynamic equations of motion of structural systems
 Different representations of dynamics systems (second-order, state-space, input-output relations)
 Integration methods for the equations of motion in continuous and discrete time (direct integration, modal analysis, explicit and implicit methods, stiff equation methods)
 Discrete-time Fourier analysis of structural systems and mechanical/physical filters
 Dynamic response of non-classically damped systems
 Approximate methods: dynamic order reduction of dynamic systems (truncation, Ritz and Lanczos vectors, substructuring)
 Dynamic formulation and response of space continuous structural systems
 Application of passive control of structural vibrations (tuned mass dampers, viscoelastic, viscous, frictional and metallic dampers)

Keywords

state-space, linear systems, damping, earthquake engineering, vibration control, dynamic response

Learning Prerequisites**Required courses**

CIVIL-420 or equivalent; CIVIL-224 or equivalent

Recommended courses

Course in matrix structural analysis

Important concepts to start the course

Linear algebra, differential equations, matrix structural analysis, virtual displacements, modal analysis, programming skills in Matlab and/or Python

Learning Outcomes

By the end of the course, the student must be able to:

- Understand in detail the fundamental concepts that control the dynamic response of structures
- Compute the dynamic response of nonlinear structural systems with localized material nonlinearity
- Formulate the equations of motion of different types of structural dynamic systems
- Apply and understand the different technique for passive vibration control of structures
- Use proficiently the technique of discrete Fourier analysis of structures
- Use and learn discretization techniques for the analysis of continuous structural systems
- Compute the dynamic response on any linear dynamic system classically or non classically damped

Teaching methods

Lectures, exercises and assignments. The aim of the course is to achieve a good combination between professor - and student- centered activities.

Expected student activities

Attend to lectures and exercise classes, and work individually in homeworks. Come to office hours if assistance is needed regarding lectures and seek support of TAs regarding homeworks.

Assessment methods

The assignments and exam count 50% each toward the final grade

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Websites

- <http://Yes>

Moodle Link

- <https://go.epfl.ch/CIVIL-467>

Prerequisite for

No