2EL1810 – Structural Dynamics & Acoustics

Instructors: Didier Clouteau
Department: DÉPARTEMENT MÉCANIQUE ENERGÉTIQUE PROCÉDÉS
Language of instruction: ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 60
On-site hours (HPE): 35,00
Elective Category : Engineering Sciences
Advanced level : Yes

Description

Vibrations and wave propagation play an key role in many areas: geophysics, behaviour of civil engineering structure subjected to wind, earthquakes or waves, stability and comfort of aeronautical and terrestrial vehicles. Acoustics is also essential in the transportation vehicles for both internal comfort and external noise.
The aim of this course is to provide students with essential knowledge, methods and tools for the analysis and quantification of these phenomena in structural dynamics and acoustics. It will be based on a set of case-studies to illustrate the fundamental concepts of resonance and radiation.

Quarter number

SG6

Prerequisites (in terms of CS courses)

No prerequisites. However, it is recommended to have followed the course of mechanics of continuous media or a course on waves.

Syllabus

1. Dynamic response of an oscillator, principle of vibration reduction (Lecture and tutorial)
2. Mechanical and acoustic waves and resonances (Lecture and tutorial)
3. Vibrations of beams (Lecture and tutorial)
4. Case-study 1: vibration of bridges
5. Construction of reduced Multi-Degree-Of-Freedom models in dynamics (Lecture and tutorial) & reminder on continuum mechanics (self-taught)
6. Case-study 2.1: building under wind and earthquake loads (reduced models)

7. Case-study 2.2 : building under wind and earthquake loads (Finite element models)
8. Introduction to advanced dynamic models (Lecture and tutorial)
9. Acoustic radiation (Lecture and tutorial)
10. Acoustic resonance (Lecture and tutorial)
11. Case-study 3: Analysis of a scientific paper
12. Final exam

Class components (lecture, labs, etc.)

S1-S3, S5, S8-S9 : lectures and tutorials

S4, S6-S7, S11: Case studies

Grading

2-hr written exam (weight 0.55) + Case studies (weight 0.15 each)

Course support, bibliography

Lecture notes +course slides

Resources

Lectures will be given in French and recorded lectures in English will be made available to students.
Tutorial classes: 35 students with at least one in French and one in English.
Software: Comsol Multiphysics and Python notebook

Learning outcomes covered on the course

Completing this course students will be able to:

- model the dynamic behaviour of structures using a relevant model : (3D , beams,...)
-model the acoustic behaviour of an enclosure and the radiation patern of a acoustic source or an open system.
- model transient and random environmental loads (Wind , seism...)
- build a low frequency surrogate model to solve practical vibration or acoustic problems.

Description of the skills acquired at the end of the course

C1.2 Ability to model the dynamic behaviour of a structure

C1.2 Ability to model random external loads (Wind, earthquakes)

C1.2 Ability to model simple acoustic problems

C1.3 Ability to solve vibration and acoustic problems in the low frequency domain using a modal approach, either in the time or in the frequency domain