Continuous media dynamics

In brief

Course langage: French

Presentation

Prerequisites

The 1st year courses in mechanics/mechanics of continuous media are sufficient.

Learning objectives

To continue/expand the training in mechanics of continuous media with emphasis on movements and dynamic phenomena.

In particular:
- To know the basic concepts used by engineers in the field of dynamics, vibrations and acoustics in fluids and solids. On the basis of a series of practical exercises and two basic courses reduced to the essentials, a number of dynamic phenomena, of a vibratory or acoustic nature, which occur in these media are presented and modelled. The course illustrates how engineers use these phenomena in the design, optimisation, monitoring and maintenance of industrial mechanical systems.
- To know the basics and essential properties of turbulence, in order to be able to deal with and model the various practical situations that will arise in S9 or during international mobility courses. Theoretical foundations will be laid to analyse and model the phenomena associated with turbulent flows. This will make students aware that, in nature and industry, flows are essentially turbulent. Dealing with these flows requires specific skills and tools (both analytical and modelling) which are very different from those used for laminar flows (seen in Year 1).

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Description of the programme

For the part on dynamics, vibrations and acoustics, some examples of practical exercises that complement the two class sessions:
- Experimental determination of a vibration mode
- Reconstruction of a motion by modal superposition

- Measurement of the acoustic power of a source
- Measurement of the absorbing properties of materials
- Audio analysis of acoustic signals, levels and sound indicators
- Numerical calculation of structural modes with Abaqus and Matlab (finite element method and Ritz method)

For the part on the introduction to turbulence in fluid mechanics:
Four lecture sessions on:
- Appearance of turbulence, laminar/turbulent transition, need for statistical treatment (Reynolds decomposition)
- Balance equations for mean quantities, Reynolds tensions, kinetic energy of turbulence
- Basic modelling (mixing length, turbulent viscosity), characteristic scales, Kolmogorov spectrum
- Application to the case of mixing of a scalar, turbulent diffusivity, analogy with the random walk (but with length and velocity scales characteristic of the flow and not of the fluid as in the laminar regime)
These four lecture sessions are completed by practical sessions (4 x 2 hr practical sessions), in order to illustrate the notions presented in the lecture by some concrete examples.

Generic central skills and knowledge targeted in the discipline

- C1: Scientific and technical innovation: for example, to prepare for an S8 laboratory internship in one of these fields or for an international academic course in a mechanics-related speciality where these concepts will be covered in much greater depth
- C2: Mastering complexity and systems :
-> Learn to model and analyse a problem, choosing the most relevant method and/or level of modelling (C2)
-> Master the basics of modelling/numerical simulation methods associated with these types of situations in order, for example, to do the 2A course in one of the fields concerned (C2)
-> Know how to interpret experimental results (C2)

How knowledge is tested

- Five graded practical tests (organised in pairs or triples with a mandatory report at the end of each session) (50%)
- A 2-hour written test on turbulence (50%)

Bibliography

Schubert,Kim, "Fundamentals of electronics", Morgan & Claypool publishers, 2013. Floyd, Buchla, « Electronics Fundamentals Circuits, Devices, and Applications », 8th edition, 2014, Pearson. Floyd, « Digital Fundamentals », 11th edition, Pearson, 2015. Larminat , « Commande des systèmes linéaires », Hermes Science publication,1996. Granjon, « Automatique 3ème édition », 2015, Dunod

Teaching team

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Sustainable Development Goal

Quality education

Affordable and clean energy

Descent work and economic growth

Responsible consumption and production

Climate action

Total des heures		**30h**
CM	Master class	12h
TD	Directed work	8h
TP	Practical work	10h

Useful info

Name responsible for EU

Lead Instructor

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