Mechanics

ECTS credits
4 credits

In brief

Course langage: French

Presentation

Learning objectives

To present the concepts and tools of continuum mechanics (CM).

This scientific discipline concerns the study of the motion and deformation of systems under the action of forces. It allows the modelling of most mechanical problems encountered by engineers in applications.

Examples include the analysis of the airflow around a wind turbine blade in order to optimise its performance, the study of the deformation and resistance of these same blades under extreme wind conditions and, finally, the impact of the acoustic nuisance generated by the wind turbine in a nearby environment.

This continuum mechanics course has been designed to support in a coherent way all the advanced mechanics courses of the second and third years of the engineering training. The fundamental concepts of the discipline are presented at the highest level of current knowledge in a unified presentation valid for all macroscopic fluid and solid media.

Because it limits the number of essential notions, this vision is pedagogically efficient, and it best prepares students for the modelling of complex multi-physical and multi-scale mechanical systems.

Description of the programme

The first part of this course is devoted to the general concepts of the discipline:

Algebra and tensor analysis - Fundamental concepts of CM
Deformation of continuous media: deformation tensors

Forces in continuous media: stress tensors
General equations of CM: conservation of mass, fundamental principle of dynamics, first and second principles of thermodynamics

The rest of the course is concerned with three priority applications for an engineer:

1) Linear elasticity

Passage from the general equations of CM to the equations of elasticity
The behavioural relation of a linear elastic solid - Some analytical solutions of elasticity problems
Notions on numerical resolution by finite elements

2) Fluid mechanics

Translation of the general equations of CM for incompressible fluid flows - Behaviour of Newtonian fluids
Solving classical fluid mechanics problems
Hydraulic circuits

3) Linear acoustics

Passage from the general equations of CM to the equations of acoustics
Propagation of acoustic waves, notion of acoustic modes

Generic central skills and knowledge targeted in the discipline

- Mastery of a scientific discipline to create value and innovation
- Ability to understand, formulate and solve a complex multiphysics problem
- Ability to extend the scope of knowledge to other disciplines

How knowledge is tested

1) Continuous assessment: during each of the 14 practical work sessions, a test without documents is carried out:

Either a short test of 3 minutes at the beginning of the session (on 2 points)
Or a long test of 30 minutes at the end of the session (out of 20 points) as a closing test for each block: CM, Elasticity, Fluids, Acoustics.

2) Classic written evaluation (three hours) "without documents" at the end of the module.

Bibliography

- Jean Coirier, Mécanique des milieux continus, 2e édition, Dunod
- Paul Germain, Patrick Muller, Introduction à la Mécanique des milieux continus, 2e édition,Masson

- Paul Germain, Mécanique, Tome I et II, École polytechnique, Ellipse
- Jean Salençon, Mécanique des milieux continus, Tome I et II, École polytechnique

Teaching team

Stéphane Bourgeois, Bruno Cochelin, Thierry Désoyer, Marc Jaeger, Lili Kimmoun, Bruno Lombard, Cédric Maury, Daniel Mazzoni, Emmanuelle Sarrouy, Julien Touboul

Total des heures		**72h**
CM	Master class	26h
TD	Directed work	28h
AA		18h

Useful info

Name responsible for EU

Lead Instructor

Bruno Cochelin

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