

Applied Mechanics - Structures, Aerodynamics and Flight Mechanics

In brief

➤ **Course language:** French

Presentation

Prerequisites

Continuum mechanics, linear elasticity, fluid mechanics

Learning objectives

- To acquire the knowledge necessary to understand structural models (assumptions and application framework), as well as the associated design methods:
 - Know how to model beam-based structures
 - To master the methods of dimensioning in linear elasticity
 - Know how to pose and analyze a problem of beam lattice design in a finite element software
 - Acquire the fundamental notions in aerodynamics:
 - Know the basics of aerodynamics around shaped obstacles
 - Know how to dimension forces on load-bearing profiles
 - Understand the concept of local models in fluid mechanics
 - Acquire the fundamental concepts of meteorology and flight mechanics:
 - Understand the structure of the atmosphere, as well as the genesis of meteorological disturbances
 - Know how to calculate the wind from pressure maps
 - Understand the aerodynamic functioning of an aircraft in flight
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Description of the programme

- Part 1: Structures
 - Reminder of three-dimensional elastodynamics (kinematics, sthenics, Hooke's law, local equations, integral formulations)

- Beam models :
 - Saint Venant principle
 - Kinematic assumptions of Euler-Navier-Bernoulli
 - Establishment of the thin beam model
 - Energy theorems (Ménabréa and Castigliano)
 - Dimensioning
- Part 2: Aerodynamics
 - Recall of incompressible fluid mechanics
 - Potential flows
 - Aerodynamic coefficients
 - Laminar / turbulent boundary layer
- Part 3: Flight mechanics
 - Introduction to meteorology.
 - Structure of the atmosphere and numerical values of the atmosphere
 - Geostrophic and local wind
 - Clouds
 - Fronts and disturbances
 - Mechanics of flight
 - Aerodynamics of a bearing profile
 - Marginal vortices
 - The flaps hypersustentateurs
 - Rudders and controls
 - Straight horizontal flight
 - Climb and descent: slope and rate of climb.
 - Stability of flight

Generic central skills and knowledge targeted in the discipline

- Master modeling tools to validate innovative technological solutions (C1)
- Know how to model and analyze complex structures (C2)
- Master the methods of dimensioning (C2)
- Know how to calculate aerodynamic forces on structures (C2)
- Understand the basics of meteorology (C2)
- Understand the complexity of aircraft flight (C2)

How knowledge is tested

- DS = 2 hour written exam (65%)
- CC = 3 TP CR (35%)

Bibliography

- P. Ballard et A. Millard, Poutres et arcs élastiques, Ed. Ecole Polytechnique, 2009
- I. Paraschivoiu, Subsonic aerodynamics, Ed. Ecole Polytechnique de Montréal, 2003
- P.K. Kundu and I.M. Cohen, Fluid mechanics, Elsevier, 2010
- S. Malardel, Fondamentaux de météorologie, Cépaduès - Météo France, 2008
- S. Bonnet J. Verrière, Mécanique du vol de l'avion léger, Cépaduès, 2006

Teaching team

- Stéphane Bourgeois
- Olivier Boiron
- Lili Kimmoun

Sustainable Development Goal



Building Resilient Infrastructure



Sustainable cities and communities



Responsible consumption and production

Total des heures		30h
CM	Master class	14h
TD	Directed work	8h
TP	Practical work	8h