Applied Mechanics - Structures, Aerodynamics and Flight Mechanics

In brief

Course langage: 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

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