Composites and laminates

ECTS credits
2 credits

Semester
Fall

In brief

Course langage: French

Presentation

Prerequisites

- Continuum mechanics, linear elasticity (see 1st year Mechanics course)
- Beam and plate models (see 3rd year Thin structures and instabilities course)

Learning objectives

- Discover the different types of composite materials and their implementation
- Acquire the methods of calculation of structures in composite materials
- Master the notion of anisotropy in linear elasticity
- Know how to replace a heterogeneous medium by an equivalent homogeneous medium (micro-macro approaches) in a modeling approach
- Master the concepts of modeling laminates (plate models)
- Know how to analyze the failure criteria specific to heterogeneous materials

Description of the programme

- General information on composite materials:
  -- constituents: inclusions, fibres, resins, fabrics
  -- processing: molding, pultrusion, centrifugation, filament winding
  -- finished products: laminates, plates and sandwich beams
- Elastic behavior of heterogeneous media:
  -- notion of representative volume element (RVE) and equivalent homogeneous behavior
  -- characterization of the RVE (random and periodic media) and anisotropic elasticity

-- homogenization methods (Voigt, Reuss, effective moduli, periodic homogenization, estimates and bounds of Hashin and Shtrickman) and implementation in a FE code (Abaqus)
- Failure modes and criteria of laminates (maximum stress, maximum strain, Tsai-Hill, Hoffman, Tsai-Wu)
- Models of laminated and sandwich plates
- Applications to the design of composite structures

Generic central skills and knowledge targeted in the discipline

- Know a range of materials and their potential for different applications
- Use models of heterogeneous materials
- Define simplified models of heterogeneous materials for efficient calculations
- Be able to propose innovative material models

How knowledge is tested

- DS : written evaluation 2 h (75 %)
- CC : Reports on Practical Work (25 %)

Bibliography

- Course slides
- M. Bornert, T. Bretheau et P. Gilormini, Homogénéisation en mécanique des matériaux, tomes 1 et 2, Hermes, 2001
- J.-M. Berthelot, Matériaux composites : comportement mécanique et analyse des structures, Tec&Doc, 1999
- D. Gay, Matériaux composites, Hermes, 1991

Teaching team

Stéphane Bourgeois

Total des heures		**24h**
CM	Master class	16h
TD	Directed work	4h
TP	Practical work	4h

Useful info

Name responsible for EU

Lead Instructor

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