Mécanique des solides et des structures

Lecturer
Philippe BOUILLARD (Coordinator)

Course mnemonic
CNST-H2001

ECTS credits
5 credits

Language(s) of instruction
French

Course period
Second term

Campus
Solbosch

Course content

Section 1: Introduction

0.1 Introduction

0.2 Einstein notational conventions

Section 2: Solid mechanics

I.1 Solid statics (2D and 3D stress tensor, principle stresses)

I.2 Solid kinematics (strain, deformation, principle strains)

I.3 Constitutive equations (Hooke's law, 2D plane states)

I.4 General problem of elasticity

Section 3: Structural mechanics and strength of materials

II.1 Structural safety (limit states, stress and strain analysis)

II.2 Static scheme (statically determined and undetermined structures)

II.3 Structural element: the beam (MNV diagrams)

II.4 Tension/Compression (stresses in cables, ropes, circular vessels and pipes, composite beams, pretension, thermal effects)

II.5 Bending moment (flexural stresses and strains, composite beams, pretension)

II.6 Shear force (shear stresses and strains)

II.7 Oblique bending (flexural stresses and strains) - not included in the exam

II.8 Compound bending (flexural stresses and strains)

II.9 Introduction to torsion (shear stresses and strains) - not included in the exam

II.10 Virtual work and beam deflection (Moh's integrals)

II.11 Testing and advanced constitutive models (von Mises and Tresca yield criteria, creep, fatigue) - not included in the exam

II.12 Plastic tension/compression - not included in the exam

II.13 Plastic bending - not included in the exam

II.14 Buckling (Euler's theory for beams and columns buckling)

Objectives (and/or specific learning outcomes)

By the end of the module, the student should be able to :

1 Describe the structural design process.
2 Identify the structural safety requirements (Eurocodes)
3 Analyse real-life structures.
4 Accurately calculate the beam's structural internal forces
5 Apply the linear elastic models to the beams and recognise their limits.
6 Resolve comprehensive beam dimensioning problems.
7 Describe the non-linear behaviour of the beams.
8 Explain the structural instability concept and apply the Eulerian buckling model.

Pre-requisits and co-requisits

Pre-requisites courses

MECA-H100 | Mécanique rationnelle I | 5 crédits

Co-requisites courses

MATH-H1001 | Eléments d'algèbre et d'analyse | 5 crédits and MATH-H1002 | Analyse I | 5 crédits

Courses having this one as pre-requisit

CNST-H302 | Soil mechanics | 5 crédits, CNST-H303 | Analyse de structures | 5 crédits, CNST-H303 | Analyse de structures | 6 crédits and PROJ-H305 | Projet de conception des structures | 5 crédits

Courses having this one as co-requisit

ARCH-H300 | Projet d'architecture III | 15 crédits, ARCH-Y008 | Form-active structures | 4 crédits, CHIM-H302 | Pollution du milieu physique | 5 crédits and CNST-H311 | Technologie et comportement du béton et des matériaux cimentaires | 5 crédits

Teaching method and learning activities

Lectures and tutorials.

The lectures are based on flipped classes. The student has to prepare the chapter(s) planned beforehand and the lecture is dedicated to discussing the main questions. All material is available on ULB UV. The lecture will be organised physically if possible, online if not.

The tutorials are briefly introduced with theoretical concepts and individually monitored.

Contribution to the teaching profile

This module aims to develop the structural design procedure in a modern approach (Eurocodes).

This module contributes to many programme learning outcomes (available in French only).

References, bibliography and recommended reading

Coirier, J., 1997, 'Mécanique des milieux continus. Concepts de base', Dunod, Paris.

Frey, F., 2000, 'Vol. 2. Analyse des structures et milieux continus. Mécanique des structures', Presses polytechniques et universitaires romandes, Lausanne.

The full reference list is included in the slides.

Course notes

Syllabus and Université virtuelle

Other information

Place(s) of teaching

Solbosch

Contact(s)

BATir Dept., CP 194/2, C Building, level 5, room C-5-206 (Solbosch campus) email: Philippe.Bouillard@ulb.be.

Evaluation method(s)

written examination

written examination

Closed question with multiple choices (MCQ), Open question with short answer and Open question with developed answer

Evaluation method(s) (additional information)

Written exam with two parts: theory (TH) and tutorials (EX).

Determination of the mark (including the weighting of partial marks)

50% TH + 50% EX.

Main language(s) of evaluation

French

Programmes

Programmes proposing this course at the Brussels School of Engineering

BA-IRAR | Bachelor in Engineering : Architecture | unit 2 and BA-IRCI | Bachelor in Engineering Sciences | option Bruxelles/unit 2