# Introduction to material sciences

Crédits ECTS
3 crédits

## En bref

**Langue de cours:** Anglais

# Présentation

## Prérequis

- Fundamental concepts of forces and moments
- Basic principles of static equilibrium
- Undergraduate level knowledge of material constitution (atoms, molecules, ions) and their organization.

## Objectifs d'apprentissage

At the end of this course, students will be able to:

- Understand stress, strain, and material behavior under load
- Analyze simple structures under tension, compression, shear, torsion, and bending
- Evaluate stresses and verify strength conditions
- Understand how the macroscopic properties of materials, in particular mechanical properties, are related to the microscopic, at the atomic level, constituents, bands and arrangements.

## Description du programme

**I- Material Structure and mechanical behavior**

The first part of the course will describe the essential features of material science, from the atomistic and molecular mechanisms to the continuum description of properties of materials. Particular focus will be put on the mechanical behaviour of materials used in biomedical applications: elastic and plastic deformation, creep, and fracture of materials including crystalline and amorphous

metals, ceramics, and (bio)polymers. The course will also address the design and processing of materials from the atomic to the macroscale to achieve a desired mechanical behaviour. Selection methods will be proposed based on both fundamental material science and processing of materials.

**II- Strength of Materials**

This course introduces the fundamental principles of Strength of Materials, focusing on the analysis of stresses, strains, and deformations in solid structures under mechanical loading. The course begins with a short review of mechanical actions, including forces and moments, in order to ensure that all students have the necessary background. It then introduces essential concepts such as stress, strain, and material behavior, with an emphasis on elastic and plastic responses. The theoretical framework is established through classical assumptions (continuity, homogeneity, isotropy, linear elasticity) and basic kinematics of deformation. The concept of internal forces is developed using the method of sections. The course covers the main loading cases encountered in engineering: tension, compression, shear, torsion, and bending. For each case, stress–strain relationships, experimental behavior, and strength conditions are studied. Particular attention is given to beam analysis, including internal forces, equilibrium conditions, and the construction of shear force and bending moment diagrams.

## Bibliographie

R. K. Bansal, Strength of Materials, Fourth Edition

## Equipe pédagogique

Yannick KNAPP (yannick.knapp@univ-avignon.fr)

Amal BECHIKH (amal.bechikh@centrale-med.fr)

| **Total des heures** | | **24h** |
|---|---|---|
| CM | Cours Magistral | 16h |
| TD | Travaux Dirigés | 8h |

# Infos pratiques

## Nom responsable UE

### Responsable pédagogique

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