

MSE-300

Theory of materials: from structures to properties

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Cursus	Sem.	Type
Materials Science and Engineering	BA6	Obl.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	3 weekly
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

Macroscopic properties of solids are analysed using symmetry arguments, tensors, thermodynamics, and simple phenomenological models.

Content

1. The tools and formalism of phenomenological descriptions: symmetry, tensors, and thermodynamics
2. Description of practically important macroscopic properties (in the equilibrium state): dielectric response, elasticity, piezoelectricity, pyroelectricity, thermal dilatation and others
3. Description of dynamic equilibrium properties and transport properties: dielectric relaxation, electrical conductivity, heat conductivity, and thermoelectric phenomena
4. Use of simple phenomenological models for analysis of properties (such as Landau theory of structural phase transitions)
5. Application-relevant problems that require analysis of anisotropic properties of solids

Keywords

symmetry, tensors, anisotropy, thermodynamics

Learning Prerequisites**Required courses**

No obligatory courses: the introduction covering mathematics and physics used in the course will be provided

Strongly recommended: basics of crystallography; general physics: thermodynamics, electrostatics; basics of linear algebra

Recommended courses**Learning Outcomes**

By the end of the course, the student must be able to:

- Apply the symmetry arguments, tensors and thermodynamics for a description of the physical properties of materials.

Teaching methods

Ex cathedra and exercises

Assessment methods

Midterm test + exam during the exam session

Resources

Ressources en bibliothèque

- [Physical properties of crystals / Nye](#)
- [Introduction to solid state physics / Kittel](#)