

PHYS-307

**Physics of materials**

La Grange Thomas

Cursus	Sem.	Type
Ing.-phys	MA1, MA3	Opt.
Physicien	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Lecture	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

This course illustrates some selected chapters of materials physics needed to understand the mechanical and structural properties of solids. This course deals primarily with the physics of dislocation. The course also links diffusion kinetics to the fundamental physics of phase transformations.

**Content****1. Materials, definitions, structure**

Binding energy in metals, ceramics and polymers. Crystal structure and amorphous materials. Theory of elasticity: stress and strain fields.

**2. Diffusion**

Diffusion in alloys. Physical and chemical diffusion.

**3. Plastic deformation and dislocations**

Phenomenology. Deformation of single crystals. Burgers' vector. Elasticity theory: interactions among dislocations. Creation and annihilation of dislocations.

**4. Dislocation dynamics**

Friction forces due to the lattice, to point defects and to dislocations. Movement equations. Partial dislocations and stacking faults. Dissociation mechanisms: dislocations in face centred cubic metals.

**5. Dislocation kinetics**

Thermal activation of plastic deformation. Dislocation climb. Deformation tests. Relaxation phenomena and mechanical spectroscopy.

**6. Thermodynamics of phase transformations**

Thermodynamical principles of phase transformations. Phase diagrams. Alloy solidification. Solid-solid phase transformations.

**Keywords**

dislocations, deformation, diffusion, elasticity, phase transformations, melting, precipitation crystallography

**Learning Prerequisites****Recommended courses**

linear algebra I,II  
analysis III, IV  
physics I,II

**Learning Outcomes**

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

- Develop the formalism of dislocation theory
- Model the plastic deformation of materials
- Sketch a phase diagram and its thermodynamic basis

### **Transversal skills**

- Use a work methodology appropriate to the task.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.

### **Teaching methods**

Oral Lectures and exercises in the classroom. Lecture, exercise and reference materials will be made available on a Moodle. A questions and answer forum is also available on the moodle. Additionally, zoom meeting or in-classroom session will be arranged for exam preparation

### **Assessment methods**

Oral exam in English

### **Resources**

#### **Moodle Link**

- <https://go.epfl.ch/PHYS-307>

### **Prerequisite for**

Physics of new materials