Bachelor in Physics
(Academic Year 2022-23)

Materials Physics		Code	800510	Year	3rd	Sem.	1st
Module	Applied Physics	Topic	Applied Physics-Compulsory	Character	Optative		

	Total	Theory	Exercises
ECTS Credits	6	4.2	1.8
Semester hours	45	31	14

Learning Objectives (according to the Degree's Verification Document)

- Know the structure and the main physical properties of materials.
- Be able to recognize and establish the basic relationships between the microstructure and physical properties of materials.
- Know the possibilities of controlling the properties of materials through their design.
- Acquire the basic notions about the applications of different types of materials.

Brief description of contents

Crystals, disordered and amorphous solids; structure and physical properties of materials; alloys; preparation of materials; nanomaterials; materials in micro- and nanoelectronics; Ceramic materials.

Prerequisites

Coordinator	Ana Irene Urbieta Quiroga		Dept.	FM
	Office	105	e-mail	anaur@fis.ucm.es

Theory/Exercises – Schedule and Teaching Staff

Group	Lecture Room	Day	Time	Professor	Period/ Dates	Hours	T/E	Dept.
B	4ª	Tu, Th	14:00-15:30	Paloma Fernández Sánchez	First Semester	45	T/P/S	FM

T: Theory, E: Exercises

Office hours

Group	Professor	Schedule	E-mail	Location
B	Paloma Fernández Sánchez	M, X, J. 11:00-13.00	arana@ucm.es	Room 115, second floor, East

Syllabus

1. Crystals, disordered and amorphous solids. Short and long-range structural order. Single-, poly- and nanocrystalline materials. Crystalline materials: crystal systems and lattices. Cohesion: primary and secondary bonds. Micro- and nanostructures. Real crystals: defects, surface, diffusion processes.

2. Structure and physical properties of materials. Relationship between structure and properties. Metals, ceramics, semiconductors, polymers and soft matter, composites. Preparation and design of materials. Phase transformations.

3. Mechanical properties. Elasticity, anelasticity, plasticity. Hardening. Degradation mechanics. Properties at the nanoscale.

4. Electrical properties. Electronic conduction: metals and semiconductors. Ionic conduction. Dielectrics (ferro- and piezoelectricity). Nanostructures and quantum confinement. Materials in micro- and nanoelectronics.

5. Optical properties. Light absorption and emission. Photoconductivity. Nanostructures in optoelectronic devices.

6. Magnetic properties. Origin of magnetism. Dia- and paramagnetism. Hard and soft magnets. Magnetic nanostructures.

7. Thermal properties. Thermal expansion and conductivity. Thermoelectric effect, generation of heat and cooling.

Bibliography

Basic

- "Understanding solids. The Science of Materials". Richard Tilley, Wiley, 2004
- "The science and engineering of materials" D. Askeland, W. Wright. Cengage Learning has currently 4 similar titles available as both e-book paper (https://www.cengage.co.uk/search/?keyword=askeland)
- "Materials Science and engineering", W. D. Callister and D.G. Rethwisch, Wiley, 2020

Advanced

- "Introduction to Soft Matter", Ian W. Hamley, Wiley (2000)
- "Nanomaterials: An Introduction to Synthesis, Properties and Applications", Dieter Vollath, Wiley, 2008

Online Resources

Campus virtual and professor´s web page piloto.fis.ucm.es/paloma and links therein

Methodology

Lectures to explain the fundamental concepts that will include examples and applications. For these classes, computer projection will be used fundamentally. The students will have the material used in class well in advance. A flipped classroom methodology will be applied.

Practical classes to solve exercises and collaborative work. The work performed during these sessions will be a part of the evaluation.

Evaluation Criteria

Exams	Weight:	70%

The exam will consist of a series of theoretical and practical questions (of a similar level to those solved in class).

The use of books will not be allowed.

Other Activities	Weight:	30%

In this group, the exercises carried out in class and participation in classes will be taken into account. Since the methodology used will contain different gamification elements, these will also be considered for evaluation.

Final Mark

Final mark will be NFinal=0.7NExam+0.3NOtherActiv, where NExam and NOtherActiv are (from 0 to 10) the marks obtained in the two previous sections.

The mark in the extraordinary call will be obtained exactly with the same evaluation procedure.