Bachelor in Physics
(Academic Year **2021-22**)

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	43	30	13

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	Paloma Fernández Sánchez		**Dept.**	FM
	Office	115	**e-mail**	arana@ucm.es

Theory/Exercises – Schedule and Teaching Staff

Group	Lecture Room	Day	Time	Professor	Period/ Dates	Hours	T/E	Dept.
B	**5**	Tu, Th	14:00-15:30	Paloma Fernández Sánchez	First Semester	43	T/P/S	FM

T: Theory, E: Exercises

Office hours

Group	Professor	Schedule	E-mail	Location
B	Paloma Fernández Sánchez	Mo-Wed-Fr: 9:30-11:30	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

On-campus teaching 100% (Scenario 0)

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.

Semi-online teaching (Scenario 1)

Modality B. Face-to-face classes will be dedicated to problem solving, practical cases, group work, etc., repeating these activities for each subgroup. Previously, the necessary material to understand the theory will be provided to the students in the corresponding learning platform.

Online teaching (Scenario 2)
Videos, notes, slides, articles and bibliographic material will be added to Moodle so that students can develop the skills required to pass the subject. In addition to the material provided in Moodle asynchronously, one or two online sessions per week will be scheduled so that students can exchange ideas both with the teacher and with each other and solve doubts. The topics to be developed during that week will be previously notified by email to the students in order to take better advantage of these sessions. Students must send through the learning platform or by mail the deliverable tasks that will be considered for evaluation. Most of these tasks will be done in a group.

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.		