# Course guide
# 230485 - ADMAT - Advanced Materials

**Last modified:** 25/05/2023

**Unit in charge:** Barcelona School of Telecommunications Engineering
**Teaching unit:** 713 - EQ - Department of Chemical Engineering.

**Degree:** BACHELOR'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2011). (Optional subject).

**Academic year:** 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, English

## LECTURER

**Coordinating lecturer:** Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura

**Others:** Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

**Specific:**
FQES2. Knowledge of the interactions at different matter scales. Ability to analyze functional capabilities of physical systems at various scales.
FQES3. Knowledge of structural and functional applications of materials. Knowledge of the physical systems of low dimensionality. Ability to identify systems and/or materials suitable for different engineering applications.

**Generical:**
3. ABILITY TO IDENTIFY, FORMULATE, AND SOLVE PHYSICAL ENGINEERING PROBLEMS. Planning and solving physical engineering problems with initiative, making decisions and with creativity. Developing methods of analysis and problem solving in a systematic and creative way.

**Transversal:**
1. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
2. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
4. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

## TEACHING METHODOLOGY

Classes are divided into three categories: lectures, laboratory practical classes and discussion classes, in which the work done by the students is analyzed and discussed.

## LEARNING OBJECTIVES OF THE SUBJECT

Learn the basics about advanced materials with high performance technology and biotechnology. Acquire the theoretical foundations for understanding and design hybrid systems based on the combination of materials of different chemical nature. Learning to thinking about structure- properties relationships. Learn the patterns of reasoning that are applied at the level of research on advanced materials.

## STUDY LOAD

| Type | Hours | Percentage |
|---|---|---|
| Hours large group | 52,0 | 34.67 |
| Hours small group | 13,0 | 8.67 |
| Self study | 85,0 | 56.67 |

**Total learning time:** 150 h

## CONTENTS

### 1. Advanced ceramics

**Description:**
Advanced inorganic materials: concepts and applications. Functionalization of inorganic surfaces. Functionalized surfaces applied to Biotechnology, Biomedicine and Environmental Engineering. Porous ceramics: porous glasses. Nanostructured ceramics and their applications in Nanotechnology.

**Full-or-part-time:** 8h
Theory classes: 6h 30m
Guided activities: 1h 30m

### 2. Biominerals

**Description:**
Mineralization of biomolecules. Templating of minerals using biomolecules. Adsorption of biomolecules on inorganic surfaces. Encapsulation of biomolecules in inorganic minerals. Biomedical and biotechnological applications of biominerals: Transfection and tissue engineering.

**Full-or-part-time:** 7h 30m
Theory classes: 7h 30m

### 3. Advanced polymers and biopolymers

**Description:**
Biodegradable polymers. Shape memory effects in polymers. Biomedical applications of biodegradable polymers. Hydrogels. Nanoparticles and nanocapsules. Controlled drug delivery using advanced polymers.

**Full-or-part-time:** 9h 30m
Theory classes: 7h 30m
Laboratory classes: 2h

### 4. Nanofibers

**Description:**
Materials for the fabrication of nanofibers. Preparation of nanofibers. Functionalization of nanofibers. Applications of nanofibers.

**Full-or-part-time:** 9h 30m
Theory classes: 7h 30m
Laboratory classes: 2h

### 5. Ultra-thin membranes

**Description:**
Materials for the fabrication of ultra-thin membranes. Preparation of ultra-thin membranes. Giant free-standing nanomembranes. Functionalization of ultra-thin membranes. Applications of ultra-thin membranes in Electronics and Biomedicine.

**Full-or-part-time:** 9h 30m
Theory classes: 7h 30m
Laboratory classes: 2h

### 6. Self-Assembled Materials

**Description:**
Formation of new materials by self-assembly. Energetics and conditions for the self-assembly process. Self-assembled nanostructures. Applications of self-assembled materials: hydrogels and drug delivery systems.

**Full-or-part-time:** 9h 30m
Theory classes: 8h
Guided activities: 1h 30m

### 7. Dendrimers and dendronized polymers

**Description:**
Dendrimers and dendrons: Concepts and preparation. Synthesis and design of dendronized polymers. Functionalization of dendrimers and dendronized polymers. Molecular objects. Applications of dendrimers and dendronized polymers in Electronics and Biomedicine.

**Full-or-part-time:** 6h 30m
Theory classes: 6h 30m

### 8. Advanced metals

**Description:**
Fabrication, processing and applications of advanced alloys. Porous metals. Functionalization of metallic surfaces and advanced treatments for corrosion protection. Fabrication of metallic nanoparticles and their applications. Biometallic materials.Fabrication, processing and applications of advanced alloys. Porous metals. Functionalization of metallic surfaces and advanced treatments for corrosion protection. Fabrication of metallic nanoparticles and their applications. Biometallic materials.

**Full-or-part-time:** 6h
Theory classes: 4h
Laboratory classes: 2h

## GRADING SYSTEM

NC= 0.15NL + 0.15NT + 0.20ND + 0.50NE
Where NC is the course mark, NL is the laboratory mark, NT is the mark of the work done during the course, ND is the mark from the discussion classes and NE is the final exam mark.

## EXAMINATION RULES.

Laboratory: it is mandatory to attend 80% of practices corresponding and deliver questionnaires within established classes.
Jobs: NT is the average of the ratings associated with different work during the course.
Discussion: ND depends on the quality of the discussion provoked by each student in the different works, both in terms of questions and answers.
Final examination: it consists of several theoretical and practical questions related with the topics explained along the course.

## BIBLIOGRAPHY

**Basic:**
- Migliaresi, C.; Motta, A. Scaffolds in tissue engineering: biological design, materials, and fabrication [on line]. Boca Raton, FL: CRC Press, 2014 [Consultation: 15/04/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=1579433. ISBN 9789814463218.
- Pethrick, R.A. Polymer structure characterization: from nano to macro organization in small molecules and polymers. 2a ed. Royal Society of Chemistry Publishing, 2014. ISBN 978-1-84973-433-2.
- Halary, J.L.; Lauprêtre, F.; Monnerie, L. Polymer materials: macroscopic properties and molecular interpretations [on line]. Hoboken, NJ: John Willey & Sons, 2011 [Consultation: 15/04/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=700534. ISBN 9780470922019.

## RESOURCES

**Audiovisual material:**
- Nom recurs. Suitable bibliographic resources will be provided for each lesson through the ATENEA electronic system.