

Course guide

240IMA11 - 240IMA11 - Biomaterials

Last modified: 16/05/2023

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 702 - CEM - Department of Materials Science and Engineering.

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).
 MASTER'S DEGREE IN NEUROENGINEERING AND REHABILITATION (Syllabus 2020). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 4.5 **Languages:** English

LECTURER

Coordinating lecturer: MARTA PEGUEROLES NEYRA

Others: MARTA PEGUEROLES NEYRA
 MONTSERRAT ESPAÑOL PONS

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
 CEEBIO2. Design and develop biomaterials for medical applications, with therapeutic purposes or diagnosis, able to substitute and/or regenerate the living tissues, whether by themselves or integrated in complex devices.

TEACHING METHODOLOGY

Sessions will be taught in a theory, practical cases and laboratory practices format in which the subject's specific competencies will be introduced. Present directed activities to work on spoken and written communication and team work will take place. Autonomous learning and the solvent use of information resources by means of non-presence directed activities will also be encouraged.

LEARNING OBJECTIVES OF THE SUBJECT

The course presents the study of biomaterials and materials for medical applications, designed to substitute and/or regenerate living tissues, with therapeutic or diagnostic aims. We review the different types of biomaterials, their characteristics and the interactions between biomaterials and the host organism. We also describe the techniques to assess the biocompatibility of materials.

The specific objectives are:

- To become familiar with common characteristics and distinctive features of different types of materials used in medicine and rehabilitation.
- To know the basic principles of biocompatibility of materials for medical applications.
- To identify the basic criteria that must be met for a material to be implanted in the human body.
- Understanding the biological principles that affect the body's interactions with biomaterials receptor (receptor response in the body) and relate them to the service behavior of biomaterial (biomaterial response and degradation).
- Biomaterials applied to neuroengineering and rehabilitation

STUDY LOAD

Type	Hours	Percentage
Hours large group	36,0	32.00
Hours small group	4,5	4.00
Self study	72,0	64.00

Total learning time: 112.5 h

CONTENTS

T1. Introduction

Description:

- Types of materials, concept of biomaterial
- Historical evolution of biomaterials
- Biocompatibility

Related activities:

Participative lecture

Full-or-part-time: 4h

Theory classes: 2h

Self study : 2h

T2. Interactions host-biomaterial

Description:

- Biological response of the host organism to biomaterials, biocompatibility.
- Cells and extracellular matrix
- Tests to evaluate in vitro biocompatibility ISO 10993, cytotoxicity
- Bacteria, in vitro evaluation
- Thrombogenicity, in vitro evaluation

Related activities:

Participative lecture

Full-or-part-time: 16h 10m

Theory classes: 4h 30m

Self study : 11h 40m

T3. Hard biological tissues

Description:

- Bone: constitution, structure and properties.
- Bone cells: osteoblasts, osteoclasts, osteocytes
- Bone formation and bone diseases

Related activities:

Participative lectures

Laboratory sessions

Full-or-part-time: 19h 10m

Theory classes: 4h 30m

Laboratory classes: 3h

Self study : 11h 40m

T4. Metallic biomaterials

Description:

- Metallic biomaterials, basic concepts
- Stainless steel, titanium c.p., titanium alloys, cobalt alloys, shape memory alloys: characteristics, properties and applications.
- Surface modifications: physical, inorganic chemistry, functionalization of biomolecules

Full-or-part-time: 20h 10m

Theory classes: 5h 30m

Laboratory classes: 3h

Self study : 11h 40m

T5. Polymeric biomaterials

Description:

- Soft biological tissues
- Polymeric materials: natural polymers, stable polymers, biodegradable polymers and hydrogels
- Mechanisms of degradation and medical applications
- Hydrogels and drug release, applications in neuroengineering

Related activities:

Participative lectures

Laboratory session

Full-or-part-time: 19h 10m

Theory classes: 4h 30m

Laboratory classes: 3h

Self study : 11h 40m

T6. Composite materials

Description:

- Nervous system
- Neurological disorders or injuries
- Composites materials for applications in physical medicine and rehabilitation.

Full-or-part-time: 16h 10m

Theory classes: 3h

Laboratory classes: 1h 30m

Self study : 11h 40m

T7. Bioceramics materials

Description:

- Ceramic materials: inert, bioactive and reabsorbable ceramics.
- Calcium phosphate ceramics
- Composite materials
- Applications in orthopedic surgery and traumatology. Applications in Dentistry.

Related activities:

Cooperative learning: group work
Oral presentation of the work

Full-or-part-time: 17h 40m

Theory classes: 3h
Laboratory classes: 3h
Self study : 11h 40m

GRADING SYSTEM

A student's grade will be:

Final Mark= $0,3 \cdot \text{Final Exam} + 0,3 \cdot \text{Midterm Exam} + 0,2 \cdot \text{Lab Practices} + 0,2 \cdot \text{Exercices}$

BIBLIOGRAPHY

Basic:

- Vallet Regi, María; Munuera, Luis. Biomateriales aquí y ahora. Madrid: Dykinson, cop. 2000. ISBN 8481556750.
- Ratner, Buddy D. Biomaterials science : an introduction to materials in medicine. 3rd ed. Amsterdam: Elsevier Academic, 2013. ISBN 9780123746269.

RESOURCES

Other resources:

Teaching material available in Atenea.