BIOENG-460

Biomaterials and tissue engineering

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Cursus	Sem.	Type
Biomedical technologies minor	E	Opt.
Biotechnology minor	E	Opt.
Life Sciences Engineering	MA2, MA4	Opt.
Neuroprosthetics minor	E	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

This course covers the fundamental concepts of the design, function and application of state-of-the-art biomaterials, and an overview of how engineering approaches can be used to investigate and manipulate cell and tissue functions.

Content

Introduction

Part I: Biological fundamentals
Cells, extracellular matrices and tissues
Proteins and protein adsorption, immunological aspects of biomaterials

Part II: Biomaterials classes
Biomaterials for devices, structural and chemically degradable biomaterials
Micro- and nanoparticles
Extracellular matrix-mimicking biomaterials
Hydrogels as biomaterials
Self-assembly and supramolecular biomaterials

Part III: Emerging design and applications of biomaterials
Tailoring materials for stem cell biology
Biomaterials for neuroengineering
Biomaterials in medical devices
Macro-materials for tissue engineering
Micro-/nano-materials for drug delivery

Part IV: Specific topics
Immune tissue engineering
Soft tissue engineering (skin)
Airway tissue engineering
Tissue engineering for cancer
Organoids

Part V: Presentations of group projects

Learning Prerequisites

Required courses

None.

Recommended courses

BIOEING-399 Immunoengineering
BIOENG-315 Materials science for bioengineers

Important concepts to start the course

This class requires a basic knowledge in biology, physics, chemistry, and materials science.

Learning Outcomes

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

- Elaborate key effectors and their functions driving protein- and cell-materials interactions
- Formulate the basics of inflammation induced by materials in the body
- Elaborate the basics of stem cell function and tissue regeneration, and how materials can influence regeneration
- Systematize the different general applications of biomaterials
- Contextualise specific examples of biomaterials on the basis of application and understands their selection criteria
- Judge the suitability of a material for a certain application based on structure-property relationships
- Formalize the key concepts in the molecular engineering of bioactivity and bioresponsiveness

Transversal skills

- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Make an oral presentation.
- Demonstrate a capacity for creativity.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Communicate effectively, being understood, including across different languages and cultures.
- Use a work methodology appropriate to the task.
- Set objectives and design an action plan to reach those objectives.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.

Teaching methods

Lectures integrated with exercises
Group case study

Assessment methods

Group project: 40%
Final written exam: 60%

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes