UNIVERSITY of NICOSIA

Course Code	Course Title	ECTS Credits
MENG-422	Biomaterials	6
Department	**Semester**	**Prerequisites**
Engineering	Fall, Spring	MENG-270
Type of Course	**Field**	**Language of Instruction**
Elective	Engineering	English
Level of Course	**Year of Study**	**Lecturer(s)**
1st Cycle	4th	Dr Ernestos Sarris
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	None

Objectives of the Course:

The main objectives of the course are to:

- Introduce students to the properties of biomaterials and the fundamentals of biomaterial mechanics and engineering design
- Discuss the characteristics, advantages and disadvantages of important types of materials and alloys used as implants in bioengineering
- Explain important concepts on biocompatibility and practical aspects regarding corrosion, mechanical durability, failure due to fatigue or fracture, friction, lubrication and wear

Learning Outcomes:

After completion of the course students are expected to:

- Demonstrate knowledge of the basic principles and fundamental properties of biomaterials
- Identify advantages and disadvantages of different biomaterials – natural or alloys – and make judicious choices on their selection depending on the application and objectives sought
- Design implants using different types of biomaterials based on analytical and computational tools
- Assess the mechanical condition and durability of implants taking into account interactions with biological cells, possible mechanical failures and fatigue
- Apply fundamental knowledge and design processes to several applications including orthopedics implants, cardiovascular devices, etc.

Course Contents:

- Introduction to biomaterials
- Types of bonds in biomaterials (ionic, metallic, covalent, etc.)
- Types of biomaterials (ceramics, metals, polymers, composites)
- Impact and future of biomaterials
- Natural biomaterials

- Mechanical properties of materials (tensile/compressive/shear/bend/flexural tests)
- Electrochemical properties (e.g. corrosion)
- Biocompatibility and material selection for implant design
- Sterilization of biomedical implants
- Structure and properties of metals for medical implants (e.g. titanium and its alloys, stainless steel, cobalt-chromium alloys, etc.)
- Structure and properties of polymers (molecular structure, types of polymerization, physical states of polymers, common polymeric biomaterials, hydrogels, etc.)
- Ceramics (general properties, classifications, bioceramics, etc.)
- Mechanical behavior of structural tissue
- Elasticity
- Viscoelasticity
- Failure theories
- Fracture mechanics and fatigue
- Friction, lubrication, and wear
- Case studies (orthopedics, cardiovascular devices, oral and maxillofacial devices, soft tissue replacements)

Learning Activities and Teaching Methods:

Lectures, demonstration videos, in-class examples, in-class exercises

Assessment Methods:

Homework, midterm exams, final exam.

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Lisa A. Pruitt and Ayyana M. Chakravantula	Mechanics of Biomaterials: Fundamental principles of implant design	Cambridge University Press, 1st edition	2011	978-0521762212

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani	Introduction to Biomaterials: Basic Theory with Engineering Applications	Cambridge University Press, 1st edition	2013	978-0521116909
Buddy Ratner, Alan S. Hoffman, Frederick J. Schoen, Jack E. Lemons	Biomaterial Science: An introduction to materials in medicine	Academic Press, 3rd edition	2012	978-0123746269