UNIVERSITY of NICOSIA

Course Code	Course Title	ECTS Credits
MENG-420	Biomechanics	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 Constantinos Hadjistassou
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 biomedical engineering and biomechanics;
- Overview of anatomy, physiology and cellular organisation;
- Outline the domains of biosolid and biofluid mechanics;
- Explain the concepts of stress, strain and equilibrium;
- Analyse skeletal biomechanics and muscle movement;
- Present the fundamentals of haemodynamics and the circulatory system;
- Give the basics of the respiratory system, kidney functions and brain biomechanics;
- Acquaint attendees with torsion and viscoelasticity;
- Give the common governing equations in cardiovascular dynamics;
- Provide applications of engineering solutions to health ailments;
- Explain the basics of physiological modelling and biotransport phenomena;
- Applications of biomedical sensors, signal processing and tissue engineering.

Learning Outcomes:

Upon completion of the course students are expected to:

- Appreciate the roles of biomedical engineering and biomechanics;
- Know the anatomical units, the physiology and cellular organization of animate life;
- Become familiar with principles of biosolid and biofluid mechanics;
- Calculate the stress, strains and equilibria of body motions;
- Obtain engineering solution to skeletal biomechanics involving muscle movement
- Apply equations of flow to understand blood flow;
- Familiarize themselves with the functions of the respiratory and circulatory systems;
- Know the tasks accomplished by the kidneys and features of brain biomechanics
- Solve problems associated with torsion and viscoelasticity;

- Be able to explain blood rheology and cardiovascular dynamics;
- Appreciate real world health-care applications of biomechanics;
- Have a clear idea of physiological modelling tools associated with biotransport processes;
- Know the uses of biomedical sensors, signal processing and tissue engineering.

Course Contents:

Course syllabus comprises:

- Modern health care systems and roles of biomedical engineers;
- Cellular organisation, types of tissue, muscular system, nervous system, skeletal system;
- Material stress, strength, fracture mechanics, elongation, strain, stresses in fluids;
- Cartilages, tendons, ligaments, muscles, lubrication of joints;
- Fluid mechanics of blood flow, continuity and Navier-Stokes equations, non-Newtonian mechanics;
- Oxygen and carbon dioxide exchange, heat transfer, diffusion and convection, tissue metabolism, nutrient delivery and waste product removal;
- Functions of kidneys, pH homeostasis, organic molecule removal, brain biomechanics, cerebral blood flow;
- Deformation of biological tissue, shear stresses due to torsion, viscoelasticity;
- Applications of biomechanics: vessel stenosis, atherosclerotic plaques, aneurysms, *f*MRI;
- Multi-scale biomedical modelling, computational fluid dynamics, visualisation and validation;
- Applications of biomedical sensors, signal processing and tissue engineering.

Learning Activities and Teaching Methods:

Lectures, in-class exercises, examples

Assessment Methods:

Problem sheets, simulation exercise, mid-term, final exam

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Humphrey J.D. & Delange S.L.	An Introduction to Biomechanics: Solids And Fluids, Analysis And Design	Springer	2015	978-1-4939-2623-7

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Ethier C. R. & Simmons C. A.	Introductory Biomechanics: From Cells To Organisms	Cambridge University Press	2007	978-0-511-27360-5

Enderle J.D., Blanchard S.M. & Bronzino J. D.	Introduction to biomedical engineering, 3rd ed.	Academic press	2012	978-0-12-374979-6