Course Code	Course Title	ECTS Credits
MED-101	Physics in Medicine I	6
School	**Semester**	**Prerequisites**
Medical School	Fall (Semester 1)	None
Type of Course	**Field**	**Language of Instruction**
Required	Medicine	English
Level of Course	**Year of Study**	**Lecturer(s)**
Undergraduate	1st	Dr Constantinos Zervides
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	None

General Objectives of the Course:

The main objectives of the course are:

- To give students an introduction to physics of the human body.
- To cultivate an appreciation of the importance of physics in medicine.
- To assist students in the development of strong problem-solving skills.
- To help students cultivate critical thinking in their approach to learning.
- To help clarify physical principles through experimentation.

Learning Outcomes:

The following list provides the learning objectives that will be covered in the lectures, lab practical sessions and tutorials of each week:

Week 1

LOBs covered during lectures:

Introduction

Week 2

LOBs covered during lectures:

1. Describe the concepts of force, pressure, torque and equilibrium.
2. Explain motion in one plane and levers.
3. Investigate statics in the body.
4. Explain the sense of touch.
5. Analyse the kinematics, dynamics and energetics of human motion.
6. Outline body stability and skeletal muscles action.
7. Discuss the overall and local stability of the body.
8. Analyse standing starts, walking, running and jumping.
9. Investigate body collisions to understand body motion and action.
10. Classify the types of locomotion of human motion.

Week 3

LOBs covered during lectures:

11. Describe stress, strain and fracture of body materials and parts.
12. Explain the performance of the human body under normal and extraordinary conditions.

13. Describe harmonic and non-harmonic elastic behaviour.
14. Discuss time-independent material models.
15. Use time-dependant viscoelastic models to characterise and describe stress-strain relations of body materials.
16. Discuss the different models of bone fractures.

Tutorial (all groups):
Review of topics covered in weeks 1 & 2.

Week 4

LOBs covered during lectures:

17. Discuss conservation of energy and heat flow.
18. Analyse the models of body heat loss.
19. Explain the link between different body heat loss models and body temperature.

LOBs covered during lab practical (all groups):

20. Investigate heat transfer by radiation.
21. Investigate heat transfer by conduction.
22. Investigate heat transfer by convection.

Week 5

LOBs covered during lectures:

23. Measure pressure in the human body.
24. State the law of Laplace and apply it to the circulatory system.
25. State the continuity equation and apply it to the circulatory system.
26. State Bernoulli's equation and one of its applications in medicine.
27. Apply Poiseuille's equation to flow in tubes.
28. Examine blood pressure variations along arteries, veins and capillaries.
29. Investigate the consequences of non-uniformities in arteries.

Tutorial (all groups):
Review of topics covered in week 3 & 4.

Midterm Exam

Week 6

LOBs covered during lectures:

30. Describe flow in the circulation system using models.
31. Examine normal and abnormal conditions of the circulation system using models.

Tutorial (all groups):
Review of topics covered in week 5.

Week 7

LOBs covered during lectures:

32. Analyse volume, pressure and air flow during breathing using models.
33. Outline the physical nature of lung operating units, i.e. alveoli.
34. Describe the physical consequences of a diseased lung using models.

Tutorial (all groups):

Review of topics covered in week 6.

Week 8

No lectures or practicals completed during this week.

Week 9

LOBs covered during lectures:

35. Describe the properties of sound waves.
36. Describe how sound is produced in speech.
37. Characterise the human voice.
38. Outline sound propagation in the outer and middle ear.
39. Explain how nerve signals are generated in the inner ear.
40. Explain how the cornea and crystalline lens image light on the retina.
41. Develop models of lens systems.

Week 10

LOBs covered during lectures:

42. Develop optical models of the eye.
43. Link image formation and eye properties to vision and visual perception.
44. Outline the physics of the perception of colour.
45. Explain the importance of electrical conduction for the human body.
46. Describe the propagation of electrical signals in the nerves.
47. Describe the physics of cell membranes in regards to electrical processes.
48. Analyse the electrical properties of the heart.
49. Analyse the electrical signals of the brain.
50. Discuss the importance of body electrical signals to diagnosis.

Week 11

LOBs covered during lectures:

51. Outline feedback and control in the body.
52. Describe how high blood pressure is controlled in the body.
53. Describe how temperature is regulated in the body.

Tutorial (all groups):

Review of topics covered in weeks 7 - 9.

Week 12
LOBs covered during lectures:
-Review Session

Course Contents:

Lecture Topics:

- Statics of the body.
- Kinematics, standing and walking.
- Running and jumping.
- Collisions of the human body.
- Elastic properties of the body.
- Viscoelasticity.
- Bone fractures.
- Conservation of energy and heat flow.
- Loss of body heat.
- Body temperature.
- Characteristic pressures in the body.
- Basic physics of pressure and flow of fluids.
- Pressure and flow in the body.
- Physics of the circulation system.
- Modelling the circulatory system and the heart.
- The physics of the alveoli and breathing.
- Volume of the lungs.
- Breathing under usual and unusual conditions.
- The physics of sound waves.
- Speech production.
- Hearing and other vibrations in the body.
- Focusing and imaging with lenses.
- Imaging and detection by the eye.
- Electrical properties of body tissue.
- Nerve conduction.
- Electrical properties and signals of the heart and the brain.
- Basics of feedback and control.
- Regulation of temperature and control of blood pressure.

Laboratory Experiments and Demonstrations:

- Heat and thermodynamics.

Learning Activities and Teaching Methods:

Lectures, Tutorials, Laboratory Practical Sessions.

Assessment Methods:

Laboratory report (10%), Midterm Exam (30%), and Final Exam (60%). Assessment is by Single Best Answers (SBAs) and Short Answer Questions (SAQs).

Required Textbooks/Reading:

Authors	Title	Edition	Publisher	Year	ISBN
I.P. Herman	Physics of the Human Body	2nd Edition	Springer	2016	9783319239309

Recommended Textbooks/Reading:

Authors	Title	Edition	Publisher	Year	ISBN
R.K.Hobbie and B.J.Roth	Intermediate Physics for Medicine and Biology	5th Edition	Springer	2015	9783319126814
P. Davidovits	Physics in Biology and Medicine	4th Edition	Academic Press	2012	9780763730406
K. Franklin, P. Muir, T. Scott, L. Wilcocks, P. Yates and G. Carrington	Introduction to Biological Physics for the Health and Life Sciences	2nd Edition	John Wiley & Sons	2010	9780470665930
J. Newman	Physics of the life sciences	1st Edition	Springer	2008	9780387772585