Course Code	Course Title	ECTS Credits
MED-103	**Biology 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 Christiana Charalambous
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	None

General Objectives of the Course:

This course is the first part of a two parts course in General Biology. The main objectives of the course are:

- To make students aware of the diversity/complexity of organisms, the major categories of biological molecules and their basic functions.
- To describe the structure-function of cell organelles and demonstrate the differences between prokaryotic and eukaryotic cells.
- To demonstrate the energy requirements of organisms through the study of energy pathways such as photosynthesis and respiration.
- To make students aware of the biological processes of cell division, reproduction and genetic inheritance.
- To provide students the opportunity to study the scientific method through experiments and to practice problem solving techniques.
- To provide students the opportunity to practise on basic laboratory equipment, to collect and report data and interpret results accurately.

General Learning Outcomes:

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

Week 1

LOBs covered during lectures

1. Identify the levels of organization of living organisms (biological hierarchy).
2. Describe the properties of living organisms.
3. Identify the classification of living organisms (taxonomy).
4. Explain Darwin's theory on the origin of species (evolution) including its two main concepts (natural selection and decent with modification).

LOB covered during lab practical:

5. Describe the basic laboratory safety regulations and how to write a scientific lab report.

Week 2

LOBs covered during lectures:

6. Define molecules, compounds and elements and identify key chemical elements and their properties.
7. Define isotopes and radioisotopes and provide examples of their clinical applications.
8. Describe and compare ionic bonds, covalent bonds, hydrogen bonds and Van der Waals interactions.
9. Describe the properties of water and its role in living organisms.
10. Define hydrophilic/hydrophobic molecules, acid/bases, pH and buffers.

LOBs covered during tutorial:

11. Define the steps of the scientific method.
12. Define hypothesis and know what requirements hypotheses should fulfil.
13. Define independent, dependent, standardized variables and control treatments.

Week 3

LOBs covered during lectures:

14. Describe the structure and function of different types of biologically important carbohydrates in living organisms.
15. Describe the structure and function of different types of biologically important lipids in living organisms.
16. Name the 20 amino acids and identify the group that they belong to (polar, non-polar, electrically charged).
17. Describe the structure and function of different types of proteins in living organisms, including the 4 different levels of protein structure.
18. Discuss the role of the change in primary protein structure in the pathogenesis of sickle cell anaemia.
19. Describe and compare the structure and function of DNA and RNA.

LOBs covered during lab practical:

20. Describe the tests that can be carried out to indicate the presence of monosaccharides, disaccharides and starch.
21. Describe the tests that can be carried out to indicate the presence of lipids.
22. Describe the tests that can be carried out to indicate the presence of proteins.
23. Describe the tests that can be carried out to indicate the presence of DNA.

Week 4

LOBs covered during lectures:

24. Describe the different types of light and electron microscopes and compare their application in studying cell morphology.
25. Compare the basic structure of prokaryotic and eukaryotic cells.
26. Compare the structure of plant vs animal cells and identify the function of the different cell structures and organelles.

LOBs covered during tutorial:

27. Convert between units of the metric system.
28. Convert blood sugar concentration from mM to mg/dl and vice versa.
29. Calculate the body mass index (BMI) based on the height and weight.

Week 5

LOBs covered during lectures:

30. Describe the structure and function of the different components and filaments of the cytoskeleton, including the role of the centrosome, the flagella and the cilia.
31. Describe the structure and function of the different extracellular components.
32. Identify the different types of intercellular junctions in animal cells vs plant cells and their function.

LOBs covered during lab practical:

33. Identify the parts of the compound microscope.
34. Describe the steps required to locate and focus on any specimen using the low-power or high-power objective.
35. Define optic field and calculate by approximation the real size of any specimen under view.
36. Describe the function of the electron microscope and its role in histopathological sample examination.

Microscopy field trip (Visit to CING Electron Microscopy and Molecular Pathology department) (TBC)

Week 6

LOBs covered during lectures:

37. Describe the properties (structure and function) of the plasma membrane.
38. Identify the structure and function of different types of membrane lipids, proteins and carbohydrates.
39. Compare active transport processes with passive transport processes and describe the processes of diffusion and osmosis.
40. Describe and compare the processes of exocytosis and endocytosis.

LOB covered during lab practical:

41. Define hypotonic, hypertonic and isotonic in terms of relative concentrations of osmotically active substances.
42. Explain how incubating plant and animal cells in hypotonic, hypertonic and isotonic solutions affects their structure and function.

Week 7

LOBs covered during lab practical:

41. Define hypotonic, hypertonic and isotonic in terms of relative concentrations of osmotically active substances.
42. Explain how incubating plant and animal cells in hypotonic, hypertonic and isotonic solutions affects their structure and function.

Week 8

LOBs covered during lectures:

43. Explain the mechanisms by which cells communicate with each other in local vs distal signalling.
44. Describe the stages of the cell signalling process.
45. Identify the different types of intracellular and plasma membrane receptors and describe their function.
46. Describe the role of second messengers in the cell signalling cascades.
47. Explain the thermodynamic laws and describe the concepts of endergonic and exergonic reactions.
48. Describe the structure, function, production and hydrolysis of ATP.
49. Define an enzyme and explain the regulation of enzymatic activity by allosteric regulation and negative feedback inhibition.
50. Describe the different types of enzyme inhibitors and their mode of action.

LOBs covered during tutorial:

51. Describe methods for measurements of biomolecule concentrations using blood and urine strips.

Midterm Exam

Week 9

LOBs covered during lectures:

52. Identify the structure and function of the mitochondria.
53. Identify the location of the different stages of cell respiration in animal cells.
54. Explain how organisms derive and utilize energy through cellular respiration.
55. Describe the processes of alcohol fermentation and lactic acid fermentation.
56. Compare aerobic to anaerobic respiration in organisms.

LOBs covered during tutorial:

57. Discuss the clinical consequences for a patient suffering from a metabolic disorder.
58. Define solvent, solute, solution molarity, mole and molecular weight.
59. Calculate isotonic, hypotonic and hypertonic solution concentrations.
60. Calculate drug dosage and concentration.

Week 10

LOBs covered during lectures:

61. Identify the structure and function of chloroplasts.

62. Explain how organisms derive and utilize energy through photosynthesis.
63. Identify the location of the different stages of photosynthesis in plant cells.
64. Identify and compare the processes of chemiosmosis in mitochondria vs chloroplasts.
65. Explain cell division and its role in unicellular vs multicellular organisms.
66. Describe the different stages of the cell cycle, including the different stages of mitosis.

Topics covered in lab practicals

67. Define dependent, independent, standardized variables and control treatments in the experiment.
68. Explain how varying environmental conditions such as pH affects the rate of enzyme activity.
69. Plot enzyme activity vs pH.

Week 11

LOBs covered during lectures:

70. Describe cell cycle control through the checkpoints, including the role of cyclin-cdks, the tumour suppressor genes Rb and p53 and cdk inhibitors (CKIs) in cell cycle regulation.
71. Describe the characteristic of cancer cells related to cell cycle dysregulation including the difference between benign and malignant tumours.
72. Describe the organisation of the eukaryotic genome in the human karyotype.
73. Define and compare haploid and diploid cells.
74. Define and compare autosomes and sex chromosomes.
75. Define the terms chromatin, sister chromatids, chromosome and homologous chromosomes.
76. Describe the process of meiosis and explain its role in gamete production.
77. Compare mitosis to meiosis and distinguish the general purpose of mitosis from the purpose of meiosis.
78. Discuss the mechanisms that contribute to genetic variation.

LOB covered during lab practical:

79. Identify the phases of mitosis in an onion root tip.
80. Identify the phases of meiosis in lilium anthers.

Week 12

LOBs covered during lectures:

-Review Session

Course Contents:

Topics covered in lectures

- Introduction to the Science of Life, Levels of Organization.
- The chemical basis of life.

- Properties of Water, pH, Acid/bases.
- Structure and function of macromolecules in the living cell.
- Prokaryotic vs. Eukaryotic cells: cellular organelles: structure vs. function.
- Membrane structure and function.
- Cell communication.
- Laws of Thermodynamics, ATP regeneration, Enzyme Activity, Feedback Inhibition.
- Cellular respiration; electron transport and oxidative phosphorylation.
- Photosynthesis; the light and dark reactions.
- Cell Reproduction: Cell Cycle and Cell Cycle regulation.
- Meiosis.

Topics covered in laboratory practicals

- Introduction and Laboratory Safety Issues.
- Biomolecules: Qualitative determination of Sugars, Lipids, Proteins and Nucleic Acids.
- Microscopy: Microscopy and microscopic preparations.
- Cell structure and Function: Osmosis.
- Enzymes: Effect of pH on enzyme activity.
- Mitosis and Meiosis.

Topics covered in tutorials

- The process of Science: Forming and testing a Hypothesis. Independent, Dependent, standardized variables.
- The metric system.
- Biomolecules: Calculation of biomolecule concentration using blood and urine strips.
- Calculation of solution and drug concentration: Calculation of solution concentrations (percentage and molar) and drug dosage calculation.
- Medical interview of a patient suffering with a metabolic disorder.

Learning Activities and Teaching Methods:

Lectures, Tutorials, Laboratory Practical Sessions.

Assessment Methods:

Laboratory reports (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
L. A. Urry, M.L. Cain, S.A. Wasserman, P.V. Minorsky, J.B. Reece	Campbell Biology	11th Edition	Pearson	2017	978-013-4093413

Recommended Textbooks/Reading:

Authors	Title	Edition	Publisher	Year	ISBN
Bruce Alberts,	Molecular	6th	Garland	2015	9780-815-

Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter	Biology of the Cell	Edition	Publishing Inc.		344643
N.A. Campbell, N.E. Ervin	Biology: Concepts and Connections	7th Edition	Pearson	2014	9781292026350
A. Jones, R. Reed and J. Weyers	Practical skills in Biology	3rd Edition	Prentice Hall	2003	0-130-45141X