UNIVERSITY of NICOSIA

Year 1

Course Title	**Principles of Cellular Function & Biochemistry I**				
Course Code	**VET-101**				
Course Type	Required				
Level	Undergraduate				
Year / Semester	Year 1/ Semester 1 (Fall)				
Teacher's Name	**Course Lead:** Dr Manos C. Vlasiou **Contributor:** None				
ECTS	6	Lectures/week	3	Laboratories/week	2
Course Purpose and Objectives	The course aims to provide students with fundamental knowledge of the basic concepts regarding cellular structure and function and an overview of biochemical pathways in cells. More specifically, the course covers a description of cellular structure and its various organelles and a deeper exploration of the Central Dogma. The course will cover the structure and function of important biomolecules such as nucleic acids, proteins, carbohydrates, and lipids and their biochemical properties that allow them to fulfil their biological function. The course will also include tutorials and laboratory sessions to supplement and enhance the understanding of the concepts covered in lectures.				
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:** **1.** Describe the chemistry of life. Water, ionic and covalent bonds, hydrogen bonds, van der Waals interactions, hydrophilic, hydrophobic, micelles, diffusion. **2.** Thermodynamics, enthalpy, entropy, and examples of free energy calculations. **3.** Describe the architecture of life: prokaryotic and eukaryotic cells, emphasizing their similarities and differences. **4.** Describe an animal cell's detailed structure and function, including the structure and function of the various structures and organelles such as the cell membrane, cytoplasm, smooth and rough endoplasmic reticulum, nucleus, the Golgi apparatus, mitochondria, lysosomes, and peroxisomes. **Tutorial 1:** *Writing a Lab Report*				

Week 2

LOBs covered during lectures:

5. Describe the basic structure of nucleic acids and compare the structures of DNA and RNA.
6. Discuss hydrogen bonding and its importance in the structure of the double DNA helix.
7. Briefly describe the hierarchical organization within the nucleus, such as histones, chromatin, and chromosomes.
8. Describe DNA replication in prokaryotic and eukaryotic organisms.

Tutorial 2: *How to write a scientific essay*

Week 3

LOBs covered during lectures:

9. Describe DNA transcription in prokaryotic and eukaryotic organisms.
10. Discuss gene expression, it's regulation in prokaryotic and eukaryotic cells and provides examples.
11. Discuss DNA replication and repair.
12. Explore the fundamental processes related to the cell cycle and cancer
13. Theoretical aspects of the PCR technique.

Tutorial 3: *Problem-solving Tutorial for LOBs (Week 1-3)*

Week 4

LOBs covered during lectures:

14. Explore the chemistry of amino acids, focusing on the effects of pH on the amino acid protonation states.
15. Discuss proteins' primary, secondary, tertiary, and quaternary structures.
16. Describe the interactions in protein structure, such as the hydrophobic effect, charge-charge interactions, and hydrogen bonding.
17. Explore the structure-function relationship of proteins.
18. Discuss the different purification techniques for proteins.
19. Discuss the SDS-PAGE electrophoresis technique.

Tutorial 4: *PCR technique and SDS-PAGE electrophoresis Explained*

Week 5

LOBs covered during lectures:

20. Define RNA transcription and initiation, elongation, and termination steps.
21. Describe DNA supercoiling during translation.
22. Describe the splicing reaction.
23. Perform a polymerase chain reaction (PCR) experiment using genomic DNA.
24. Define the terms genetic code and decipheration of the code.
25. Explain the ribosome structure and its role in the translation process.
26. Define codon-anticodon pairing.
27. Explain the factors that terminate translation.
28. Explain the termination pathway in ribosomes.

Tutorial 5: *Problem-solving Tutorial for LOBs (Week 4-5)*

Week 6

LOBs covered during lectures:

29. Discuss the chemical structure and properties of essential carbohydrates in biochemistry.
30. Discuss the chemical formation of glycosidic bonds and the different types.
31. Explain lipids and fatty acids' general structure and chemical properties.
32. Discuss the lipid and fatty acid composition of cellular membranes.
33. Explain the architecture of biological membranes and their properties.
34. Explain how membrane composition can affect its properties and function and how various organisms adjust their membranes for environmental adaptation.

Laboratory Session 1: *DNA isolation*

Week 7

LOBs covered during lectures:

35. Describe membrane transport and how various molecules cross membranes based on chemical principles.
36. Define the thermodynamics relation to the transport process.
37. Describe mediated and non-mediated transport.
38. Describe the role of transport proteins.
39. Describe the role of the cell membrane in cell-to-cell communication.

Week 8

LOBs covered during lectures:

40. Understanding that enzymes are powerful and highly specific catalysts.
41. Explain that free energy is a useful thermodynamic function for understanding enzymes.
42. Describe how enzymes accelerate reactions by facilitating the transition state formation.
43. Explain the Enzyme's activation energy.
44. Describe the catalytic mechanisms.
45. Explain lysozymes and protease activity.

Laboratory Session 2: *Polymerase chain reaction (PCR)*

Week 9

LOBs covered during lectures:

46. Enzyme kinetics.
47. Explain the energy profile of a biochemical reaction with and without an enzyme.
48. Discuss basic chemical principles of thermodynamics and kinetics in the context of enzyme kinetics.
49. Explain the principles of Michaelis-Menten kinetics.
50. Explain the Lineweaver-Burk plot and how it can be used to study enzymatic activity.
51. Discuss the different types of enzyme inhibition and their effects on an enzyme's Lineweaver-Burk plot.
52. Describe the control of the enzyme's activity.

Tutorial 6: *Problem-solving Tutorial for LOBs (Week 6-8)*

Week 10

LOBs covered during lectures:

53. Discuss protein function.
54. Discuss oxygen binding to myoglobin and hemoglobin.
55. Describe the heme complex and hemoglobin structure.
56. Describe the muscle contraction and structure of myosin.
57. Describe the role of antibodies in the immune system.
58. Discuss the control of the Cell Cycle and its implications in cancer development.
59. Discuss the role of apoptosis in the development of cancer.

Laboratory Session 3: *Restriction Digestion*

Week 11

Revision of the topics in total.

Laboratory Session 4: *DNA electrophoresis*

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	Week 12 Revision questions for weeks 9-10.		
Prerequisites	None	Required	None
Course Content	• Chemistry of life and the Cell • Nucleic Acids • DNA Replication and Repair • Amino Acids and Proteins • RNA Transcription and Protein Synthesis • Carbohydrates and Lipids • Membrane Transport • Enzymatic Catalysis • Enzymes Kinetics, Inhibition, and Control • Protein Function and Apoptosis		
Teaching Methodology	Lectures, small group tutorials, and small group laboratory sessions.		

Bibliography

Authors	Title	Edition	Publisher	Year	ISBN
Jeremy M. Berg, Lubert Strayer	**Biochemistry**	**9th edition**	**WH Freeman**	**2019**	**978-1319114657**
Donald Voet, Judith G. Voet, Charlotte W. Pratt	**Fundamentals of Biochemistry**	**5th edition**	**Wiley**	**2016**	**978-1-118-91840-1**
Geoffrey Cooper	The Cell: A Molecular Approach	8th edition	Oxford	2019	978-1605358635
Thomas M. Devlin	Textbook of Biochemistry with Clinical Correlations	7th edition	John Wiley and Sons, Inc	2011	978-0-470-28173-4

Assessment	Course assignment 30% (15% Lab report, 15% Written Essay) final written exam 60% and participation 10%
Language	English