<table>
<tr><td>Course Title</td><td colspan="5">Biochemistry I</td></tr>
<tr><td>Course Code</td><td colspan="5">MED-204</td></tr>
<tr><td>Course Type</td><td colspan="5">Required</td></tr>
<tr><td>Level</td><td colspan="5">Undergraduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">Year 2/ Semester 3 (Fall)</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Course Lead:
Prof Chloe Antoniou
Contributor:
Dr Stella Voskou</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>3</td><td>Laboratories / week</td><td>2</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The aim of this course is to provide students with a detailed understanding of the structure and function of important biomolecules, as well as an in depth comprehension of their metabolism and related disorders. This course is the first course of a series of two biochemistry courses. The specific objectives of the course will be accomplished through lectures, laboratory sessions and tutorials in order for students to understand the material, but also to develop skills in order to apply their knowledge.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">The following list provides the learning objectives that will be covered in the lectures, laboratory practicals and tutorials of each week:
Week 1
Lobs covered during lectures:
1. Describe the structure of amino acids.
2. Explain the biochemical properties such as hydropathy, pKa and properties of side chains e.g. disulphide bond formation.
3. Discuss the formation of peptide bonds, their properties and contributions to a protein's structure.
4. Explain the four levels of protein structure and provide examples.
5. Define terms such as "subunit", "domain" and "motif".
6. Discuss how a mutation can affect a protein's structure using examples.

Lobs covered in lab practical:
7. Explain Beer's law and how it can be used to measure concentrations of purified proteins used to measure concentrations of purified proteins.
8. Explain the principles behind the Bradford Assay.
9. Carry out a Bradford assay and generate a standard curve.
10. Determine the concentration of an unknown protein sample using the Bradford assay.</td></tr>
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Week 2

Lobs covered during lectures:

11. Explain the energy profile of reaction with and without an enzyme.
12. Provide examples of the different catalytic strategies that enzymes employ to perform function.
13. Explain the principles and mathematics of Michaelis-Menten kinetics.
14. Explain the Lineweaver-Burk plot and how it can be used to determine KM and Vmax.
15. Discuss the different types of enzyme inhibition and their effects on an enzyme's Lineweaver-Burk plot.
16. Discuss allostery (allosteric enzymes and allosteric regulation).
17. Provide examples of allosteric enzymes and allosteric effectors of enzymes.

Lobs covered during laboratory practical:

18. Measure the amount of product formed (using absorbance measurements) vs time for the reaction catalysed by lactate dehydrogenase (LDH) at different substrate concentrations.
19. Measure the amount of product formed (using absorbance measurements) vs time for the reaction catalysed by lactate dehydrogenase (LDH) at different substrate concentrations in the presence of an inhibitor.
20. Determine the Lineweaver-Burk plots with and without the inhibitor, calculate the KM and Vmax and determine what type of inhibition is observed.

Week 3

Lobs covered during lectures:

21. Describe the structural and oxygen binding similarities and differences between myoglobin and hemoglobin.
22. Explain the effects of 2,3 bisphosphoglycerate on haemoglobin's oxygen binding properties.
23. Discuss the amino acid sequence and oxygen binding differences between adult and fatal haemoglobin.
24. Define "allostery" and "cooperativity".

Lobs covered during laboratory practical:

18. Measure the amount of product formed (using absorbance measurements) vs time for the reaction catalysed by lactate dehydrogenase (LDH) at different substrate concentrations.
19. Measure the amount of product formed (using absorbance measurements) vs time for the reaction catalysed by lactate dehydrogenase (LDH) at different substrate concentrations in the presence of an inhibitor.
20. Determine the Lineweaver-Burk plots with and without the inhibitor, calculate the KM and Vmax and determine what type of inhibition is observed.

Week 4

Lobs covered during lectures:

25. Explain the principles behind protein folding.
26. Discuss the role of chaperones in protein folding.
27. Discuss how protein misfolding is implicated in diseases such as Alzheimer's, Parkinson's and prion diseases and other amyloidosis.
28. Explain the basic principles behind commonly used proteomic techniques such as protein purification techniques and mass and structure determination.
29. Explain the applications and importance of proteomic techniques in medical research.

Lobs covered during tutorial:

30. Outline the sections of a typical lab report and explain what type of information belongs to each section.
31. Discuss the guidelines of the lab report assignment.

Week 5

Formative Midterm Exam

Week 6

Lobs covered during lectures:

32. Outline the reactions of glycolysis.
33. Outline the reactions of gluconeogenesis.
34. Discuss the regulation of glycolysis and gluconeogenesis.
35. Explain the anaerobic fates of pyruvate and their importance.
36. Discuss the formation of sorbitol and its medical implications.
37. Discuss the inborn errors of metabolism associated with glycolysis and gluconeogenesis.

Week 7

Lobs covered during lectures:

38. Describe the reactions of the Krebs cycle, including the conversion of pyruvate to acetyl CoA.
39. Explain the regulation of the Krebs cycle.
40. Discuss inborn errors of metabolism associated with enzymes of the Krebs cycle.
41. Describe the electron transport chain and explain how it leads to the establishment of a proton gradient in mitochondria.
42. Explain the process of ATP synthesis.

Week 8

Lobs covered during lectures:

43. Describe the process of glycogen breakdown.
44. Describe the process of glycogen synthesis.
45. Discuss how glycogen breakdown and synthesis are regulated.
46. Describe the biochemical basis of glycogen storage disorders.

47. Describe how fructose is processed by different cells to enter glycolysis or gluconeogenesis.
48. Describe how galactose is processed to enter glycolysis or gluconeogenesis.
49. Discuss fructose intolerance and galactosemia.

Week 9

Lobs covered during lectures:

50. Define terms such as transamination and deamination.
51. Describe the reactions of the urea cycle.
52. Define essential and non-essential amino acids.
53. Outline the steps in the metabolism of each of the 20 amino acids.
54. Discuss amino acid metabolism disorders.

Lobs covered during laboratory practical:

55. Explain the principles of SDS-PAGE.
56. Explain how SDS denatures proteins.
57. Describe the process of preparing a protein gel.
58. Run, stain, destain and analyse an SDS-PAGE gel.

Week 10

Lobs covered during lectures:

59. Explain the process of fatty acid breakdown (including unsaturated fatty acids and fatty acids with an odd number of carbons).
60. Explain the process of fatty acid synthesis (including double bond formation).
61. Explain how essential fatty acids are used to generate other important fatty acids.
62. Discuss the role of carnitine in fatty acid metabolism.
63. Discuss disorders of fatty acid metabolism.
64. Define ketone bodies.
65. Explain how ketone bodies are synthesized and broken down.
66. Describe the conditions which result to ketone body accumulation.
67. Discuss the consequences of ketone body accumulation.

Week 11

Lobs covered during lectures:

68. Discuss the release of hormones during the fed and fasting states.
69. Discuss the effects on metabolism of the fed and fasting states.
70. Discuss the metabolic consequences of diabetes.

Week 12

Lobs covered during lectures:

Revision

Prerequisites	None	Required	None

Course Content	**Topics covered in lectures:** • Properties of Amino Acids • Proteins structure • Introduction to Enzymes • Enzyme kinetics • Enzyme inhibition • Allosteric Enzymes • Haemoglobin • Protein folding and misfolding - medical implications • Proteomic technologies • Structure of lipids and properties of biological membranes. • Structure of Carbohydrates • Introduction to Metabolism • Glycolysis & Gluconeogenesis • The Krebs Cycle • Oxidative Phosphorylation • Glycogen Metabolism • Fructose and Galactose Metabolism • Amino acid metabolism • Lipid and Fatty Acid Metabolism • Ketone body metabolism • Integration of metabolism **Topics covered in lab practical's:** • Methods in determining protein concentration. • Kinetics of lactate dehydrogenase in the absence and presence of an Inhibitor. • Protein electrophoresis. **Topics covered in tutorials:** • How to write a good lab report. • Problem solving tutorials.
Teaching Methodology	Lectures, Tutorials, Laboratory Practical Sessions.
Bibliography	**Required Textbooks/Reading:**

Authors	Title	Edition	Publisher	Year	ISBN
David L. Nelson and Michael M. Cox	Lehninger Principles of Biochemistry	7th edition (Internatio nal)	W. H. Freeman and Company	2021	9781319381493 (paperback)

Recommended Textbooks/Reading:

Authors	Title	Edition	Publisher	Year	ISBN
Roger L Miesfield and Megan McEvoy	Biochemistry	2nd Edition	W.W. Norton & Company	2021	9780393533538 (paperback)
Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter	Molecular Biology of the Cell	7th Edition	Norton & Company	2022	9780393884852 (paperback)
Michael A. Lieberman and Rick Ricer	BRS Biochemistry ,Molecular Biology & Genetics	7th Edition	Lippincott Williams & Wilkins	2019	9781496399236

Assessment

For the course MED-204 Biochemistry I there will be a Formative Midterm Exam. The grade for the course will be contributed by a Lab Report (20%) and a Summative Final Exam (80%). Written exams consist of Single Best Answer MCQs (SBAs) and Short Answer Questions (SAQs).

Note: Please note that lab reports will be accepted only from students who attended the laboratory session which the lab report is based on.

Mandatory Lab Title: *"Kinetics of lactate dehydrogenase in the absence and presence of an Inhibitor*"

Please refer to the weekly timetable for the exact date and time of the laboratory session that you need to attend.

Language

English