Course Title	**Biochemistry I**				
Course Code	**MED-204**				
Course Type	Required				
Level	Undergraduate				
Year / Semester	Year 2/ Semester 3 (Fall)				
Teacher's Name	**Course Lead:** Dr Chloe Antoniou				
ECTS	6	Lectures / week	3	Laboratories / week	2
Course Purpose and Objectives	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.				
Learning Outcomes	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, pK_a and properties of side chains e.g. disulfide 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. 8. Explain the principles behind the Bradford Assay. 9. Carry out a Bradford assay and generate a standard curve. 10. Determine the concentration of a protein sample using the Bradford assay and using A_{280nm} measurements and compare the two.				

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 K_M and V_{max}.
15. Discuss the different types of enzyme inhibition and their effects on an enzyme's Lineweaver-Burk plot.

Lobs covered during laboratory practical:

16. Measure the amount of product formed (using absorbance measurements) vs time for the reaction catalyzed by lactate dehydrogenase (LDH) at different substrate concentrations.
17. Measure the amount of product formed (using absorbance measurements) vs time for the reaction catalyzed by LDH at different substrate concentrations in the presence of a constant concentration of an inhibitor.
18. Determine the Lineweaver-Burk plots with and without the inhibitor, calculate the K_M and V_{max} and determine what type of inhibition is observed.

Week 3

Lobs covered during lectures:

19. Discuss allostery (allosteric enzymes and allosteric regulation).
20. Provide examples of allosteric enzymes and allosteric effectors of enzymes.
21. Describe the structural and oxygen binding similarities and differences between myoglobin and haemoglobin.
22. Explain the effects of 2, 3 bisphosphoglycerate on hemoglobin's oxygen binding properties.
23. Discuss the amino acid sequence and oxygen binding differences between adult and foetal haemoglobin.
24. Define "allostery" and "cooperativity".

Lobs covered during tutorial:

25. Outline the sections of a typical lab report and explain what type of information belongs to each section.
26. Discuss what is expected from the students regarding their lab report assignment.

Week 4

Lobs covered during lectures:

27. Explain the principles behind protein folding.
28. Discuss the role of chaperones in protein folding.
29. Discuss how protein misfolding is implicated in diseases such as Alzheimer's, Parkinson's and prion diseases and other amyloidosis.
30. Explain the general structure of phospholipids and glycolipids.
31. Describe the standard nomenclature and properties of fatty acids.
32. Explain the basic principles behind commonly used proteomic techniques such as protein purification techniques and mass and structure determination.
33. Explain the applications and importance of proteomic techniques in medical research.

Lobs covered during tutorial:

Problem solving tutorial

Week 5

Lobs covered during lectures:

34. Discuss the lipid and fatty acid composition of cellular membranes.
35. Explain the architecture of biological membranes and their properties.
36. Explain how membrane composition can affect its properties (e.g. fluidity) and function (e.g. lipid rafts).
37. Discuss the structure and properties of important carbohydrates in biochemistry.
38. Discuss the formation of glycosidic bonds and the different types.
39. Describe the structure of important disaccharides and polysaccharides in biochemistry***.***

Lobs covered during tutorial:

Revision

Week 6

Lobs covered during lectures:

40. Describe basic concepts in metabolism (□G, coupled reactions, strategies of pathway regulation).
41. Describe the structure and function of molecules used in metabolism (NADH, FADH2, acetyl CoA, etc.).
42. Outline the reactions of glycolysis.

43. Outline the reactions of gluconeogenesis.

Formative Midterm Exam

Week 7

Lobs covered during lectures:

44. Discuss the regulation of glycolysis and gluconeogenesis.
45. Explain the anaerobic fates of pyruvate and their importance.
46. Discuss the formation of sorbitol and its medical implications.
47. Discuss the inborn errors of metabolism associated with glycolysis and gluconeogenesis.
48. Describe the reactions of the Krebs cycle, including the conversion of pyruvate to acetyl CoA.
49. Explain the regulation of the Krebs cycle.
50. Discuss inborn errors of metabolism associated with enzymes of the Krebs cycle.

Week 8

Lobs covered during lectures:

51. Describe the electron transport chain and explain how it leads to the establishment of a proton gradient in mitochondria.
52. Explain the process of ATP synthesis.
53. Describe the process of glycogen breakdown.
54. Describe the process of glycogen synthesis.
55. Discuss how glycogen breakdown and synthesis are regulated.
56. Describe the biochemical basis of glycogen storage disorders.

Lobs covered during tutorial:

Problem solving tutorial

Week 9

Lobs covered during lectures:

57. Describe how fructose is processed by different cells to enter glycolysis and/or gluconeogenesis.
58. Describe how galactose is processed to enter glycolysis and/or gluconeogenesis.
59. Discuss fructose intolerance and galactosaemia.
60. Define terms such as transamination and deamination.
61. Describe the reactions of the urea cycle.

62. Define essential and non-essential amino acids.
63. Outline the steps in the metabolism of each of the 20 amino acids.
64. Discuss amino acid metabolism disorders.

Lobs covered during laboratory practical:

65. Explain the similarities and differences between native and denaturing protein electrophoresis.
66. Explain how SDS denatures proteins.
67. Describe the process of preparing a protein gel.
68. Run, stain, destain and analyze an SDS-PAGE gel.

Week 10

Lobs covered during lectures:

69. Explain the process of fatty acid breakdown (including unsaturated fatty acids and fatty acids with an odd number of carbons).
70. Explain the process of fatty acid synthesis (including double bond formation).
71. Explain how essential fatty acids are used to generate other important fatty acids.
72. Discuss the role of carnitine in fatty acid metabolism.
73. Discuss disorders of fatty acid metabolism.
74. Define ketone bodies.
75. Explain how ketone bodies are synthesized and broken down.
76. Describe the conditions which result to ketone body accumulation.
77. Discuss the consequences of ketone body accumulation.

Lobs covered during tutorial:

Problem solving tutorial

Week 11

Lobs covered during lectures:

78. Describe how ethanol is metabolized by the human body. Describe the reactions of the urea cycle.
79. Discuss the effects of chronic alcohol abuse on metabolism.
80. Describe body mass index (BMI) and obesity.
81. Discuss the release of hormones during the fed and fasting states.
82. Discuss the effects on metabolism of the fed and fasting states.
83. Explain the role of important genes and proteins in obesity.

<table>
<tr><td></td><td colspan="3">84. Discuss the health risks associated with obesity.
85. Discuss type I and type II diabetes mellitus and gestational diabetes.
86. Explain what insulin resistance and metabolic syndrome mean.
87. Discuss the metabolic consequences of diabetes.

Lobs covered during tutorial:
Problem solving tutorial

Week 12
Lobs covered during lectures:
Revision</td></tr>
<tr><td>Prerequisites</td><td>None</td><td>Required</td><td>None</td></tr>
<tr><td>Course Content</td><td colspan="3"><u>Topics covered in lectures:</u>
Properties of Amino Acids
Proteins structure and function
Haemoglobin
Protein folding and misfolding - medical implications
Enzymes: basic principles
Enzyme kinetics
Enzyme inhibition
Allosteric inhibition
Structure of lipids and fatty acids.
Properties of biological membranes.
Structure of carbohydrates.
Introduction to metabolism – general principles
Glycolysis & Gluconeogenesis
The Krebs cycle
Oxidative phosphorylation
Glycogen metabolism
Fructose and galactose metabolism
Amino acid metabolism
Lipid and fatty acid metabolism
Ketone Body Metabolism
Metabolism of ethanol and the effects of chronic alcohol use on metabolism</td></tr>
</table>

<table>
<tr><td></td><td>

Integration of metabolism

<u>Topics covered in lab practicals:</u>

Methods in determining protein concentration.
Kinetics of lactate dehydrogenase in the absence and presence of an Inhibitor.
Preparation of cell lysates for SDS-PAGE
Protein electrophoresis.

<u>Topics covered in tutorials:</u>

How to write a good lab report.
Proteomic technologies.
Problem solving tutorials.

</td></tr>
<tr><td>Teaching Methodology</td><td>Lectures, Tutorials, Laboratory Practical Sessions.</td></tr>
<tr><td>Bibliography</td><td>
Required Textbooks/Reading:
<table>
<tr><th>Authors</th><th>Title</th><th>Edition</th><th>Publisher</th><th>Year</th><th>ISBN</th></tr>
<tr><td>David L. Nelson and Michael M. Cox</td><td>Lehninger Principles of Biochemistry</td><td>7th Edition (International)</td><td>W. H. Freeman and Company</td><td>2017</td><td>9781319108243</td></tr>
</table>
Recommended Textbooks/Reading:
<table>
<tr><th>Authors</th><th>Title</th><th>Edition</th><th>Publisher</th><th>Year</th><th>ISBN</th></tr>
<tr><td>Roger L Miesfield and Megan McEvoy</td><td>Biochemistry</td><td>1st Edition</td><td>W.W. Norton & Company</td><td>2017</td><td>9780393615081 (paperback)</td></tr>
<tr><td>Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts,</td><td>Molecular Biology of the Cell</td><td>6th Edition</td><td>Garland Science</td><td>2015</td><td>9780815344322 (hardcover) 9780815344643 (pape</td></tr>
</table>
</td></tr>
</table>

	and Peter Walter					rback)
	Michael A. Lieberman and Rick Ricer	BRS Biochemistry, Molecular Biology & Genetics	6th Edition	Lippincott Williams & Wilkins	2014	9781451175363
Assessment	For the course MED-204 Biochemistry I there will be an online Formative Midterm Exam. The grade for the course will be contributed by a Lab Report (10%) and a Summative Final Exam (90%). Written exams consist of Single Best Answer MCQs (SBAs) and Short Answer Questions (SAQs).					
Language	English					