LANDMARK UNIVERSITY, OMU-ARAN

COURSE COMPACT

COLLEGE: SCIENCE AND ENGINEERING
DEPARTMENT: BIOLOGICAL SCIENCES
PROGRAMME: BIOCHEMISTRY
COURSE COMPACT for: ADVANCED ENZYMOLOGY

Course

Course code:	BCH 411
Course title:	Advanced Enzymology
Credit unit:	2
Course status:	Compulsory

Lecturers' Data

Name of the lecturers:	Dr. O.M. Oluba (Ph.D)
Department:	Biological Sciences
College:	Science and Engineering
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Office Location:	Rm A305, 1ST College building

Consultation Hours: Mon – Wed (1- 2PM)

INTRODUCTION TO THE COURSE

Course Description:

The course is designed to build on students' existing enzymology knowledge attained in BCH 312. The course contents will help students appreciate the principles underlying mechanistic and kinetics studies of enzyme reactions. Steady-state enzyme kinetics and transient kinetics methods will be considered in order to gain further insight into the reaction mechanism of enzymes, substrate/products models and reaction schemes. Chemistry of enzyme catalysis, regulation of enzyme activity and synthesis, regulatory enzymes, molecular models for allosterism, multienzyme complexes, enzyme reconstitution, and recent advances in enzymology will also considered. The students will understand the importance of enzyme regulation and the various devices employed to achieve regulation.

Course Justification:

Enzymes are biological catalysts with numerous applications in medicine and industries. For instance, enzymes are targets for novel drug development against many disease conditions. Purified enzymes are also being utilized as catalyst for biochemical reactions e.g. fermentation or bioconversion to ethanol fuel. Furthermore, enzymes are increasingly being applied as biosensors for detection and monitoring purposes.

Course objectives

At the end of the courses, students will be able to;

1. Describe the various laboratory procedures for the isolation purification and characterization of enzymes.
2. Identify some criteria for determining the purity of enzymes.
3. Describe the various laboratory procedures that measure the rate of enzyme reactions.
4. Describe special techniques employed in the study of enzyme kinetics.
5. Explain the mechanisms and kinetics of enzyme-catalyzed reactions for both single substrate and bi-substrate enzymes.
6. Describe general features characterizing regulatory (genetic, covalently and non-covalently regulated) enzymes and proposed models for allosteric behavior of enzymes.
7. Describe multienzyme complexes and mechanistic advantages offered by them.
8. Describe membrane and enzyme reconstitution techniques and advantages.

Method of Grading- An example below

S/N	Grading	Score (%)
1.	CA1	7
2.	CA2	15
3.	CA3	8
4.	Final Examination	70
	Total	**100**

Course Delivery Strategies – Illustration below

Course delivery will be by face-to-face method, participatory method and Lecture method. Assignments will be given out to students periodically as individual and in groups.

LECTURE CONTENT

For this section- the lecturer provides the topic of each week, objectives, description, study question and other information posted below.

1. **Week 1 – 2:** Enzyme kinetics (steady state and transient kinetic method)

2. **Objectives**

   The students at the end of lectures for week should be able to understand the role of enzymes as a biological catalyst, how enzymes are able to carry out biochemical catalysis and established principles in enzyme catalysis

3. **Description**

   First hour:
   Introduction to enzyme catalysis,
   Second hour:
   Enzyme Kinetics; One substrate saturation kinetics, kinetic equations
   Third hour:
   Linear plots; Michaelis – Menten, Hanes and Eadie – Hofstee plots; Significance of kinetic parameters

4. **Study Question:**

   Derive the Michaelis – Menten kinetic equation
   What are the significances of the kinetic Parameters

5. **Reading List –**

   Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-417-19350-0

   Lehninger Principles of biochemistry, Fourth Edition (2005) by David L.

   Biochemistry by Nelson and Michael M. Cox

   Harper's Illustrated Biochemistry, (2003) twenty-sixth edition. McGram-Hill companies Limited. ISBN-0-07-121766-5

   Nelson. D. L. and Cox, M. M. (2004) integration and hormonal Regulation of Mammalian Metabolism. Lehninger Principles of Biochemistry. 4th edition. Worth publishers, New York, pp. 881 -918.

6. **Week 3 – 4:** Chemistry of enzyme catalysis

7. **Objectives (list the objectives)**

The students at the end of the lectures for the week should be able to understand various enzyme kinetic assumptions and inhibitions.

8. **Description**

First hour:
The steady – state assumption; steady – state versus Michaelis – Menten kinetics
Second hour
Enzyme inhibition; reversible, partially irreversible and total irreversible inhibition
Third hour
Reversible inhibition: competitive, uncompetitive and non-competitive; Determination of inhibition constant

9. **Study Question :**

Differentiate between the steady – state and Michaelis – Menten kinetic assumptions
Tabulate the characteristics of the different types of reversible enzyme inhibition
How can the inhibition constant (K_I) be determined in competitive, uncompetitive and non-competitive inhibition

10. **Reading List –**

Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.

Lehninger Principles of Biochemistry, Fourth Edition (2005) by David L.

Biochemistry by Nelson and Michael M. Cox

Harper's Illustrated Biochemistry, (2003) twenty-sixth edition. McGraw-Hills companies limited. ISBN-0-07-121766-5

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11. **Week 5 – 6:** Multi enzyme complexes

12. **Objectives (list the objectives)**

The students at the end of the lectures for the week should be able to known and understand the various multi enzyme complexes and mechanisms that are involved in biochemical catalyzes

13. **Description**

First hour:
Introduction to multi – enzyme complex catalysis
Second hour
Description of various multi – enzyme complex catalysis; sequential, compulsory-order, random-order, substitution, ping-pong, double displacement and Theorell-chance mechanisms
Third hour
Description of two-three substrate enzyme catalysis

14. **Study Question:**

Using appropriate illustration, describe multi-substrate enzyme catalyzed reaction mechanism that occur in living. Give at least two examples of each.
How can the kinetic parameters be deduced from two and three substrate enzyme catalyzed reaction

15. **Reading List –**

Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.

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16. **Week 7:**Regulatory enzymes and molecular models for allosterism

17. **Objectives (list the objectives)**

The student at the end of the lectures for the week should be able to understand the concept of allosterism in enzyme catalysis

18. **Description**

First hour:
Non-linear kinetics and concept of allosteric interactions
Second hour
Description Allosteric models; Monod, Wyman and Changeux (MWC) and Koshland, Nementry and Filmer (KNF) models.
Third hour
Determination of allosteric rate constants, significance of allosterism in enzyme catalysis

19. **Study Question :**

Discuss homotropic and heterotropic allosteric interactions
Enumerate the significance of allosterism in enzyme catalysis.

20. **Reading List –**

Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.

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Week 8: Class Test

Week 9: Enzymes Assays

21. **Objective:** The students at the end of the lectures for the week should be able to;

1. Explain enzyme activity and unit of measurement
2. Describe relevance of enzyme assay to enzyme kinetics
3. Describe the approaches to the measurement of enzyme activities

4. Describe how to select a suitable assay method for use
5. Highlight factors that may influence enzyme assays
6. Describe the principal basis for the enzyme assay

7. **Reading List –**

Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.

Lehninger Principles of Biochemistry, Fourth Edition (2005) by David L.

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8. **Week 10:** Criteria for determining purity of enzymes

Objectives: The student at the end of the lectures for the week should be able to:

1. Explain the significance of enzyme purity
2. Highlight and describe the various techniques for determining enzyme purity
3. Highlight the merits and demerits of the techniques used for determining enzyme purity
4. **Reading List :**

Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.

Lehninger Principles of Biochemistry, Fourth Edition (2005) by David L.

Biochemistry by Nelson and Michael M. Cox

Harper's Illustrated Biochemistry, (2003) twenty-sixth edition. McGraw-Hills companies limited. ISBN-0-07-121766-5

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Week 11: Enzyme Reconstitution

Objective: The student at the of the lectures for the week should be able to:

1. Describe enzyme reconstitution
2. Explain the significance of enzyme reconstitution
3. Highlight and describe various methods useful for enzyme reconstitution
4. **Reading List –**

Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.

Lehninger Principles of Biochemistry, Fourth Edition (2005) by David L.

Biochemistry by Nelson and Michael M. Cox

Harper's Illustrated Biochemistry, (2003) twenty-sixth edition. McGraw-Hills companies limited. ISBN-0-07-121766-5

Nelson. D. L. and Cox, M. M. (2004) integration and hormonal Regulation of Mammalian Metabolism. Lehninger Principles of Biochemistry. 4th edition. Worth publishers, New York, pp. 881 -918.

Week 12: Regulation of enzyme activity and synthesis
Objectives: The students at the end of the lectures for the week should be able to;

1. Describe the significance of enzyme regulation
2. Mention the various ways by which enzymes can be regulated
3. Describe the relationship between enzyme activity and genetic control
4. **Reading List –**

Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.

Lehninger Principles of Biochemistry, Fourth Edition (2005) by David L.

Biochemistry by Nelson and Michael M. Cox

Harper's Illustrated Biochemistry, (2003) twenty-sixth edition. McGraw-Hills companies limited. ISBN-0-07-121766-5

Nelson. D. L. and Cox, M. M. (2004) integration and hormonal Regulation of Mammalian Metabolism. Lehninger Principles of Biochemistry. 4th edition. Worth publishers, New York, pp. 881 -918.

Week 13: Biochemical regulatory mechanisms

Objectives: The student at the end of the lectures for the week should be able to;

1. Highlight the various regulatory mechanisms for enzyme activity
2. Explain each of the regulatory mechanism with relevant examples
3. **Reading List –**

Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.

Lehninger Principles of Biochemistry, Fourth Edition (2005) by David L.

Biochemistry by Nelson and Michael M. Cox

Harper's Illustrated Biochemistry, (2003) twenty-sixth edition. McGraw-Hills companies limited. ISBN-0-07-121766-5

Nelson. D. L. and Cox, M. M. (2004) integration and hormonal Regulation of Mammalian Metabolism. Lehninger Principles of Biochemistry. 4th edition. Worth publishers, New York, pp. 881 -918.

Week 14: Recent advances in enzymology

Objective: The students at the end of the lectures for the week should be able to;

1. Review the application of enzymes to everyday living
2. Identify and describe various technology advancements where enzymes have been explored

Week 15: Revision

Recommended Reading

3. Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.

4. Lehninger Principles of Biochemistry, Fourth Edition (2005) by David L.

5. Biochemistry by Nelson and Michael M. Cox

6. Harper's Illustrated Biochemistry, (2003) twenty-sixth edition. McGraw-Hills companies limited. ISBN-0-07-121766-5

7. Moore. J.T. and Langley, R. (2008). Biochemistry for Dummies. Wiley publishing Inc., Indianapolis

8. Schuster, S., Fell, D.A., & Dandeker, T. (2000) A general definition of metabolic pathways useful for systematic organization and analysis of complex metabolic networks. Nat. Biotechnol. 18,326-332.

9. Nelson. D. L. and Cox, M. M. (2004) Lehninger Principles of Biochemistry. 4th edition. Worth publishers, New York.

10. Metzler, D. E. (2001) The Specificity of enzyme action. Biochemistrty. The Chemical Reactions of Living cells 2nd edition. Pg 455-469.

11. Murray, R.K., Granner, D.K., Mayes, P. A. and Rodwell, V. W.(2003). Enzymes: Mechanism of Action. Harper's Illustrated Biochemistry. 26th edition. Pg 49-51

12. Purich, D. L. (1996) Contemporary Enzyme Kinetics and Mechanism. New York: Academic press.