



SCHOOL OF PHARMACY AND HEALTH SCIENCES

COURSE: **BCM 2345: BIOCHEMISTRY V (ENZYMOLGY)**

CREDIT UNIT: 3

1. Course Description.

The course will introduce students to biomolecules with catalytic activity (enzymes), enzyme kinetics, the mechanisms of enzyme catalysis, the mechanisms of enzyme regulation in the cell and application of enzymes in medicine.

2. Course Description.

The course aims to impart knowledge in enzymology because of its relevance in supporting cellular metabolic processes as well as clinical relevance in the diagnosis, prognosis and treatment of diseases

3. Link to University Mission and Program Learning Outcomes:

- i. **High order thinking:** The ability to collect, analyze and evaluate information and formulate conclusions. Students develop and demonstrate the ability to think critically, analytically and creatively.
- ii. **Literacy:** Competence in oral, written, quantitative, and technological skills. Students develop and demonstrate competency in oral and written communication as well as demonstrate scientific, quantitative and technological literacy.
- iii. **Global understanding and multicultural perspective:** Awareness, knowledge and appreciation of both the diversity and commodity of cultures. Students acquire these perspectives through formal study of languages, history, literature and the arts and through working, studying and living cooperatively in a radically, ethnically, and culturally diverse environment. Further, students acquire an understanding of economic, historical, political, geographic and environmental relationships on a global basis.
- iv. **Preparedness for career:** Mastery of a field of knowledge and its multi-cultural and multinational application. Such mastery is accomplished through both formal study and various experienced forms of learning such as internships and field experiences.

- v. **Community service and development:** A sense of being part of a community and a desire to be of service to it. Students are given opportunities to participate in community service, citizenship, or social action projects or activities.
- vi. **Leadership and ethics:** As part of their growth and development, students formulate and articulate the ethical standards which will guide their professional and personal lives.

4. Program learning outcomes

By the end of their training the graduates should be able to:

1. Plan, organize and control the manufacturing, compounding, packaging and quality of pharmaceutical products.
2. Plan, organize and manage the procurement, storage and distribution of pharmaceutical materials and products.
3. Interpret and uphold the laws, regulations and ethics that govern the practice of pharmacy.
4. Provide pharmacist-initiated care to patients and ensure the rational use of medicines.
5. Provide information, advice and education on disease, health, community health and medicines-related issues.
6. Participate in pharmaceutical and medical research and evaluate critically new therapies and current advances in formulation and modes of drug action to ensure the optimal selection and use of medicines.

5. Course Learning Outcomes:

Upon successfully completion o of the course, the student should be able to:

1. Explain relationship between the structure and function of enzymes;
2. Describe the kinetics of enzyme catalysis
3. Discuss mechanism of enzyme inhibition
4. Discuss factors that influence enzyme activity
5. Explain mechanisms for enzyme regulation
6. Describe the application of enzymes and their inhibitors in medicine

6. Course Prerequisite

BCM 1342: Biochemistry of Biomolecules

7. COURSE CONTENT

week	Topic	Activity and learning outcome	Reading
Week 1	Introduction to Enzymology: <ul style="list-style-type: none"> - Definition of enzymes, - Enzyme functions and properties 	(outcomes 1) Lecture	Grant, R., & Grisham, C. (2013),5th Edition chapter 13 (ebook)

	<ul style="list-style-type: none"> - Enzyme cofactors and prosthetic groups, - Enzyme classification 		Antonio Blanco and Gustavo Blanco (2017) <i>Medical Biochemistry</i> . Elsevier Science & Technology (ebook): Chapter 8 Lehninger Principles of Biochemistry. 6th Edition, Chapter 6
Week 2	Activity of enzymes: <ul style="list-style-type: none"> - Enzyme activation - Factors affecting enzyme activity, 	(outcomes 1) Lecture and class discussion	Grant, R., & Grisham, C. (2013), 5th Edition chapter 13 and 15 (ebook) Lehninger Principles of Biochemistry. 6th Edition, Chapter 6
Week 3	Enzyme Activity: <ul style="list-style-type: none"> - Enzyme kinetics - Michaeli-Menten equation - Lineweaver Burk plots 	(outcome 1,2, 3) Lecture and class discussion (Individual assignment one)	Grant, R., & Grisham, C. (2013), 5th Edition chapter 13 and 14 (ebook) Lehninger Principles of Biochemistry. 6th Edition, chapter 6
Week 4	Enzyme Inhibition: <ul style="list-style-type: none"> - Reversible inhibitors - Competitive inhibitors - Noncompetitive inhibitors - Uncompetitive inhibitors - Irreversible inhibitors - Suicide inhibitors 	Quiz 1: Covering wk. 1, 2 and 3 work (outcomes 1,2,3,4) Individual assignment 1 due in week 5, Group work due in week 6	Grant, R., & Grisham, C. (2013), 5th Edition chapter 13 (ebook) Lehninger Principles of Biochemistry. 6th Edition, Chapter 6
Week 5	Mechanisms of enzyme catalysis: <ul style="list-style-type: none"> - Proximity and orientation - Acid-base catalysis - Metal ion catalysis - Covalent bond catalysis 	(outcomes 2,3) Lecture and class discussion (Individual assignment one due)	Grant, R., & Grisham, C. (2013), 5th Edition chapter 14 (ebook) Lehninger Principles of Biochemistry. 6th Edition, Chapter 14
Week 6	Mechanisms of enzyme catalysis: <ul style="list-style-type: none"> - Metal ion catalysis - Covalent bond catalysis 	(outcomes 2,4) Lecture and class discussion and a video	Grant, R., & Grisham, C. (2013), 5th Edition chapter 14 (ebook) Lehninger Principles of Biochemistry. 6th Edition, Chapter 15
Week 7	Mid Term Exam	Mid Term Exam	

Week 8	Regulatory enzymes: <ul style="list-style-type: none"> - Allosteric enzymes - Enzymes regulated through covalent modification - Enzymes regulated through proteolytic cleavage (Zymogens) 	(outcomes 2,4) Lecture and class discussion	Grant, R., & Grisham, C. (2013), 5th Edition chapter 14 and 15 (ebook) Lehninger Principles of Biochemistry. 6th Edition, Chapter 15
Week 9	Clinical enzymology: <ul style="list-style-type: none"> - Enzymes as markers for diagnosis - Isoenzymes <ul style="list-style-type: none"> - liver enzymes - cardiac enzymes - pancreatic enzymes - Muscle enzymes 	(outcomes 2,4,5) Lectures, class discussion, clinical scenarios	Crook, M. (2012). Clinical biochemistry and metabolic medicine. Chapter 18, 8th Edition. ebook Vasudevan chapter 23, Voet et al. Principles of Biochemistry, 4th Edition.
Week 10	Clinical enzymology: <ul style="list-style-type: none"> - Factors Affecting Results of Plasma Enzyme Assays - Enzymes as therapeutic agents - Enzymes as drug target - Practical Enzymology: <ul style="list-style-type: none"> - Enzyme assay - Kinetic methods - End point methods 	(outcomes 2,4,5,7) Lectures, class discussion, clinical scenarios (group work Due week 12),	Crook, M. (2012). Clinical biochemistry and metabolic medicine. Chapter 18. 8th Edition. ebook Vasudevan chapter 23, Voet et al. Principles of Biochemistry, 4th Edition.
Week 11	Enzymes in drug metabolism: <ul style="list-style-type: none"> - Introduction to drug metabolism - Role of enzymes in Xenobiotic metabolism - Cyt P450 & Transfarases 	Quiz 2: Covering wk. 8, 9 and 10 work Lecture and class discussion Individual Assignment two; Me (Mechanism of drug action due in week 12) (outcomes 2,4,5,6)	Anzenbacher, P., & Zanger, U. M. (Eds.). (2012). Metabolism of drugs and other xenobiotics. Chapter 1 and 10, Edition 1. ebook Voet et al. Principles of Biochemistry, 4th Edition. Chapter IV
Week 12	Enzymes in drug metabolism: <ul style="list-style-type: none"> - Introduction to drug metabolism - Role of enzymes in Xenobiotic metabolism 	Lecture and class discussion Group assignment on drug metabolism due	Anzenbacher, P., & Zanger, U. M. (Eds.). (2012). Metabolism of drugs and other xenobiotics. Chapter 1 and 10, Edition 1. ebook

	Hydrolytic enzymes and transporting enzymes	(outcomes 2,4,5,6)	Voet et al. Principles of Biochemistry, 4th Edition. Chapter IV
Week 13		End Term Exam	

8. TEACHING APPROACHES

Lectures, power point presentations, and class discussions. These will take a participatory approach. **Video demonstrations and/or CD-Roms** on Enzymology when available, after the relevant topic has been covered. **Assignment criteria:** Students will be given several individual or group research assignments on topics relevant to the course. These could include lectures, discovery learning, problem-based learning, experimental learning, group-based learning, independent studies and e-learning.

9. KEY INSTITUTIONAL AND ACADEMIC POLICIES

- Seven absences from class will result in an automatic grade F
- All references used to do assignments should be cited correctly
- Assignments should be done and submitted on the due dates given. Any late submission will be penalized (2 marks per day)
- No make ups are given for tests assignments and exams unless with reasons supported in the student handbook
- Quiz's and exams will be physically written in class or on Respondus lockdown browser

10. Course Assessment;

Distribution of Marks

Attendance & Participation	5%
Continuous Assessment Tests /Quizzes (at least 2)	20%
Group Assignment	10%
Individual	10%
Mid-Quarter Exam	25%
Final Exam	30%
Total	<u>100%</u>

11. Grading

90 – 100	A
87 - 89	A ⁻
84 - 86	B ⁺
80 - 83	B
77 - 79	B ⁻
74 - 76	C ⁺
70 - 73	C

67 - 69	C ⁻
64 - 66	D ⁺
62 - 63	D
60 - 61	D ⁻
00 - 59	F

12. Core Reading Materials for the Course

- Grant, R., & Grisham, C. (2013). *Biochemistry*. 5th Edition Ebook Central
- Antonio Blanco and Gustavo Blanco (2017) *Medical Biochemistry*. Elsevier Science & Technology (ebook)-Central
- Crook, M. (2012). *Clinical biochemistry and metabolic medicine*. 8th Edition
- Anzenbacher, P., & Zanger, U. M. (Eds.). (2012). *Metabolism of drugs and other xenobiotics*. 1st Edition
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13. Recommended Reference Materials;

- Nelson, D. L. & Cox, M. M. (2012). *Lehninger Principles of Biochemistry*. 6th Edition. W. H. Freeman & Co., New York
- Donald Voet, Charlotte W. Pratt, Judith G. Voet (2012) *Principles of Biochemistry*, 4th Edition International Student Version
- Vasudevan DM, Sreekumari S. and Vaidyanathan K (2010)- *Textbook of Biochemistry for Medical Students*, 7th Edition
- Rodwell, V., Bender, D., et (2015) *Harper's Illustrated Biochemistry*. McGraw-Hill Medical Publishing Division
- Buchholz, Klaus et al. (2012) *Biocatalysts and Enzyme Technology*. Wiley-Blackwell