



SCHOOL OF PHARMACY AND HEALTH SCIENCES

COURSE: **BCM 1342 B: BIOCHEMISTRY OF BIOMOLECULES (BIOCHEMISTRY II)**
CREDIT UNIT: Credit Units: 4.5

Course Description.

The student will learn the nature of biological forms, the mechanisms of life and the mechanisms of life processes in terms of chemistry and biology.

Link to University Mission and Program Learning Outcomes:

- **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.
- **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.
- **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.
- **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.
- **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.
- **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.

Program learning outcomes

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

1. Produce pharmaceutical products utilizing appropriate procedures and standards;
2. Manage a supply chain for pharmaceutical materials and products;
3. Apply regulatory and ethical instruments that govern the practice of pharmacy;
4. Design therapeutic management regimens for patients;
5. Disseminate knowledge on health related issues;
6. Participate in health research

Course Learning Outcomes:

Upon completion of this course, students should be able to:

1. Discuss the importance of Biomolecules in biological systems
2. Explain the structure of the four major classes of Biomolecules (Carbohydrates, lipids , proteins and Nucleic acids)
3. Explain the mechanisms of biochemical reactions
4. Discuss buffers and buffering systems in the body
5. Use Handel Hasselbach equation in physiological buffers preparation
6. Perform some biochemical analyses

COURSE CONTENT

week	Topic	Practical's	Activity and learning outcome	Reading
Week 1	Introduction to Biomolecules; Simple building blocks, biomolecules, macromolecules Acids and bases; Definitions, Acid strength, dissociation constants	GROUP WORK 1	(outcomes 1) Lecture and class discussion	Reginald Grant Chapter 1/ Lehninger chapter 2/ Harpers Chapter 2
Week 2	Dissociation of water and pH; Derivation of Kw, Relationship of pH to Kw, and pKa to Ka, Henderson-Hasselbalch equation Titrations and equivalence points Buffers; What a buffer is, Relationship between buffering and Henderson-Hasselbalch equation, Buffering capacity , How to make a buffer, Physiologically important buffers		(outcomes 1) Lecture and class discussion	Reginald Grant Chapter 1/ Lehninger chapter 2/ Harpers Chapter 2
Week 3	Chemistry of Carbohydrates Monosaccharide structures; Aldoses and ketoses, Optical isomers (Fischer projections, Enantiomers, Diastereomers, Epimers), Cyclic structures) Hemiacetals and hemiketals (Anomers, Haworth projections, Furanoses and pyranoses) Monosaccharide reactions Oxidation-reductions, Esterification reactions, Formation of glycosides, Sugar derivatives	Practical 1 &2 Titration procedure for Weak Acids	(outcomes 1, 2) Lecture and class discussion	Reginald Grant Chapter 7/ Lehninger chapter 7

Week 4	<p>Chemistry of Carbohydrates</p> <p>Oligosaccharides; Sucrose, Lactose</p> <p>Polysaccharides; Cellulose and starch, Forms of starch (Amylose, Amylopectin)</p> <p>Polysaccharides; Glycogen, Chitin, Cell walls (Bacterial cell walls – peptidoglycan, Plant cell walls – cellulose, pectin, and lignin), Glycosaminoglycans</p> <p>Glycoconjugates: Proteoglycans, Glycoproteins and glycolipids</p> <p>Individual assignment 1</p>	<p>PRACTICAL 3: Preparation Of Buffers</p>	<p>(outcomes 1,2,3,4) Lecture and class discussion Quiz 1: Covering wk. 1, 2 and 3 work (outcomes 1,2,3,4) Lecture and class discussion</p>	<p>Reginald Grant Chapter 7/ Lehninger chapter 7</p>
Week 5	<p>Protein chemistry</p> <p>Amino Acid Structure; Stereochemistry (Chirality, D and L stereoisomers), Classification of amino acids (Nonpolar side chains, Neutral polar side chains, Acidic side chains, Basic side chains, Uncommon amino acids)</p> <p>Acid/Base properties of amino acids; Independent ionization of carboxyl, amino, and side chain groups, Charge dependence on pH (Zwitterions, Electrophoresis, Isoelectric pH)</p> <p>Peptide bonds; Formation, Planar nature of bond</p> <p>Small peptides of biological interest</p>	<p>DISCUSSION OF PRACTICALS 1, 2 & 3</p>	<p>(outcome 2,4) Lecture and class discussion</p>	<p>Reginald Grant Chapter 5& 6/ Lehninger chapter 3 & 4</p>
Week 6	<p>Three dimensional structure of proteins</p> <p>Protein structure linked to function; Native versus denatured conformations , Levels of protein structure and the forces holding them together (Primary, Secondary, Tertiary, Quaternary structures)</p> <p>Secondary structure: α, β helices, Bulges and turns, Supersecondary domains collagen, fibrous vs globular proteins</p> <p>Tertiary structure; Myoglobin as an example of protein structure, Folding around heme, Coordination of iron, Denaturation and refolding</p> <p>Quaternary structure; Hemoglobin as an example of protein structure, Conformational changes and hemoglobin function (Positive cooperativity of O₂ binding, Bohr effect, Effects of BPG binding)</p>	<p>PRACTICAL 4A</p> <p>Tests for Various Carbohydrates Benedict's Test for reducing sugars</p> <p>PRACTICAL 4B</p> <p>Tests for Various Carbohydrates Quantitative determination of glucose in urine using Benedict's method</p>	<p>(outcome 2,4)</p>	<p>Reginald Grant Chapter 5& 6/ Lehninger chapter 3 & 4</p>

	Thermodynamics and protein folding; Weak forces, Importance of hydrophobic interactions Individual assignment 2			
Week 7	MID SEMESTER EXAMIANCTIONS			
Week 8	Enzymes Classification of enzymes Enzyme E.C numbers Enzymes as biological catalysis's Enzyme active site Enzymes and reaction rates Enzymes catalytic power and specificity Rate limiting steps in enzyme catalyzed reactions	PRACTICAL 5 The Beer-Lambert's Law	(outcome 1,2,4,5) Lecture and class discussion	Reginald chapter 13 / Lehninger chapter 10
Week 9	Chemistry of lipids Classification of lipids, properties and functions (fatty acids, triglycerols, phosphoacylglycerols, waxes, sphingolipids, glycolipids and sterols) Membrane lipids	PRACTICAL 6 Biuret method for Protein assay	(outcomes 1,2,4,5) Lecture and class discussion	Reginald chapter 8/ Lehninger chapter 10
Week 10	Chemistry of lipids Properties and functions of sterol and glycolipids Fat soluble vitamins (D, A, E, K) structure and function	Practical 7 Extraction and Thin layer chromatography of serum lipids	(outcomes 2,4,5) Lecture and class discussion	Reginald chapter 8/Lehninger chapter 10
Week 11	Chemistry of Nucleic acids Structures of nucleotides (Purines and pyrimidines, nucleosides and nucleotides, Phosphodiester bonds) DNA structure: The double helix, Conformational variations; A, B and D forms of DNA,	DISCUSSION OF PRACTICALS 5, 6&7	(outcomes 2,3,4,5) Lecture and class discussion	Reginald chapter 10&11/ Lehninger chapter 8
Week 12	Chemistry of Nucleic acids RNA STRUCTURE AND TYPES Function of RNA		(outcomes 2,3,4,5) Lecture and class discussion Quiz 2: Covering wk. 8,9,10,11 &12 work	Reginald chapter 10&11/ Lehninger chapter 8

Week 13		End Term Exam
Week 14	-	Practical and Oral examinations

5. TEACHING APPROACHES

Lectures, power point presentations and class discussions: The instructor will give lectures in class to explain to the students various topics on Biomolecules. The lectures will take a participatory approach where the instructor will involve students by frequently asking them questions that are meant to keep them alert in class and trigger class discussions. The instructor will also be free to answer questions from the students in the course of the lectures.

Practical's: The students will perform 6 practical's and prepare reports to enhance understanding of the course.

Video shows on Biomolecules structure and function will be shown in class when available after the relevant topic has been covered.

Assignment criteria: Students will be given at least one research assignment on a relevant topic the instructor thinks is important and relevant to the course, but which will not be adequately covered in class due to limited time.

6. 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
- All online quizzes and Examinations will be administered under **Respondus Lock down and Zoom**
- Assignments should be done and submitted on the due dates
- No make ups are given for tests, assignments and exams
- Late submission of assignments and practical's will be penalized
- Practical's and assignments submitted after students have been issued back the marked books will not be marked
- For the course to be considered complete, all comments of the course must be completed

7. COURSE TEXT & OTHER READINGS

Ebook: Reginald Grant (2013). Biochemistry (International 5th Edition), Publisher CENGAGE Learning

Nelson, D. L. & Cox, M. M. (2013). Lehninger Principles of Biochemistry. 6th Edition. W. H. Freeman & Co., New York

Other Reference Texts

Victor Rodwell, David Bender Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil (2015).

Harpers Illustrated Biochemistry. 30th Ed. ISBN 0071825347. Publisher: McGraw-Hill Medical

Voet Donald (2012) .Principles of Biochemistry. Publisher John Wiley & Sons, Limited

8. COURSE EVALUATION

Attendance	5%
Participation	5%
Continuous Assessment Tests /Quizzes	10%
Individual/group assignment	10%
Mid-Quarter Exam	20%
Final Exam	25%
Continuous Practical exercises	10%
End semester Practical Exam	10%
Viva	5%
Total	100%

9. GRADING SYSTEM

A	90-100
A-	87-89
B+	84-86
B	80-83
B-	77-79
C+	74-76
C	70-73
C-	67-69
D+	64-66
D	62-63
D-	60-61
F	0-59