

INTERAMERICAN UNIVERSITY OF PUERTO RICO
Metropolitan Campus
FACULTY OF SCIENCE AND TECHNOLOGY
Department of Natural Sciences
SYLLABUS

I. GENERAL INFORMATION

Title of the Course	:	BIOCHEMISTRY OF HUMAN PHYSIOLOGY
Code and Number	:	BMSC 4015
Credits	:	3
Academic Term	:	
Professor	:	
Place and Office Hours	:	
Office Telephone	:	(787) 250-1912 ext. 2323
Email	:	@intermetro.edu

II. Course Description:

Study of the metabolic transformations suffered by chemical compounds and biopolymers at the cellular level. Physiological studies comprising bioenergetics, vitamin and hormone metabolism, anabolism and catabolism of carbohydrates, lipids and proteins, energy production through the tricarboxylic acid cycle and oxidative phosphorylation. **Requirement: CHEM 2222 (Organic Chemistry II).**

III. Objectives

1. Describe the molecular structures of biomolecules and biological polymers.
2. Explain cellular metabolic pathways or pathways.
3. Explain how enzymes carry out biochemical transformations in organisms.
4. Understand the energy transformations that occur in cells.
5. Relate anabolic and catabolic biochemical reactions with physiological aspects that occur in humans.
6. Apply ethical principles in aspects of biochemistry related to the physical well-being of people.

Competences of the profile of the graduate of the BS in Biomedical Sciences that are attended in this course

1. Analyze and use evidence-based information to validate scientific arguments.
2. Solve problems using the right methodology and knowledge integration.

IV. Course Content:

The topics of the course content appear in according to the chapters of the textbook. Keep in mind that the class's topics can be presented from another perspective, not necessarily as it appears in the book and additional information might be included.

First Unit: Introduction and Fundamentals (Chapters 1 and 2)

- A. Importance of biochemistry. Types of biomolecules and biopolymers
- B. Energy and Metabolism
 - 1. Catabolism and anabolism
 - 2. Laws of thermodynamics (First and Second Law)
 - 3. Prediction of the spontaneity of reactions according to:
 - to. Gibbs free energy and its relation to enthalpy and entropy
 - b. Entropy of the Universe and the Second Law
 - 4. The origin of life
- C. Water molecule: its chemical and physical properties.
- D. Review of types of chemical bonds, intermolecular forces, macromolecules and functional groups.
- E. Review of aqueous solutions chemistry
- F. Hydrophobic effect and its biological importance.
- G. Acid-base balance.
 - a. K_w . The pH and pOH of a solution.
 - b. Acid-base reactions. Conjugate pairs.
 - c. Strength of acids and bases (pK_a and pK_b)
 - d. Buffers (Using the Henderson-Hasselbalch equation)
 - e. Acid-base titration curves and their interpretation.
 - f. Buffer's system in humans

Second Unit: Molecular Structure and Function

- A. From Genes to Proteins (Chapter 3)
 - 1. Structure of nucleotides in DNA, RNA and their functions.
 - 2. Formation of a nucleic acid (chemical nucleotide binding)
 - 3. Primary, secondary and tertiary structure of DNA and RNA
 - 4. The Central Dogma and Genomes
 - 5. Genetic manipulation techniques, recombinant DNA, CRISPR.
 - 6. DNA Replication Process (Chapter 20, section 20.1, class discussion)
 - 7. Gene Expression (Chapter 21, Section 21.2, Class Discussion)
 - a. Transcription and Translation Process
 - b. Control of gene expression
- B. Amino Acids and Proteins (Chapter 4)
 - 1. Structure and chemical properties of amino acids
 - a. Chemical structure and classification of the 20 common amino acids.
 - b. The ionization state and its dependence on pH
 - c. Stereochemical aspects of amino acids and their consequences
 - d. The isoelectric point (I_p) of an amino acid and its importance.

2. Protein Structure and Function (Chapter 4 and 5)
 - a. Peptide bonding and conformant
 - b. Structural levels and intermolecular forces
 - c. The problem of protein folding
 - d. Myoglobin, Hemoglobin. Its interaction with O₂ at the molecular level.
 - e. Collagen, keratin and its biological function at the molecular level.
 - f. Protein sequencing using the Edman method and mass spectrometry.
 - g. Post-translational modifications in proteins
 - h. Types of conformational disease and their origin
 - i. Protein purification techniques (chromatography, SDS-PAGE)
3. Enzymatic catalysis (Chapters 6 and 7)
 - a. Enzymes as catalysts (kinetic and thermal aspects)
 - b. The most common types of chemical catalysis
 - c. The active site and transition state geometry
 - d. The chemical mechanism of chymotrypsin
 - e. Enzyme nomenclature
 - f. Introduction to enzyme kinetics
 - g. Mechanism and the Michaelis-Menten equation. Kinetic analysis.
 - h. Meaning and importance of K_M , k_{cat} , V_{max} and the ratio of k_{cat} / K_M
 - i. Lineweaver-Burk graph and how to get the kinetic parameters
 - j. Other graphical methods to obtain the kinetic parameters.
 - k. Mechanisms of inhibition and enzymatic regulation
 - l. Identification of the types of inhibitors by graphic methods
 - m. Chemical mechanism of some inhibitors.
 - n. The design and biochemical mode of action of drugs and medicines (some examples)

B. Lipids and Membranes (Chapter 8)

1. Structure and function
 - a. Fatty acids and their derivatives. Nomenclature
 - b. Triglycerides
 - c. Eicosanoids
 - d. Phospholipids and sphingolipids
 - e. Steroids and Cholesterol
 - f. Fat-soluble vitamins
 - g. Lipid and membrane protein bilayers
 - h. Examples of lisoenzymes (lipoxygenase, cyclooxygenase)

C. Carbohydrates (Chapter 11)

1. Structure and function
 - a. Monosaccharides and disaccharide
 - b. Polysaccharides and oligosaccharides

Third Unit: Physical Aspects of Migration (Chapters 12,13,14)

A. Glucose metabolism

1. Glycolysis and glycogenolysis
 2. Gluconeogenesis and glycogen synthesis
- B. Metabolism of carbohydrate oxidation products
1. Citric acid cycle
 2. Electron transport
 3. Oxidative phosphorylation
- C. Lipid Metabolism
1. Beta oxidation of fatty acids
 2. Biosynthesis of ketone bodies
 3. Cholesterol metabolism
- B. Insulin Metabolism

Fourth Unit: Biochemical Application Techniques (Chapter 4 Section)

- A. Column Chromatography (SEC, AE, CE)
- B. Electrophoresis: (SDS-PAGE, 1D, IEF, 2D)
- C. Spectrometry of protein mass (MALDI-MS and ESI-MS)
- D. NMR, X-ray Diffraction
- E. Principles of proteomic application

V. Activities

1. Face-to-face conferences.
2. Discussion of examples in class

FOR YOUR INFORMATION: This course presents and discusses the topics using Power Point (PPT) presentations and the whiteboard. Power Point presentations may be shared or provided by the teacher, but it is NOT their obligation to do so. Be clear that these presentations are NOT prepared for the student to study from them. It is NOT recommended to use them as the only source of study for exams. You should use the textbook, and other sources to study the topics discussed in class and practice problems. PPT presentations can change continuously. Not everything discussed in class is necessarily in these presentations.

VI. Evaluation

Evaluation Criteria	Points	%
Partial Exam 1	100	25
Partial Exam 2	100	25
Partial Exam 3	100	25
FINAL Exam (everything)	100	25

At least three partial tests and one final exam of all material discussed during the trimester are planned.

Exams are offered in the first 90 minutes on the day and time of class. **Students are expected to attend on time to lectures and tests.** . You will NOT be given extra time if you are late for the exam.

For exams you can bring a simple scientific calculator, pencil or pen.

CURVE: The following evaluation scale will be applied in the final grade.

100-85 A

84-75 B

74- 65 C

64-55 D

54-0 F

VII. SPECIAL NOTES

1. Ancillary services or special needs

Any student who requires auxiliary services or special assistance must request them at the beginning of the course or as soon as he acquires knowledge of those he needs, through the corresponding registration in the Office of the Professional Counselor, Mr. José Rodríguez, located in the University Orientation Program (Office 111).

2. Honesty, fraud and plagiarism

Dishonesty, fraud, plagiarism and any other inappropriate behavior in relation to academic work constitute major infractions sanctioned by the General Student Regulations. Major infractions, as provided for in the General Student Regulations, may result in the suspension of the University for a defined period of more than one year or the permanent expulsion from the University, among other sanctions.

3. Use of electronic devices

Cell phones and any other electronic device that could interrupt teaching and learning processes or alter the environment conducive to academic excellence will be deactivated. Pressing situations will be addressed, as appropriate. The handling of electronic devices that allow access, storage or sending data during evaluations or exams is prohibited.

4. Compliance with the provisions of Title IX

The Federal Higher Education Act, as amended, prohibits discrimination on the basis of sex in any academic, educational, extracurricular, athletic, or any other program or employment, sponsored or controlled by an institution of higher education regardless of whether it is conducted on or off the institution's premises, if the institution receives federal funds.

In accordance with current federal regulations, our academic unit has appointed a Title IX Assistant Coordinator who will provide assistance and guidance in relation to any alleged incident constituting discrimination based on sex or gender, sexual harassment or assault. Mr. George Rivera, Assistant Coordinator, can be reached at 787-250-1912, extension 2262 or 2147, or email griverar@metro.inter.edu.

The Normative Document entitled **Norms and Procedures to Address Alleged Violations of the Provisions of Title IX** is the document that contains the institutional rules to channel any complaint that is filed based on this type of allegation. This document is available on the website of the Inter-American University of Puerto Rico (www.inter.edu).

VIII. Educational Resources

Textbook:

Essential Biochemistry, Charlotte W. Pratt and Kathleen Cornerly, 4th Edition, John Wiley & Sons, Inc. (2017)

IX. Bibliography

Reference Texts:

1. *Biochemistry*, 8th Ed., Jeremy Berg and John L. Tymoczko, W. H. Freeman: (2015)
2. *Fundamentals of Biochemistry: Life at the Molecular Level*, 4th Ed., Donald Voet and Judith G. Voet, Wiley: (2015)
3. *Concepts in Biochemistry*, Rodney Boyer. 3rd Ed, Brooks/Cole: (2006).
4. *Lehninger Principles of Biochemistry*, 2th Edition, Nelson and Cox, W.H. Freeman: (2017)
5. *Biochemistry*, 1st Ed. Roger L. Miesfeld and Megan M. McEvoy, W.W. Norton & Company: (2017)
6. *Biochemistry: Concepts and Connections*, Dean R. Appling, Spencer J. Anthony-Cahill, and Christopher K. Mathews, Pearson: (2016)

Electronic resources:

1. Text Book Companion Site:
<http://bcs.wiley.com/hebs/Books?action=index&itemId=1118083504&bcsId=7913>
2. Interactive Concepts in Biochemistry, 3ed, Rodney Boyer
<http://www.wiley.com/legacy/college/boyer/0470003790/chapter/chapter.htm>
3. <https://www.rcsb.org/pdb/home/sitemap.do>

**REVISED
MARCH 2020**