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**Department of Biology**

**College of Education/Shaqlawa**

**University of Salahaddin**

**Subject: Enzymes and Hormones**

**Course Book: Second class**

**Lecturer's name: Dr. Noor Ali Gheni**

**Academic Year: 2022/2023**

**Course Book**

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| **1. Course name** | **Enzymes and Hormones** |
| **2. Lecturer in charge** | **Dr. Noor Ali Gheni** |
| **3. Department/ College** | **Biology/ Education/Shaqlqwa** |
| **4. Contact** | **e-mail: noor.gheni@su.edu.krd** |
| **5. Time (in hours) per week** | **Theory:    2**  **Practical: 6** |
| **6. Office hours** | **6** |
| **7. Course code** |  |
| **8. Teacher's academic profile** | **B.Sc.acheaved : 2007/ 2008**  **M.Sc. acheaved : 2008/2011**  **Employed year: 2013**  **PhD. acheaved: 2020** |
| **9. Keywords** |  |
| **10.  Course overview:**  This course surveys the structure, function, and metabolism of amino acids, proteins, carbohydrates, lipids, and nucleic acids. It introduces the concepts in cell structure, replication and growth, and metabolic regulation. By focusing on metabolic pathways, cycles, and control mechanisms. In addition, it will cover bioenergetics and metabolism of carbohydrates, lipids, amino acids and nucleotides. | |
| **11. Course objective:**  To understand the kinetics and mechanisms of action of enzymes, to become familiar with the basic methods of studying enzymes, and to appreciate how individual reactions are controlled and integrated into the metabolic pathways of the cell. Acquired theoretical and experimental knowledge will enable students to find appropriate employment in different development, scientific-research laboratories, or to continue their further studies in biochemistry or related disciplines. The objective of this course is to indicate how central metabolism and energy conservation used as a resource of understanding biological methods in general and developing problem solving skills in biochemistry. Thirdly, it provides a fundamental knowledge about the macromolecules and metabolic pathways of prokaryotes and eukaryotes, with assertion of haw works in human body systems. | |
| **12.  Student's obligation**  Sure, students play a significant role throughout the course. Based on that, there is a kind of deal between us, that all the students are obliged to attend the classes, both the theoretical and practical in the lab, during the academic year. However, they are frequently allowed not to attend the class, in in some urgent cases. Additionally, students are encouraged to see and ask me for clarifications during my office hours. Due to the previous experience, the student which has a regular attendance and look for more detailed clarification, are obtained a better result than those do not. Additionally, all the exams, assignments and reports are obligatory required from the students during the academic year 2022/2023. Since they help to evaluate the students’ achievements during the course and show the area of weakness of individual that need to be developed throughout the course.. | |
| **13. Forms of teaching**  During the classes, different equipments are used. For example, showing the information through power point slides by data show and sometimes the white board is used as well for giving more clarification and details to the students. | |
| **14. Assessment scheme**  Average per semester: 50%  Final exam 50%  **Marking System**  The grades for each piece of assessed work are as follows:   * 90-100 %  is excellent * 80-89%  is very good * 70-79%  is good * 60-69%  is a moderate pass * 50-59%  is a pass   ‌ | |
| **15. Student learning outcome:**  Upon successful completion of this course, students should be able to: explain relationship between the structure and function of enzymes; explain how enzymes are able to increase speed of an biochemical reaction in sense of thermodynamics, kinetics and molecular interactions; use catalytic strategies in interpreting mechanisms of enzymatic action; interpret and explain significant mechanisms of regulation of enzymatic action and specifies importance of enzymes in regulation of metabolism; apply appropriate methods for determination of catalytic parameters and activity of enzymes and resolve problems considering kinetics and thermodynamics of enzymatic reactions; analyze options for applying enzymes and their inhibitors in medicine and various industries; apply theoretical, practical, IT and statistical knowledge during processing experimental results and their correct | |
| **16. Course Reading List and References‌:**  ▪  **Key references**:  1. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds), 6th Edn. Macmillan Publications (2012).  2. Biochemistry VII Edition; Jeremy M Berg, John L Toymoczko and Lubert Stryer, W H Freeman and Co. (2010).  3. Physical Biology of the Cell, 2nd Edn. Rob Phillips, Jane Kondev, Julie Theriot, Hernan Garcia, Garland Publishers (2012).  4. Biochemistry; Voet, D. and Voet, J.G. [Eds.] 3rd Ed. Jhon Wiley and sons, (1999).  5. Biochemistry; David Rawn, J, Neil Patterson Publishers (1989).  6. Complex Carbohydrates, Sharon, N. Addison Wisely, (1975).  7. Methods of Enzymatic Analysis; Berg Meyer Vol. 1-X, (1974).  8. Nucleic acid Biochemistry and Molecular Biology, Mainwaring et al., Blackwell Scientific (1982).  9. Principles of Biochemistry; Smith et al., McGraw Hill (1986).  10. Proteins Structures and Molecular Properties 2nd Edn. Thomas E. Creighton, W H Freeman and Co. (1993).  11. Principles of Protein Structure, Function, & evolution, Dickerson & Geis, 2 nd Ed. BenjaminCummings (1983).  12. Biochemistry Ed. Donald Voet & Judith G. Voet, John Wiley & Sons Inc.(2010).  13. Practical Biostatistics; Mendel Suchmacher and Mauro Geller, Academic Press (2012) | |
| **17. The Topics:** | **Lecturer's name** |
| Unit-I:  **Enzymology** .Introduction to Biocatalysis, differences between chemical and biological catalysis. Nomenclature and classification of enzymes. Definition of holo-enzyme, apo-enzyme, coenzyme, cofactor. Active site, Enzyme specificity. Principles of energy ofactivation, transition state. Interaction between enzyme and substrate-lock and key, induced fit models. Fundamentals of enzyme assay, enzyme units. Outlines of mechanism of enzyme action, factors affecting enzyme activity. Commercial application of enzymes  **Unit 2:**  **Bioenergetics and Biological oxidation** 12 hours Bioenergetics: Thermodynamic principles ñ Chemical equilibria; free energy, enthalpy (H), entropy (S). Free energy change in biological transformations in living systems; High energy compounds. Energy, change, oxidationreduction reactions. Organization of electron carriers and enzymes in mitochondria. Classes of electron-transferring enzymes, inhibiters of electron transport. Oxidative phosphorylation. Uncouplers and inhibitors of oxidative phosphorylation. Mechanism of oxidative phosphorylation.  **Unite 3: Carbohydrate Metabolism**. Concept of anabolism and catabolism. Glycolytic pathway, energy yield. Fate of pyruvateformation of lactate and ethanol, Citric acid cycle, regulation, energy yield, amphipathic role. Anaplerotic reactions. Glycogenolysis and glycogenesis. Pentose phosphate pathway. Gluconeogenesis. Photosytnthesis- Light and Dark reactions, Calvin cycle, C4 Pathway. Disorders of carbohydrate metabolism- Diabetes Mellitu.  **Unit 4: Proteins**  a) Secondary structure of proteins:  b) Tertiary structure of proteins: Forces that stabilize the structure, Concept of domains, Protein denaturation.  c) Quaternary structure of proteins: Subunit interaction  d) Structure and biological functions of Collagen.  **unite 5:Nucleic acids**  a) Chemical structure & base composition of nucleic acids, Chargaff’s rules.  b) Double helical structures, Watson - Crick Model (B-DNA), Deviations from Watson - Crick Model, Other  DNA helices (A- & Z- DNA).  c) Forces stabilizing nucleic acid structures, Denaturation &renaturation, Sugar phosphate chain conformation,  Base pairing, Base stacking, Hydrophobic and ionic interactions.  **Unit6:Nucleic acids: -**  a) Tm & buoyant density and their relationship with G-C content in DNA, Satellite DNA.  b) DNA sequencing: Maxam-Gilbert & Sanger’s dideoxynucleotide sequencing.  c) Structure of m-RNA, r-RNA & t-RNA.  **Unit 7: ENZYMOLOGY**  History & Terminology  b) Classification & nomenclature of enzymes, Specificity of enzyme action (Lock & key model & Induced fit  model).  c) Enzyme catalysis: Proximity & Orientation effect, covalent catalysis, acid-base catalysis, metal ion catalysis.  d) Regulatory enzymes: - Allosteric (ATCase) & covalently modulated (Glycogen phosphorylase) enzymes.  **Unit 8: Enzyme kinetics**   Importance of measuring initial velocities, Derivation of Michaelis-Menten equation, Single &double reciprocal plots, Graphical representation of various inhibitors (Competitive, Noncompetitive &  Uncompetitive) on Lineweaver-Burke plots. Importance of Kcat / Km .Bisubstrate reactions – brief introduction to sequential and ping-pong mechanisms with examples.  a) Effect of pH, General pH profile diagram with exceptions.  b) Concept of enzyme assay & its importance, Enzyme activity units (Katal& Specific activity)  c) Enzyme isolation and purification:- Enzyme solubilization, Brief idea of various fractionation procedures,  Criteria for enzyme purity and homogeneity.  **Unit 9: Bioenergetics:**  a) Concept of free energy, Entropy, Enthalpy & Redox Potential. Determination of ΔG0’ for a reaction.  b) High energy phosphate compounds (Ex. ATP, Phosphoenol pyruvate, Creatine phosphate etc.) – phosphate potential, Free energy of hydrolysis of ATP along with reasons for high ΔG0,. Other high energy compounds.  c) ATP-ADP Cycle, Energy charge (Phosphate potential) & its relation to metabolic regulation.  **Unit 10:Protein metabolism**  a) Transamination.  b) Oxidative & Non-oxidative deamination.  c) Transport of ammonia (Carrier of ammonia – Glutamine, Alanine).  d) Urea cycle – Detailed account, Linkage of urea & TCA cycle, Compartmentation of urea cycle, Regulation,  Metabolic disorders of Urea cycle, Treatment of disorder of urea cycle.  e) Transmethylation& Decarboxylation.  f) Metabolism of phenylalanine. Glycogenic and ketogenic amino acids. | Dr. Noor Ali Gheni        (2 hrs)    (2 hrs)      (2 hrs)    (2 hrs)       (2 hrs) |
| **19. Examinations:**  ***1.  Compositional:***  **Q**/ Complete each sentence or statement  1. A reversible inhibitor that can bind to either E alone or the ES complex is referred to as a---------- ---  2. During anaerobic metabolism of glucose in muscle, there is a net production in the cytosol of lactate and :  3. ------------------inhibitor alters the Vmax of an enzyme.  4.----------- Describes the velocity of reaction when all of the available substrate binding sites on an enzyme are occupied by substrate  5. Ketosis occurs at -------------- conditions  6. The triacylglycerol present in adipose tissue is hydrolyzed by:---------------------  7.In oxidative phosphorylation, the oxidation of one molecule of NADH produces--------ATP molecules:  8. Respiratory chain is found in:------------------ .  Describe the regulation of the following metabolyic pathways (30M)  1-Regulation of Gluconeogenesis  2-Regulation of De Novo Synthesis of PyrImidine Nucleotides  3-Regulation of the Citric Acid Cycle  4- Regulation of the β-Oxidation of fatty acid | |
| **20. Extra notes:** | |
| **21. Peer review** | |