



## University of Kerala

Discipline	CHEMISTRY				
Course Code	UK3DSCCHE205				
Course Title	BIOMOLECULES AND BIOPHYSICAL CHEMISTRY-II				
Type of Course	DSC				
Semester	3				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. Higher secondary level science knowledge 2. First & second semester DSCs (chemistry) offered by UoK (preferable)				
Course Summary	This course includes topics of enzymes, lipids, kinetics of reactions, metabolism of compounds and bioenergetics. Students can learn about enzymes, classification of enzymes, importance of enzymes and their role in life. This course also discusses the chemistry of lipids and kinetics of reactions. Students learnt about metabolism of various compounds, and fundamentals of bioenergetics.				

## Detailed Syllabus:

Module	Unit	Content	Hrs
		<b>BIOMOLECULES AND BIOPHYSICAL CHEMISTRY-II</b>	<b>75</b>
1		<b>INTRODUCTION TO ENZYMES &amp; LIPIDS</b>	<b>18</b>
	1	Enzymes – Chemical nature and Features of active site. Enzyme Specificity – Stereo, reaction, substrate and broad specificity. Enzyme Commission system of classification and nomenclature of enzymes: six major classes of enzymes with one example each.	3
	2	Coenzymes and their functions - NAD, NADP+, FAD, FMN, lipoic acid, pyridoxal phosphate, biotin and cyanocobalamin. Ribozymes, Measurement and expression of enzyme activity, Definition of IU, katal, enzyme turnover number.	3
	3	Isoenzymes- Lactate dehydrogenase Applications of enzymes – Enzymes as therapeutic agents, as analytical reagents, immobilized enzymes	3
	4	Lipids: Definition, basic ideas about the biochemical functions of lipids. Classification of lipids with examples, classification of fatty acids, physical and chemical properties of fatty acids.	2



	5	Structure of the following fatty acids- stearic acid, oleic acid, linoleic acid, arachidonic acid. Structure of triacylglycerol.	2
	6	Saponification number, acid number and iodine number of fats. Essential and non-essential fatty acids with examples	2
	7	Compound lipids: membrane lipids- Structure and functions of phospholipids- phosphatidic acid, lecithin, cephalin, and phosphatidyl serine, Functions of Sphingolipids.	2
	8	Steroids: Structure and functions of cholesterol and ergosterol	1
<b>II</b>	<b>CHEMICAL KINETICS</b>		<b>9</b>
	9	Rate of reactions, various factors influencing rate, order, molecularity, zero, first, second, third order reactions. Rate determining step. Derivation of first order kinetics - fractional life time, units of rate constants	3
	10	Influence of temperature on reaction rates, Arrhenius equation, Calculation of Arrhenius parameters.	2
	11	Factors affecting enzyme catalysed reactions - effect of substrate concentration, enzyme concentration, temperature, pH and activators. Mechanism of Enzyme action - Activation energy, Interaction between enzyme and substrate- lock and key model, induced fit model. Enzyme kinetics - $K_m$ and its significance, Michaelis Menton equation (without derivation), Lineweaver- Burk plot. Significance of $K_m$ and $V_m$ values.	4
<b>III</b>	<b>INTRODUCTION TO METABOLISM</b>		<b>9</b>
	11	Metabolism- catabolism and anabolism Metabolism of carbohydrates – Glycolysis and citric acid cycle, Electron transport chain and Oxidative phosphorylation.	3
	12	Glycogenesis and glycogenolysis, Gluconeogenesis (Mention only) .	1
	13	Metabolism of lipids - Metabolism of triglycerides, Outline study of $\beta$ -oxidation of saturated and unsaturated fatty acids	3
	14	Metabolism of amino acids – Proteolysis, Urea cycle.	2
<b>IV</b>	<b>BIOENERGETICS</b>		<b>9</b>
	15	Basic concepts – System – surroundings – open, closed and isolated systems – Isothermal– isochoric and isobaric process.	3
	16	Biochemical thermodynamics, first and second law of thermodynamics, Enthalpy, Entropy and Free energy. Criteria for reversible and irreversible process - Gibbs free energy equation.	3
	17	Relationship between standard free energy change and equilibrium constant. Standard free energy changes at pH 7.0 ( $\Delta G'$ ), additive nature of $\Delta G'$ , ATP as universal currency of free energy in biological systems. Photosynthesis – solar energy harvesting	3
<b>V</b>	<b>PRACTICAL- Physical chemistry experiments &amp; Organic experiments</b>		<b>30</b>
	18	<b>Section A: Organic Quantitative Analysis: 4 Experiments from Section A are compulsory</b> 1. Saponification number of fats	15



	2. Acid number of fats 3. Iodine number of fats 4. Separation of photosynthetic pigments by TLC 5. Estimation of total chlorophyll, chlorophyll a and chlorophyll b pigments from the leaves.	
19	<b>Section B (Open ended: Any 3 experiments are to be conducted - May be selected from the list or the teacher can add experiments)</b> 1. Kinetics a. Determination of rate constant of hydrolysis of methyl acetate b. Determination of rate constant of saponification of ethyl acetate. c. Kinetics of dye degradation using spectrophotometer 2. Preparation of acidic and basic buffer 3. Measurement of pH of buffers using pH meter 4. Heat of neutralisation of strong acid – strong base titration.	15

**References:**

1. Dr. U. Satyanarayana, Dr. U. Chakrapani, *Biochemistry*, Books and Allied (P) Ltd
2. J. L. Jain, Sunjay Jain, Nitin Jain, *Fundamentals of Biochemistry*, S. Chand & Co. Ltd.
3. RK Murray, DK Granner, PA Mayers, VW Rodwell, *Harper's Biochemistry*, Prentice-Hall International Editions.
4. Sharma, Madan and Pahlania, *Principles of Physical Chemistry*, Vishal Publishing Co.
5. J.D. Lee, *Concise Inorganic Chemistry*.
6. Puri, Sharma and Kalia, "*Inorganic Chemistry*".
7. Arthur I. Vogel, B. S. Furniss, *Vogel's Textbook of practical organic chemistry*, 5th ed., Longman Scientific & Technical, London, 1996.

**Course Outcomes**

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Critically analyze the chemical nature, classification, specificity, catalytic function, and applied aspects of enzymes and lipids, including structural and functional roles of coenzymes, isoenzymes, membrane lipids, and steroids, integrating biochemical principles with real-world applications.	An	PSO-1,2,3
CO-2	Critically analyze the kinetics and mechanisms of chemical and enzyme-catalyzed reactions by evaluating the influence of various factors on reaction rates, interpreting kinetic parameters, and applying models such as the Arrhenius equation and Michaelis-	An	PSO-1,2,3



	Menten kinetics to real-world chemical and biochemical systems.		
CO3	Evaluate and integrate the biochemical pathways of carbohydrate, lipid, and protein metabolism—including glycolysis, the citric acid cycle, oxidative phosphorylation, $\beta$ -oxidation, and the urea cycle—to explain energy production and metabolic regulation in living systems.	E	PSO-1,2,3
CO 4	Critically analyze and apply the principles of thermodynamics, including energy transformations, free energy changes, and equilibrium in biochemical systems, with special emphasis on ATP metabolism and solar energy capture in photosynthesis.	C	PSO-1,2,3
CO 5	Develop advanced analytical and instrumental skills to quantitatively evaluate organic compounds, investigate reaction kinetics, and apply physicochemical principles to study biochemical systems and environmental processes.	C	PSO-1,2,3,4

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: BIOMOLECULES AND BIOPHYSICAL CHEMISTRY-II**

**Credits: 3:0:1 (Lecture:Tutorial:Practical)**

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,6 PSO-1,2,3	An	F, C	L	-
2	CO-2	PO-1,6 PSO-1,2,3	An	F, C	L	-
3	CO3	PO-1,6 PSO-1,2,3	E	F, C	L	-
4	CO 4	PO-1,6 PSO-1,2,3	C	F, C	L	-
5	CO 5	PO-1,6 PSO-1,2,3	C	F, C	-	P

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**



**Mapping of COs with PSOs and POs:**

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	3	3	2	-	-	1	-	-	-	-	2	-	-
CO 2	3	3	2	-	-	1	-	-	-	-	2	-	-
CO 3	3	3	2	-	-	1	-	-	-	-	2	-	-
CO 4	3	3	2	-	-	1	-	-	-	-	2	-	-
CO 5	3	3	2	-	-	1	-	-	-	-	2	-	-

**Correlation Levels:**

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

**Mapping of COs to Assessment Rubrics:**

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓

