University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK2DSCCHE105**				
Course Title	**BIOMOLECULES AND BIOPHYSICAL CHEMISTRY-I**				
Type of Course	**DSC**				
Semester	2				
Academic Level	100 - 199				
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. Any first semester DSC (Chemistry) offered by UoK (preferable)				
Course Summary	The course covers the chemistry of carbohydrates, amino acids and proteins, heterocyclic and bio inorganic compounds, solutions & colloids, Acids, Bases & Buffers. Students learn about the, physical and chemical properties of different classes of biomolecules and their importance. They gain a detailed understanding of solutions of acids, bases, and buffer. Students also get an idea about the biologically important heterocyclic compounds				

Detailed Syllabus:

Module	Unit	Content BIOMOLECULES AND BIOPHYSICAL CHEMISTRY-I	Hrs 75
1	**CARBOHYDRATES**		**9**
	1	Classification, configuration of D & L glyceraldehydes. Structure of ribose, 2-deoxy ribose, glucose, fructose, mannose and galactose. Properties of glucose and fructose - due to functional groups - hydroxyl, aldehyde and ketone, action of acids and alkali on sugars, Reducing actions of sugars	3
	2	Pyranoside structures of glucose and fructose. Furanoside structure of fructose (structure elucidation not expected). Mutarotation and epimerization. Glycosides and amino sugars.	2
	3	Structure and biological importance of disaccharides - sucrose, lactose, maltose and cellobiose. Inversion of sucrose.	2
	4	Structure and important properties of the following structural polysaccharides (cellulose, chitin, pectin) and storage polysaccharides (starch, inulin, glycogen), Glycosaminoglycans- heparin, hyaluronic acid.	2
II	**PROTEINS AND NUCLEIC ACIDS**		**12**
	5	Amino acids -Classification and properties, Essential and non-essential amino acids, Zwitter ion, isoelectric point	2
	6	Synthesis of amino acids - glycine, alanine and tryptophan.	3

		Polypeptides and proteins - peptide linkage. Peptide synthesis - Carbobenzoxy, Sheehan and solid phase synthesis	
	7	Proteins -primary, secondary, tertiary and quarternary structure of proteins. Denaturation and colour reactions of proteins	3
	8	RNA and DNA – Structure of purines and pyrimidines, nucleosides, nucleotides, phosphodiester linkages.	2
	9	Hydrolysis of nucleoproteins, structure of nucleic acids. their biological role. Replication of DNA.	2
III	**SOLUTIONS, COLLOIDS, ACIDS, BASES & BUFFERS**		**15**
	10	Meaning of normality, molarity, molality, percentage solution, mole fractions, simple numerical problems from the above	2
	11	Fundamental principles of diffusion and osmosis, biological importance of osmosis. Isotonic, hypotonic and hypertonic solutions.	2
	12	Meaning of true solution, colloidal solution, and coarse suspension, distinction between lyophilic and lyophobic sols	1
	13	Fundamental study of Donnan equilibrium- application in biological system, membrane permeability, methods of preparation of colloidal solution, separation of colloidal solutions, elementary study of charge on colloids	3
	14	Tyndall effect, emulsion and emulsifying agents, application of colloidal chemistry.	1
	16	Dissociation of water, ionic product of water, concepts of pH, pOH, simple numerical problems of pH. Determination of pH using indicators, pH meter and theoretical calculations.	2
	17	Dissociation of weak acids and electrolytes, Bronsted and Lewis theory of acids and bases, Meaning of K_a and pK_a values.	1
	18	Buffers: buffer action, buffers in biological system, Henderson -Hasselbach equation with derivation, simple numerical problems involving application of this equation.	3
IV	**HETEROCYCLIC AND BIO INORGANIC COMPOUNDS**		**9**
	19	Structure of furan, pyrrole, thiophene, 1,3-diazole, 1,3-thiozole, pyridine, 1,3-diazine, indole, quinoline, isoquinoline, purine and pyrimidine bases (structure only), Aromaticity of five and six membered heterocyclics.	3
	20	Metalloporphyrins – cytochromes, chlorophyll, photosynthesis and respiration, haemoglobin and myoglobin, mechanism of O_2 – CO_2 transportation.	3
	21	Biological fixation of nitrogen, Carbon fixation and carbon cycle.	1
	22	Role of alkali and alkaline earth metals in biological systems Biological functions and toxicity of Cr, Mn, Ni, Cu, Se, Mo, Co, Fe & Zn (mention only).	2
V	**PRACTICAL - ORGANIC COMPOUND ANALYSIS**		**30**
	23	**Section A: Organic Qualitative Analysis (Any 5 compounds with different functional groups are compulsory)** Systematic analysis with a view to identify the organic compound (aromatic – aliphatic, saturated – unsaturated, detection of elements and	15

		detection of functional groups) – polynuclear hydrocarbons, alcohols, phenols, halogen compounds, nitro compounds, amino compounds, aldehydes, ketones, carboxylic acids, amides, urea, thiourea and esters. Only monofunctional compounds are to be given.	
	24	**Section B (Open ended: Any 3 experiments are to be conducted - May be selected from the list or the teacher can add experiments)** a. Preparation of derivatives of above analysed organic compounds b. Identification of Carbohydrates: Glucose, fructose, sucrose and starch. c. TLC - Separation and identification- Determination of Rf value of o-and p-nitroanilines, o- and p-chloroanilines, p-chlorophenol and p-nitrophenol, p-chloroaniline and p–nitroaniline, benzil and o-nitroaniline or any two amino acids.	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*, Prentiace-Hall International Editions.
4. Sharma, Madan and Pahania, *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	Analyze the characteristics of carbohydrates and evaluate their biological roles, chemical reactivity, and transformations.	An	PSO-1&5
CO-2	Understand and analyze the structural and functional properties of proteins, and nucleic acids their synthesis, classification, structural organization, and biological roles.	Ap, An	PSO-2&5
CO3	Analyze the fundamental principles and applications of solution chemistry, colloidal systems, osmosis, acid-base theories, and buffer systems and solving related numerical problems to understand their biological and practical significance.	An, E	PSO-2&5

CO 4	Analyze the structural features, aromaticity, and biological significance of heterocyclic compounds and discuss metalloporphyrins, as well as the roles and toxicities of essential and trace elements in biological systems.	An, C	PSO-2&5
CO 5	Proficiency in chemical tests to detect specific functional groups in organic compounds, to equip with essential skills for qualitative analysis in organic chemistry laboratories.	An, Ap	PSO-2&4

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

Name of the Course: BIOMOLECULES AND BIOPHYSICAL CHEMISTRY-I

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

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO1	PO-2 PSO-1&5	An	C	L	
2	CO2	PO-1 PSO-2&5	Ap, An	C	L	
3	CO3	PO-1 PSO-2&5	An, E	F	L	
4	CO4	PO-1&2 PSO-2&5	An, C	C	L	
5	CO5	PO-1 &3 PSO-1&2	An, Ap	C, M	L	

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	2	-	-	-	2	-	2	-	-	-	-	-	-
CO 2	-	2	-	-	2	2	-	-	-	-	-	-	-
CO 3	-	2	-	-	2	2	-	-	-	-	-	-	-
CO 4	-	2	-	-	2	2	2	-	-	-	-	-	-
CO 5	2	2	-	-	-	2	-	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	√			√

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