DEPARTMENT OF BIOTECHNOLOGY				*CLASS: II B.Sc. Biotechnology*				
Sem	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Contact Hours/week**	**CIA**	**Ext**	**Total**
III	Core-5	20U3LMC5	Biochemistry	5	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	✓

Course Objectives

1	To provide students with an understanding of biomolecules, the basic building blocks of living organisms.
2	To focus on the structure, unique properties, biological roles and functions of biomolecules.
3	Emphasis on the association between structure and function of various biomolecules at a chemical level with a biological perspective.

Unit	**Description**	**Hours**	**K-level**	**CLO**
I	**The foundations of biochemistry** Chemical basis of life, Water: unique properties, weak interactions in aqueous systems, weak acids & bases - buffering action, pH, hydrogen ion concentration, Henderson and Hasselbach equation. Chemical bond- covalent, ionic, hydrogen, co-ordinate and VanderWaals force.	**15**	Up to K-2	**1**
II	**Carbohydrates and Glycobiology** Definition, classification and functions of carbohydrates. Monosaccharides - structure of aldoses and ketoses; Ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, oxidation and reduction of sugars, Disaccharides - reducing and non-reducing disaccharides - lactose, maltose, sucrose. Polysaccharides – homo- and heteropolysaccharides. Carbohydrates metabolism – glycolysis and kreb cycle.	**15**	Up to K-3	**2**
III	**Amino acids and Protein** Amino acids- Structureand classification, optical properties, Chemical properties - acid base properties, titration curve.Proteins - classification & general characteristics, primary, secondary, tertiary and quaternary structure of proteins. Enzymes- definition, activation energy, theories of enzymes action - Lock and key model, induced fit theory, classification, nomenclature, enzyme kinetics - MM plot, LB plot, Coenzyme and Cofactors. Factors affecting enzyme activity, Types of inhibitions –reversible and irreversible	**15**	Up to K-4	**3**
IV	**Lipids and Vitamins** Lipids – classification and functions of lipids, fatty acids – saturated and unsaturated, nomenclature, essential fatty acids, Storage lipids - triacyl glycerol and waxes; Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols. Metabolism of fatty acids- β oxidation of fatty acids. Structure and active forms of water soluble and fat - soluble vitamins; Deficiency diseases, hypervitaminosis	**15**	Up to K-3	**4**

V	**Nucleic acids** Nucleotides - structure and properties of bases, pentoses, nucleosides, Chargaff's rule; Nucleic acid structure – Watson-Crick model of DNA, forms of DNA – A, B & Z; Structure of mRNA, tRNA and rRNA; Properties of nucleic acids – denaturation, renaturation, hyperchromicity. Functions of nucleotides – sources of energy, secondary messengers.	**15**	Up to K-4	**5**

Books for study

1. Jain JL. 2005. Fundamentals of Biochemistry. S. Chand & Company Ltd.
2. StryerL.2000 Biochemistry, Fourth edition. W.H. Freeman and Company. New York.

Books for reference

1. SatyanarayanaUandChakrapaniU. 2009. Biochemistry. Books and Allied Pvt Ltd. Kolkata.
2. Nelson DL and CoxMM. 2013. Lehninger'sPrinciples of Biochemistry. 6th edition. W.H. Freeman and Company. New York.
3. Voet DJ, Voet JG and Pratt CW. Principles of Biochemistry. 2008. 3rd edition. John Wiley & Sons, Inc. New York.

Rationale for Nature of the course

This major core paper focuses on students' ability to understand the macromolecules of living organisms. They would discern about the way by which the macromolecules are metabolised and utilised for various cellular functions.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

- Creating mind map
- Learning the metabolism using flowchart method
- Case study to analysis the disease associated with the disorders in metabolism

Web resources

www.nptel.ac.in
www.swayam.gov.in

Pedagogy

The teaching methods may include Chalk and talk, PowerPoint, demonstrations, assignments, group discussions and Problem solving

Course content designer

Dr.N.Krithiga
Ms. R. Suguna

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K – Level
CLO-1	Explain the chemical and molecular foundations of life and appreciate the role of water in biological systems.	Up to K-2
CLO-2	Illustrate the structure, properties and roles of carbohydrates.	Up to K-3
CLO-3	Analyse the structure, function and properties of amino acids, proteins and enzymes	Up to K-4
CLO-4	Relate lipids with their biological roles	Up to K-3
CLO-5	Distinguish the various components of nucleic acid and their significance.	Up to K-4

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	3	3	1	2	2
CLO-2	3	2	2	2	1
CLO-3	3	3	3	3	3
CLO-4	3	1	2	2	1
CLO-5	3	3	3	3	3

Advance application-3; Intermediate level-2 & Basic level-1

Mapping of Course outcomes with Program specific Outcomes

CLO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	--	--	--	1
CLO-2	3	2	1	--	--
CLO-3	3	2	3	3	3
CLO-4	3	2	--	3	-
CLO-5	3	2	3	3	3

Advance application-3; Intermediate level-2 & Basic level-1

LESSON PLAN

Unit	Description	Hours	Mode
UNIT - I	Chemical basis of life, Water: unique properties, weak interactions in aqueous systems	5	Chalk and talk
	Weak acids & bases - buffering action, pH, hydrogen ion concentration, Henderson and Hasselbach equation.	5	Chalk and talk Problem solving
	Bonds in biology – Chemical bond- covalent, ionic, hydrogen, coordinate and vanderwaals bond.	5	Chalk and talk
UNIT - II	Definition, classification and functions of carbohydrates. Monosaccharides - structure of aldoses and ketoses	5	Chalk and talk
	Ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, oxidation and reduction of sugars	5	Chalk and talk
	Disaccharides - reducing and non-reducing disaccharides - lactose, maltose, sucrose. Polysaccharides – homo - and heteropolysaccharides	3	Chalk and talk PPT
	Carbohydrates metabolism – glycolysis and kreb cycle	2	Chalk and talk PPT
UNIT - III	Amino acids- Structure and classification, optical properties (Stereoisomerism), Chemical properties.	5	Chalk and talk
	Proteins - classification & general characteristics, primary, secondary, tertiary and quaternary structure of proteins.	5	Chalk and talk
	Enzymes- definition, activation energy, theories of enzymes action - Lock and key theory, induced fit theory, classification, nomenclature, enzyme kinetics - MM plot, LB plot Co enzyme and cofactors. Factors affecting enzyme activity, Types of inhibitions – reversible and irreversible.	5	Chalk and talk
UNIT-IV	Lipids -classification and functions of lipids, fatty acids – saturated and unsaturated, nomenclature, essential fatty acids, Storage lipids - triacyl glycerol and waxes	5	Chalk and talk PPT
	Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols. Metabolism of fatty acids- β oxidation of fatty acids.	5	Chalk and talk
	Structure and active forms of water soluble and fat - soluble vitamins; Deficiency diseases, hypervitaminosis	5	
UNIT - V	Nucleotides - structure and properties of bases, pentoses, nucleosides, Chargaff's rule	5	Chalk and talk
	Nucleic acid structure – Watson-Crick model of DNA, forms of DNA – A, B & Z; Structure of mRNA, tRNA and rRNA	5	Chalk and talk Problem solving
	Properties of nucleic acids – denaturation, renaturation, hyperchromity. Functions of nucleotides – sources of energy, secondary messengers.	5	Chalk and talk Problem solving

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – Biochemistry Course
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)
BLUE PRINT FOR INTERNAL ASSESSMENT – I

S. No.	CLOs	K-Level	Section A		Section B		Section C (Either / or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1.	CLO 1	Up to K 2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each Question			1		2		5	10
Total Marks for each Section			4		6		10	30

BLUE PRINT FOR INTERNAL ASSESSMENT – II

S. No.	CLOs	K-Level	Section A		Section B		Section C (Either / or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1.	CLO 3	Up to K 4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
2.	CLO 4	Up to K 3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each Question			1		2		5	10
Total Marks for each Section			4		6		10	30

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Biochemistry Course

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K-Level	Section A		Section B		Section C (Either / or Choice)	Section D (Open Choice
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each Question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	**19**	15.83	**42%**
K2	5	6	10	10	**31**	25.83	
K3	-	-	20	30	**50**	41.67	**42%**
K4	-	-	10	10	**20**	16.67	**16%**
Total Marks	10	10	50	50	**120**	100.00	**100%**

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K1 Level)	1Question from Unit-I (K2 Level)
		2 Questions fromUnit-II (K3 Level)	1Question from Unit-II (K3 Level)
		2 Questions from Unit-III (K3 Level)	1Question from Unit-III (K4 Level)
		2 Questions from Unit-IV (K2 Level)	1Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K4 Level)	1Question from Unit-V (K3 Level)

K1 –Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving Problems

K4 – Examining, analyzing, presentation and make interferences with evidences