DEPARTMENT OF MICROBIOLOGY				*CLASS: I M.Sc. Microbiology*				
Sem	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Contact Hours/week**	**CIA**	**Ext**	**Total**
I	Major core - 2	21P1RMC2	Biochemistry	4	5	25	75	100

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

Course Objectives

1. To know the bioenergetics and high energy compounds
2. To recognize different types of carbohydrates and their properties
3. To gain information about the properties and classification of amino acids and enzymes.
4. To familiarize with the properties and functions of lipids.
5. To differentiate between DNA and RNA.

Course Learning Outcomes

On successful completion of the programme, the students will be able to

1. Explain the bioenergetics process and functions of enzymes.
2. Outline the classification and properties of carbohydrates.
3. Determine the structure and properties of aminoacid and enzyme.
4. Classify the types and functions of Lipids.
5. Analyze the quantity of Nucleic acid.

Unit	Description	Hours	K- level	CLO
I	**Unit - I Bioenergetics** Concept of free energy, standard free energy, determination of Gibb's free energy (ΔG) for a reaction. Relationship between equilibrium constant and standard free energy change, biological standard state and standard free energy change in coupled reactions. Biological oxidation-reduction reactions, redox potentials, relation between standard reduction potentials and free energy change (derivations and numericals included). High energy phosphate compounds – introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates along with reasons for high ΔG. Energy change.	15Hrs	Up to K2	1

II	**Unit- II Carbohydrates** Definition and classification of carbohydrates, linear and ring forms (Haworth formula). Physical properties-mutarotation and kilianicynohydrin synthesis. Chemical properties – Oxidation, reduction,osazone formation. Monosaccharides- glucose and fructose. Disaccharides – sucrose and lactose. Oligosaccharides. Polysaccharide - starch, cellulose and hemicellulose, pectin.	15Hrs	Up to K3	2
III	**Unit- III Proteins and Enzymes** Structure, classification, physical and chemical properties of aminoacids - amphoteric nature, isoelectric point, isoelectric pH and zwitter ion. Proteins - classification, physical and chemical properties and structural organization of proteins- primary, secondary, tertiary and quaternary. Enzyme - general characteristics and IUB enzyme classification. Mechanism of enzyme action. Enzyme kinetics -Michaelis - Menton equation and its significance in enzyme kinetic studies. Lineweaver-Burkeplot and Haldane-Briggs relationship.	15Hrs	Up to K3	3
IV	**Unit- IV Lipids** Definition, classification, biological functions, physical, and chemical properties. Simple lipids - triglycerides, steryl esters, and wax esters. Compound lipids – phospholipids, glycolipids. lipoproteins. Derived lipids - steroids, sterols and terpenes. Saturated fatty acids - butyric and stearic acid. Unsaturated fatty acids - linoleic and palmitic acid. Biosynthesis of lipids– cholesterol. Oxidation of fatty acid – α and β.	15Hrs	Up toK4	4
V	**Unit- V Nucleic acids** Definition, structure of purines and pyrimidines. Nucleosides and nucleotides. Different forms of DNA. Double helical model of DNA (Watson and Crick), properties - cot curve and cot value, Tm, hypo and hyper chromicity and its biological significance. Structure, occurrence and biological functions of RNA -tRNA, mRNA and rRNA. Differences between DNA and RNA. Quantification of Nucleic Acid.	15Hrs	Up to K4	5

Total 75 Hours

Books for Study

1. Murray, R.K. and Grammer, D.K. (1990). Harper's Biochemistry. 25th Edition, McGraw Hill Publication, New York.
2. Satyanarayana, U. and Chakrapani, U. (2017). Biochemistry. 5th Edition. Books & Allied Ltd. Kolkata.
3. Jain. J.L., Jain, S. and Jain, N. (2016). Biochemistry. 7th edition, S. Chand & Co., Ltd. New Delhi.
4. David, B.D., Delbecco, R., Eisen, H.N. and Ginsburg, H.S. (1990). Microbiology. 5th Edition. Harper & Row. New York.

Books for Reference

1. Voet, D. and Voet, J.G. (2010). Biochemistry. 4th Edition. John Wiley and Sons, New Jersey.
2. Engel, P. (1986). Enzyme Kinetics. 2nd Edition. John Wiley and Sons. Inc., New York.
3. Dixon and Webb. (1979). Enzymes, 3rd Edition. Academic Press, New York.
4. Nelson, D.L. and Cox, M. (2017). Lehninger Principles of Biochemistry, 7th Edition, WH Freeman publisher, USA.

Web Resources

1. https://www.sciencedirect.com/book/9780123884251/bioenergetics
2. https://microbenotes.com/carbohydrates-structure-properties-classification-and-functions/
3. https://www.thoughtco.com/amino-acid-373556
4. https://microbenotes.com/lipids-properties-structure-classification-and-functions/
5. https://biologydictionary.net/nucleic-acid/

Rationale for Nature of the course

The goal of this course is to understand the basic building blocks of living organisms, introduce the structure and properties of various biomolecules and to emphasize on the association between structure and function of various biomolecules. This course highlights on the concepts involved in the mechanism of enzyme action and to understand the significance of vitamins as vital ingredient of life.

Activities having direct bearing on skill development/ employability/entrepreneurship

To provide knowledge on biomolecules and their significance in the metabolism
To know about the structure of biomolecules found in cells, to determine their structures.
To inculcate the formulation of biomolecules such as enzymes, hormones and vitamins in drug designing.

Pedagogy

Chalk and talk, PPT, Group discussion, Seminar, Screening of educational videos and quiz

Course Learning Outcomes (CLO)

On the completion of the course the student will be able to

CLOs	Course Learning Outcome	Knowledge Level
CLO1	Explain the bioenergetics process and functions of enzymes.	Up to K2
CLO2	Outline the classification and properties of carbohydrates.	Up to K3
CLO3	Determine the structure and properties of aminoacid and enzyme.	Up to K3
CLO4	Classify the types and functions of Lipids.	Up toK4
CLO5	Analyze the quantity of Nucleic acid.	Up to K4

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

Mapping of Course Learning Outcome with Programme Specific Outcome

	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	2	2	2	2	2
CLO2	2	2	2	2	3
CLO3	3	2	3	2	3
CLO4	2	2	2	3	2
CLO5	2	3	3	3	2

Advance application–3 Intermediate level –2 Basic level –1

Mapping of Course Outcome with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CLO1	2	2	3	3	2
CLO2	2	2	2	2	2
CLO3	3	3	2	2	2
CLO4	2	2	2	1	2
CLO5	2	1	2	3	2

Advance application–3 Intermediate level –2 Basic level –1

Learning Outcome Based Education & Assessment (LOBE)

Blue Print

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 K2	2	K2 & K2	1	K1	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K3	2	K3 & K3	1	K1	2 (K3&K3)	1(K3)
3.	CLO 3	Up to K3	2	K3 & K3	1	K2	2 (K2&K2)	1(K3)
4.	CLO 4	Up to K4	2	K4& K4	1	K2	2 (K4&K4)	1(K4)
5.	CLO 5	Up to K4	2	K1& K1	1	K3	2 (K4&K4)	1(K4)
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

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

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	2	4	10	-	**16**	13.33	**35 %**
K2	2	4	10	10	**26**	21.67	
K3	4	2	10	20	**36**	30	**30%**
K4	2	-	20	20	**42**	35	**35%**
Total Marks	10	10	50	50	**120**	100.00	**100%**

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

LESSON PLAN

Units	Description	Staff	Hours	Mode
I Bioenergetics	a) Concept of free energy, standard free energy, determination of Gibb's free energy(ΔG) for a reaction.		2	Chalk and Talk
	b) Relationship between equilibrium constant and standard free energy change, biological standard state & standard free energy change in coupled reactions.		4	
	c) Biological oxidation-reduction reactions, redox potentials, relation between standard reduction potentials & free energy change (derivations and numericals included).		5	
	d) High energy phosphate compounds – introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates along with reasons for high ΔG. Energy charge.		4	
II Carbohydrates	a) Definition and classification of carbohydrates, linear and ring forms (Haworth formula)		2	Chalk and Talk
	b) Physical properties-mutarotation and kiliani cynohydrin synthesis.		2	
	c) Chemical properties – Oxidation, reduction, osazone formation.		3	
	d) Monosaccharides- glucose and fructose.		3	
	e) Disaccharides – sucrose and lactose, Oligosaccharides.		2	
	f) Polysaccharide - starch, cellulose and hemicellulose, pectin.		3	
III Proteins and Enzymes	a) Structure, classification, physical and chemical properties of aminoacids - amphoteric nature, isoelectric point, isoelectric pH and zwitter ion.		3	Chalk and Talk & PPT
	b) Proteins - classification, physical and chemical properties and structural organization of proteins- primary, secondary, tertiary and quaternary.		3	
	c) Enzyme - general characteristics and IUB enzyme classification.		3	
	d) Mechanism of enzyme action.		2	
	e) Enzyme kinetics -Michaelis - Menton equation and its significance in enzyme kinetic studies.		2	
	f) Lineweaver- Burkeplot and Haldane-Briggs relationship.		2	

Units	Description	Staff	Hours	Mode
IV Lipids	a) Definition, classification, biological functions, physical, and chemical properties.		2	PPT & Chalk and Talk
	b) Simple lipids - triglycerides, steryl esters, and wax esters.		2	
	c) Compound lipids – phospholipids, glycolipids. lipoproteins.		2	
	d) Derived lipids - steroids, sterols and terpenes.		2	
	e) Saturated fatty acids - butyric and stearic acid.		2	
	f) Unsaturated fatty acids - linoleic and palmitic acid.		2	
	g) Biosynthesis of lipids – cholesterol.		1	
	h) Oxidation of fatty acid – α and β.		2	
V Nucleic acid	a) Definition, structure of purines and pyrimidines. Nucleosides and nucleotides.		3	Chalk and Talk & PPT
	b) Different forms of DNA.		2	
	c) Double helical model of DNA (Watson and Crick), properties - cot curve and cot value, Tm, hypo and hyper chromicity and its biological significance.		4	
	d) Structure, occurrence and biological functions of RNA -tRNA, mRNA and rRNA.		3	
	e) Differences between DNA and RNA.		1	
	f) Quantification of Nucleic Acid.		2	
Total			**75 Hours**	

Course designers

1. Mrs. N.Sumathy