DEPARTMENT OF MICROBIOLOGY				*CLASS: II B.Sc. Microbiology*				
Sem	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Contact Hours/week**	**CIA**	**Ext**	**Total**
IV	Major Core	20U4RMC6	Microbial Physiology	5	5	25	75	100

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

Course Objectives:

1. To understand microbial nutrition and energy flow
2. To understand the concept of microbial metabolism and photosynthesis
3. To know the concept of catabolism and catabolic pathways in microbes
4. To gain knowledge about the microbial anabolism and anabolic pathways
5. To know about different biosynthetic pathways in microbes

Course Learning Outcome:

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

1. Outline the concept of microbial nutrition and energy flow
2. Define the basic concept of microbial metabolism and photosynthesis
3. Summarize the concept of catabolism and catabolic pathways in microbes
4. Interpret the microbial anabolism and anabolic pathways
5. Illustrate biosynthetic pathways in microbes

Unit	Description	Hours	K-level	CLO
I	**Unit I: Microbial Nutrition** Nutritional requirements of microorganisms -autotrophs, heterotrophs, phototrophs and chemotrophs. Energy production-Phosphorylation - types. Structure of ATP and its significance.	15 hrs	Up to K2	1
II	**Unit II: Transport of nutrients** Transport of nutrients – uptake of nutrients – passive diffusion – facilitated diffusion – active transport. Simple transport (uniport, symport and antiport) – group translocation and protein export system. Role of osmoregulatory proteins.	15 hrs	Up to K3	2

III	**Unit III: Metabolism** Metabolism- Types, Aerobic, anaerobic respiration and fermentation. Catabolism – Glycolysis, Kreb cycle and ED pathway. Glyoxylate Pathway and Gluconeogenesis and their significance. Fermentation – alcoholic and lactic acid. Homo and heterolactic acid fermentation.	15 hrs	Up to K3	3
IV	**Unit IV: Anabolism** Anabolism - Photosynthesis- Classification and properties of prokaryotic photosynthetic microbes. Light reaction of Cyanobacteria, Purple and green bacteria. Dark reaction - C3 cycle and reductive TCA cycle.	15 hrs	Up to K3	4
V	**Unit V: Biosynthetic Pathways** Biosynthetic Pathway of Aminoacids – leucine, valine, isoleucine, methionine, lysine. Biosynthetic Pathways - Purine and Pyrimidine pathways. Biosynthesis of Peptidoglycan.	15 hrs	Up to K4	5

Total 75 Hours

Books for Study

1. Sale, A.J. (1992). Fundamentals Principles of Bacteriology. 7thEdition. McGraw Hill Publishing Co. Ltd. New York.
2. Dubey, R.C. and Maheswari, D.K. (2005). A Text book of microbiology. S. Chand & Company Ltd. New Delhi.

Books for Reference

1. Dall, D.O and Rao, K.K. (1995). Photosynthesis. Cambridge University press. Cambridge.
2. Stainer, R.Y.,Ingraham, J.L., Wheelis, M.L and Painter, P.R. (1986). General Microbiology. Mac Milan Education Ltd. London

Web Resources

1. https://www.microbiologynutsandbolts.co.basic-concepts.
2. https://www.microbiologyinfo.com
3. https://www.microbiology -overview-youtube.com
4. https://www.introduction to microbiology. youtube.com

Rationale for nature of the course

Microbial physiology provides information on sources of energy and its utilization by microorganisms. Microorganisms play important role in environment as producers, consumers and decomposers. These are the only group of organisms which takes part in all three important stages of ecosystem. Understanding microbial physiology has greater application in industry, developing medicine and even in agriculture.

Activities having direct bearing on skill development/ employability/entrepreneurship:

- Microbial physiology has traditionally played a very important role in both fundamental research and in industrial applications of microorganisms.
- The classical approach in microbial physiology has been to analyze the role of individual components (genes or proteins) in the overall cell function.
- It is Possible to optimize industrial fermentations through introduction of directed genetic modification - an approach referred to as metabolic engineering.

Pedagogy

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

Course Learning Outcomes (CLO)

CLOs	Course Learning Outcome *On successful completion of the programme, the students will be able to*	Knowledge Level
CLO1	Outline the concept of microbial nutrition and energy flow.	Up to K2
CLO2	Define the basic concept of microbial metabolism and photosynthesis.	Up to K3
CLO3	Summarize the concept of catabolism and catabolic pathways in microbes.	Up to K3
CLO4	Interpret the microbial anabolism and anabolic pathways	Up to K3
CLO5	Illustrate biosyntheses pathways of microbes	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	3
CLO2	2	2	2	2	2
CLO3	2	2	2	2	3
CLO4	3	3	2	2	2
CLO5	2	2	2	3	2

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

Mapping of Course Outcome with Programme Outcome

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

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

LESSON PLAN

UNITS	DESCRIPTION	STAFF	HOURS	MODE
I Microbial Nutrition	a) Nutritional requirements of microorganisms - autotrophs, heterotrophs, phototrophs and chemotrophs		5	Chalk and Talk
	b) Energy production- Phosphorylation - types		5	
	c) Structure of ATP and its significance.		5	
II Transport of nutrients	a) Transport of nutrients – uptake of nutrients – passive diffusion – facilitated diffusion – active transport		5	Chalk and Talk
	b) Simple transport (uniport, symport and antiport) – group translocation and protein export system		5	
	c) Role of osmoregulatory proteins		5	
III Metabolism	a) Metabolism- Types, Aerobic, anaerobic respiration and fermentation		3	Chalk and Talk & PPT
	b) Catabolism – Glycolysis		3	
	c) Kreb cycle and ED pathway		3	
	d) Glyoxylate Pathway and Gluconeogenesis and their significance		3	
	e) Fermentation – alcoholic and lactic acid. Homo and heterolactic acid fermentation		3	
IV Anabolism	a) Anabolism - Photosynthesis		3	PPT & Chalk and Talk
	b) Classification and properties of prokaryotic photosynthetic microbes		4	
	c) Light reaction of Cyanobacteria, Purple and green bacteria		4	
	d) Dark reaction - C3 cycle and reductive TCA cycle		4	
V Biosynthetic pathways	a) Biosynthetic Pathway of Aminoacids – leucine, valine, isoleucine, methionine, lysine		6	PPT
	b) Biosynthetic Pathways - Purine and Pyrimidine pathways		5	
	c) Biosynthesis of Peptidoglycan		4	
Total			**75 Hrs**	

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 K 3	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	2	K1 & K2	1	K1	2 (K2&K2)	1(K3)
3.	CLO 3	Up to K 3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
4.	CLO 4	Up to K 3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
5.	CLO 5	Up to K 4	2	K1 & K2	1	K2	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	5	4	10	-	**19**	15.8	**41.6%**
K2	5	6	10	10	**31**	25.8	
K3	-	-	20	30	**50**	41.7	**41.7%**
K4	-	-	10	10	**20**	16.7	**16.7%**
Total Marks	10	10	50	50	**120**	100.00	**100%**

Course designers
1. Mr. P. Sasikumar