



PSGR KRISHNAMMAL COLLEGE FOR WOMEN
COIMBATORE-641004
(College of Excellence)
Autonomous and Affiliated to Bharthiar University
Accredited with 'A⁺⁺' Grade by NAAC with CGPA 3.71 (IV Cycle)
(Ranked 7th in NIRF 2024)

DEPARTMENT OF BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS) & LEARNING OUTCOMES- BASED
CURRICULAR FRAMEWORK (LOCF)
B.Sc. BIOTECHNOLOGY

SEMESTER I - II

2025 – 2028 BATCH

B.Sc BIOTECHNOLOGY

PROGRAMME LEARNING OUTCOME (PLO's):

After completion of this programme, the student will be able to

PLO1: Achieve successful technical and professional career which will turn the student into an effective researcher or as an entrepreneur.

PLO2: Acquire sound knowledge in basic sciences and applied sciences and thereby applying the principles in dealing problems in a scientific way.

PLO3: Acquire knowledge in the fields of molecular biology, genome biology, gene engineering, protein engineering, immuno technology, tissue engineering and bioinformatics.

PLO4: Have a life-long learning to follow novel developments in the field which will inspire high ethical values and technical standards.

PLO5: Be equipped to transfer this knowledge to the consumer by applying biotechnological principles in producing a research-oriented product.

PROGRAMME SPECIFIC OUTCOME (PSO's):

At the end of the programme the student will

PSO1: Ability to understand the structure and function of cells.

PSO2: Skill to make biosafe cloning host cells, design new proteins, develops new diagnostic tools, drug discovery through virtual analysis.

PSO3: Acquire skills to higher levels of learning and/or for the development of new products.

PSO4: Initiate new start-ups in areas of biotechnology.

PSO5: Comprehend current trends to meet the future challenges in biotech industry.



BACHELOR OF SCIENCE IN BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS) &
LEARNING OUTCOME-BASED CURRICULAR FRAMEWORK (LOCF)
SYLLABUS & SCHEME OF EXAMINATION
BACHELOR OF SCIENCE IN BIOTECHNOLOGY- 2025-2028 BATCH

SEMESTER	Part	Course Code	Title of the Course	Course Type	Instruction hours/week	Contact hours	Tutorial hours	Duration of Examination	Examination Marks			Credits	
									CA	ESE	TOTAL		
I	I	TAM2501/ HIN2501/ FRE2501	Tamil Paper I / Hindi Paper I / French Paper I	L	6	88	2	3	25	75	100	3	
	II	ENG2501	English Paper I	E	6	88	2	3	25	75	100	3	
	III	BT25C01	Cell and Molecular Biology	CC	4	58	2	3	25	75	100	4	
	III	BT25CP1	Cell and Molecular Biology Practical	CC	4	60	-	5	15*	35*	50	2	
	III	BT25A01	Biochemistry	GE	4	58	2	3	20	55	75	3	
	III	CE24A01/ PS24A01	Chemistry For Biologist –I/ Physics Paper–I	GE	4	58	2	3	20	55	4	4	
	III	BT25AP1/ CE23AP1/ PS23AP1	Biochemistry Practical/ Chemistry Practical for Biologist / Physics Practical	GE	4	60	-	5	15*	35*	50	2	
												2	
	IV	Non-Tamil Students											2
		NME25B1/ NME25A1	Basic Tamil I/ Advanced Tamil I	AEC	2	28	2	-	100	-	100		
		Students with Tamil as Language											
			NME23ES/ NME23WS	Introduction to Entrepreneurship/ Women Studies	AEC	2	30	-	-	100	-	100	
I-II	VI	NM25GAW	General Awareness	AEC	SS	-	-	-	100	-	100	Gr	
I-II	VI	COM25SER	Community Services 30 Hours	GC	-	-	-	-	-	-	-	-	
I-V	VI	24BONL I 24BONL II 24BONL III	Online Course I Online Course II Online Course III	ACC	-	-	-	-	-	-	-	-	

L- Language, CC- Core Courses, E- English , ACC -Additional Credit Courses, GE - Generic Elective
AEC- Ability Enhancement Courses, GC- General Courses, CA – Continuous Assessment, ESE - End Semester Examination

Practical - *CA conducted for 25 and converted into 15. ESE conducted for 75 and converted into 35.

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDITS
BT25C01	CELL AND MOLECULAR BIOLOGY	THEORY	58	2	-	4

Preamble

- Gain a thorough understanding of cellular organization and its significance in fundamental processes such as DNA replication, transcription, and translation.
- Develop a comprehensive knowledge of cellular and molecular functions, including the roles of organelles in cell-to-cell interactions, gene regulation, and cellular signalling pathways.
- Impart the skills of molecular biology and their applications in various disciplines
- Understand the principles and molecular mechanisms involved in cellular differentiation, morphogenesis and Genetic makeup.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Identify different types of cells based on their structure and genetic material.	K1
CLO2	Understand the main ideas of the cell cycle and the factors that control it.	K2
CLO3	Apply knowledge of cell signaling and communication in practical situations.	K3
CLO4	Describe how genetic processes affect the functions and behavior of cells.	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO 5
CLO1	S	S	S	S	S
CLO2	S	M	S	M	M
CLO3	S	S	M	S	S
CLO4	S	M	S	S	M

S- Strong; M-Medium

BT25C01-CELL AND MOLECULAR BIOLOGY (58 hrs)

Unit I: Basics of Cells

(11 hrs)

Cell as a basic unit: discovery of the cells, classification of cell types, *development of cell theory, early chemical investigation in cell biology. *Prokaryotic and Eukaryotic cell organization. Cytoplasmic compartments of the cell. Structure and Functions of organelles - Extracellular Vesicles: Exosomes.

Unit II: Mechanisms of Cell Transport

(12 hrs)

Chemical composition and fluidity of membranes; *dynamic nature of membranes; mechanisms of transportation across the cell membrane- passive and active transport, facilitated diffusion and endocytosis. Regulation of membrane potentials essential for cellular signaling and homeostasis.; extracellular matrices– structure and function; cytoskeleton– structure and function, Protein Sorting - Protein degradation.

Unit III: Cell Division, Cell cycle Regulation and Cell Signaling

(12 hrs)

Eukaryotic cell cycle, Cyclin, CDKs, Check points, Cell cycle inhibitors, DNA content, Fluorescence-Activated Cell Sorting (FACS), Regulation of cell cycle- factors and genes regulating cell cycle. *Mitosis and Meiosis; Cell signaling and its types: *G protein mediated, Tyrosine kinase mediated signaling. Transposable elements-prokaryotes. Apoptosis-Mitochondrial pathway.

Unit IV: Organization and functions of DNA

(12 hrs)

Chromosomes-structure, function and specialized structure. DNA as a genetic material. Central Dogma of the cell. DNA replication in prokaryotes - Transcription in Prokaryotes and Eukaryotes - RNA Processing* - Genetic code- Translation - Eukaryotes and Prokaryotes.

UNIT V: Gene Regulation and Expression

(11 hrs)

Gene regulation: prokaryotic gene regulation- Operon concept; Lac operon and Trp operon. *Post translational modifications- phosphorylation*, glycosylation, ubiquitination and methylation. DNA damage and repair, including types of damage, factors involved, various mutation types and *DNA repair mechanisms-base excision repair, SOS repair and non-homologous end joining (NHEJ)*.

TEXT BOOKS

S. No.	Authors	Title of the book	Publishers	Year & Edition
1.	S C Rastogi	Cell and Molecular Biology	New Age International Private Limited	2020 & 4th Edn.
2.	Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter	Molecular Biology of Cell	WW Norton & Co	2021 & 7th Edn.
3.	Sastry KV, Shukla V	Developmental Biology	Rastogi Publications	2018

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Bruce Alberts, Karen Hopkin, Alexander D. Johnson, David Morgan; Martin Raff, Keith Roberts; Peter Walter	Essential Cell Biology	W.W. Norton & Company	2018 & 5 th Edn.
2	D. Freifelder	Freifelders Essentials of Molecular Biology	Jones & Bartlett Publishers	2015
3	Harvey Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh; Kelsey C. Martin; Michael Yaffe; Angelika Amon	Molecular Cell Biology	W H Freeman & Co	2021 & 9 th Edn.

Course Designer:

Dr. Archana G

***Link Provided for the Highlighted Content Offered in Blended Mode**

S.No	Topics	Video Link
Unit I: Basics of Cells		
1	Development of cell theory, prokaryotic and Eukaryotic cell organization	https://youtu.be/Pxujitlv8wc?si=VUbhZk0_nCHoq-DJ https://youtu.be/URUJD5NEXC8?si=FQUxOFpsfMkacM9f
Unit II: Mechanisms of Cell Transport		
2	dynamic nature of membranes; transportation across cell membrane; membrane potentials	https://youtu.be/qBCVVszQQNs?si=iK0tnvN8sRpCvtlg https://youtu.be/RPAZvs4hvGA?si=GKW1uLOJJVV iJuxo
Unit III: Cell Division, Cell cycle Regulation and Cell Signaling		
3	Eukaryotic cell cycle, Cyclin, CDKs, Check points, Mitosis and Meiosis; Cell signaling – types of cell signaling - G protein mediated	https://youtu.be/0BqJ58ZiWwA?si=8Azil9Zg45Gtyzby https://youtu.be/DwAFZb8juMQ?si=5eyGXuPGaXqCLeRU https://youtu.be/9sF_h-bAnIE?si=rgAtHdwb8XAYJ-gy https://youtu.be/kLOwGKEvZF0?si=mRGStR-lda_2QtvR
Unit IV: Organization and functions of DNA		
4	DNA replication in prokaryotes - Transcription in Prokaryotes and Eukaryotes - RNA Processing	https://youtu.be/IjVLhoyfGAM?si=a4jjdPTy89urWGp4 https://youtu.be/_br9ahJX4Bc?si=-1AFrYmNkrp6u2cl https://youtu.be/YjWuVrzvZYA?si=XFLID0zArvA6ibmA
Unit V: Gene Regulation and Expression		
5	DNA repair mechanisms-base excision repair, SOS repair and non-homologous end joining (NHEJ). Post translational modifications-phosphorylation,	https://youtu.be/-weaa_ja_LA?si=IxDYDvh0-2MLvtB- https://youtu.be/uITWBZ-elyk?si=O5x9xcCKtA3rAY9n https://youtu.be/JnU8-M_j6sA?si=TpIfgJCLB2oqoJOE

Module No.	Topic	CLO Level	No. of periods	Content delivery method	Learning Method
Unit I Basics of Cells					
1.	Cell as a basic unit	CLO1	1	Lecture – Chalk and Talk / Group reading	Participatory Learning
2.	Discovery of the cells,	CLO1	1	Displays	Experiential Learning
3.	Classification of cell types	CLO1	1	OER	Problem-based Learning
4.	Development of cell theory	CLO1, CLO2	1	PPT / OER	Participatory Learning
5.	Early chemical investigation in cell biology	CLO1, CLO2	1	Chalk and talk/ Picture	Problem-based Learning
6.	Prokaryotic and Eukaryotic cell organization	CLO1, CLO2	1	PPT / OER	Experiential Learning
7.	Cytoplasmic compartments of the cell.	CLO1, CLO2, CLO3	1	Virtual lab	Problem-based Learning
8.	Cytoplasmic compartments of the cell.	CLO1, CLO2, CLO3	1	Lecture – Chalk and Talk / Group reading	Participatory Learning
9.	Structure and Functions of organelles	CLO1, CLO2, CLO3	1	OER	Problem-based Learning
10.	Structure and Functions of organelles	CLO1, CLO2, CLO3	1	Lecture – Chalk and Talk / Group reading	Participatory Learning
11.	Structure and Functions of organelles- Extracellular Vesicles- Exosomes	CLO1, CLO2, CLO3	1	Lecture – Chalk and Talk / Group reading	Participatory Learning
Unit – II Mechanisms of Cell Transport					
12.	Chemical composition and fluidity of membranes;	CLO1, CLO2	1	Lecture / Seminar	Participatory Learning

13.	dynamic nature of membranes	CLO1, CLO2	1	PPT	Experiential Learning
14.	dynamic nature of membranes	CLO1, CLO2	1	Lecture / Seminar	Participatory Learning
15.	transportation across cell membrane;	CLO1, CLO2, CLO3	1	PPT	Participatory Learning
16.	membrane potentials	CLO1, CLO2, CLO3	1	PPT	Problem-based Learning
17.	membrane potentials	CLO1, CLO2, CLO3	1	Lecture / Seminar	Participatory Learning
18.	extracellular matrices– structure and function;	CLO1, CLO2, CLO3	1	OER	Participatory Learning
19.	cytoskeleton– structure and function	CLO1, CLO2, CLO3	1	Lecture / OER	Experiential Learning
20.	cytoskeleton– structure and function	CLO1, CLO2, CLO3	1	Lecture / OER	Experiential Learning
21.	Protein Sorting -	CLO1, CLO2, CLO3	1	Lecture / OER	Experiential Learning
22.	Protein degradation	CLO1, CLO2, CLO3	1	Lecture/ Virtual lab	Experiential Learning
23.	Protein degradation	CLO1, CLO2, CLO3	1	Lecture/ Virtual lab	Experiential Learning
Unit – III Cell Division, Cell cycle Regulation and Cell Signaling					
24.	Eukaryotic cell cycle,	CLO2, CLO3	1	ORE / PPT	Participatory Learning
25.	Cyclin, CDKs, Check points,	CLO2, CLO3	1	Lecture PPT	Participatory Learning
26.	Cell cycle inhibitors, DNA content, FACS,	CLO2, CLO3	1	Video / Observation	Experiential Learning
27.	Regulation of cell cycle-	CLO2, CLO3	1	Video / Observation	Experiential Learning
28.	Factors and genes regulating cell cycle.	CLO2, CLO3	1	Lecture PPT	Participatory Learning
29.	Mitosis	CLO2, CLO3	1	Lecture PPT	Participatory Learning

30.	Meiosis	CLO2, CLO3	1	Seminar / PPT	Participatory Learning
31.	Cell signaling –	CLO2, CLO3	1	Video / Observation	Experiential Learning
32.	types of cell signaling - G protein mediated	CLO2, CLO3	1	Lecture PPT	Participatory Learning
33.	Tyrosine kinase mediated signaling	CLO2, CLO3	1	Video / Observation	Experiential Learning
34.	Transposable elements- prokaryotes.	CLO2, CLO3	1	Lecture PPT	Experiential Learning
35.	Apoptosis- Mitochondrial pathway	CLO2, CLO3	1	Virtual lab, Chalk and talk/ Picture	Problem-based Learning
Unit – IV Organization and functions of DNA					
36.	Chromosomes- structure	CLO4	1	Lecture	Problem-based Learning
37.	, function and specialized structure.	CLO4	1	Seminar / PPT	Participatory Learning
38.	, function and specialized structure.	CLO4	1	PPT	Participatory Learning
39.	DNA as a genetic material.	CLO4	1	PPT	Participatory Learning
40.	Central Dogma of the cell.	CLO4	1	Demonstration	Experiential Learning
41.	DNA replication in prokaryotes -	CLO4	1	Brainstorming	Experiential Learning
42.	DNA replication in prokaryotes -	CLO4	1	PPT	Participatory Learning
43.	- Transcription in Prokaryotes and Eukaryotes	CLO4	1	PPT	Experiential Learning
44.	Transcription in Prokaryotes and Eukaryotes -	CLO4	1	PPT	Problem-based Learning
45.	Transcription in Prokaryotes and Eukaryotes -	CLO4	1	PPT	Participatory Learning
46.	- RNA Processing* - Genetic code- Translation - Eukaryotes and Prokaryotes.	CLO4	1	Research article reading	Experiential Learning

47.	- RNA Processing* - Genetic code- Translation - Eukaryotes and Prokaryotes.	CLO4	1	PPT	Problem-based Learning
Unit –V Gene Regulation and Expression					
48.	Gene regulation: prokaryotic gene regulation -	CLO3, CLO4	1	Research article reading	Experiential Learning
49.	prokaryotic gene regulation-	CLO3, CLO4	1	PPT	Participatory Learning
50.	Operon concept; Lac operon and Trp operon.	CLO3, CLO4	1	Video / Observation	Experiential Learning
51.	*Post translational modifications-	CLO3, CLO4	1	Video / Observation	Experiential Learning
52.	phosphorylation*,	CLO3, CLO4	1	PPT, Socratic	Experiential Learning
53.	glycosylation, ubiquitination and	CLO3, CLO4	1	PPT, Socratic	Problem-based Learning
54.	methylation.	CLO3, CLO4	1	PPT	Participatory Learning
55.	DNA damage and repair, including types of damage,	CLO3, CLO4	1	Lecture	Problem-based Learning
56.	factors involved, various mutation types	CLO3, CLO4	1	Lecture	Experiential Learning
57.	and *DNA repair mechanisms-base excision repair,	CLO3, CLO4	1	Lecture	Experiential Learning
58.	SOS repair and non- homologous end joining (NHEJ)*.	CLO3, CLO4	1	Research article reading	Problem-based Learning

Name of the course	BT25C01-Cell and Molecular Developmental Biology
Name of the Faculty	Dr. G. Archana
Participatory Learning	40 %
Experiential Learning	40 %
Problem-based Learning	20 %

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDITS
BT25CP1	CELL AND MOLECULAR BIOLOGY	PRACTICAL	-	-	60	4

Preamble:

- To develop the knowledge on different microbiological techniques and isolate microorganisms from the various sources and to establish pure cultures
- To isolate and differentiate different cell organelles and utilize staining techniques to visualize them
- To understand the molecular techniques in separating the genetic material from the organism
- To identify the components of blood cells and summarize the concept of cell division.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand and identify techniques in isolating different microorganisms.	K1
CLO2	Acquire the skills in interpreting the specimens and inferring the results.	K2
CLO3	Demonstrate basic molecular techniques in isolating the genetic material from both prokaryotic and eukaryotic organisms.	K3
CLO4	Interpret the components of blood cells and determine the concept of gametes	K3

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	M	M	S
CLO2	S	M	S	S	M
CLO3	S	S	M	M	S
CLO4	S	M	S	S	M

S- Strong; M-Medium

BT25CP1 - CELL AND MOLECULAR BIOLOGY (60 hrs)

1. Use of simple compound microscope and Micrometry
2. Blood smear preparation and Identification of Blood cells
3. Plant cell sectioning (CS)- Dicot and monocot sections of stem and root
4. Preparations of onion peel and observations of cells
5. Osmosis and tonicity
6. Isolation of Genomic DNA
7. Separation of DNA by Agarose gel electrophoresis
8. Quantification of DNA using UV Spectroscopy
9. Quantification of DNA using Nanodrop (DEMO)
10. Mitosis
11. Meiosis

TEXT BOOKS:

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	A K Roy & M.M.Prasad	Laboratory Manual of Microbiology: Practical Manual Series: 05	New India Publishing Agency	2010
2.	Cappuccino	Microbiology: A Laboratory Manual	Pearson Education India	2014
3.	Chaitanya K. V.	Cell and Molecular Biology - A Lab Manual	PHI Learning	2013

REFERENCE BOOKS:

S.No	Authors	Title of the book	Publishers	Year& Edition
1.	Dr. H. Abdul Jaffer Ali	Microbiology Laboratory Manual	Vijay Nicole Imprints	2017
2.	R. Saravanan , D., Dhachinamoorthi , CH. M M. Prasada Rao	A Handbook of Practical Microbiology	LAP LAMBERT Academic Publishing.	2019 & 1 st Edn.
3.	Cappuccino, J. G., & Welsh, C.	Current Protocols in Cell Biology	Wiley Publication.	2019 & 1 st Edn.

Course Designer:

Dr. G. Archana
Dr. G. Anbarasi

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDITS
BT25A01	BIOCHEMISTRY	THEORY	58	2	-	4

Preamble:

- To understand the structure of simple sugars
- To elucidate the role played by different Biomolecules
- To analyze the structure of different sugars, lipids, amino acids and proteins.
- To analyze the various pathways involved in sugar metabolism and disorders associated with it.

Course Learning Outcome

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Classify the biomolecules based on structure and function	K1
CLO2	Comprehend the basics of enzymes and their role in different metabolic processes.	K2
CLO3	Acquire knowledge on importance of each biomolecule and their molecular interactions	K3
CLO4	Identify and evaluate metabolic disorders related to biomolecules, focusing on their biochemical basis	K3

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO 5
CLO1	S	S	M	S	S
CLO2	S	M	S	M	M
CLO3	S	S	M	S	S
CLO4	S	M	S	M	S

S- Strong; M-Medium

BT25A01-BIOCHEMISTRY (58 hrs)

Unit I: Introduction to Biomolecules and Carbohydrates (12hrs)

Introduction to Biomolecules - Definition, classification, and significance; Types of molecular interactions in biomolecules.

Carbohydrates - Classification & Structure; Monosaccharides, disaccharides, oligosaccharides, polysaccharides; Structure and function of glucose, fructose, galactose, sucrose, lactose, maltose; Polysaccharides - Storage: Starch & glycogen, Structural: Brief intro to *cellulose, chitin; Heteropolysaccharides - Hyaluronic acid, *chondroitin sulfate, and their biological roles.

Unit II: Proteins & Vitamins (12hrs)

Amino acids: *structure, classification, physical and chemical properties; Proteins: Biological importance*, classification, general properties. Primary structure, Secondary structure, tertiary structure (myoglobin) and quaternary structure (Hemoglobin).

Vitamins* – water soluble and fat soluble, importance of vitamins*.

Unit III: Lipids & Nucleic Acids (11 Hours)

Introduction to Lipids -Definition, biological significance, and classification; Nomenclature and general properties; Simple Lipids- Fatty acids (Structure, classification & properties); *Triglycerides: Structure and biological role; Role in physiological functions - cholesterol, steroids, prostaglandins & eicosanoids; Compound Lipids- Phospholipids, Sphingolipids, Glycolipids; *Lipoproteins; β -Oxidation of Lipids.

Nucleic Acids – Structure and Function, DNA: Watson & Crick model & types of DNA; RNA: Structure, types, and functions

Unit IV: Enzymes (11hrs)

Enzymes – properties, classes of enzymes, enzyme reaction, theories of enzyme reaction, *MM equation, *LB plot, factors affecting enzyme reaction, enzyme units, enzyme assay, coenzyme, apo- and holo-enzymes. Co-factors, and prosthetic group, Isoenzymes. *Enzyme inhibition-Reversible (competitive, uncompetitive, non-competitive) and irreversible inhibition.

Unit V: Bioenergetics & metabolic disorders (12hrs)

Introduction to metabolism: *catabolism & anabolism. Energy metabolic pathways – Glycolysis, Krebs's cycle, Oxidative phosphorylation, Substrate level phosphorylation; Gluconeogenesis, pentose phosphate pathway. Metabolic Disorders of Energy Metabolism :Glycolysis (*hemolytic anemia), Krebs's Cycle: (neurological impairments), Oxidative Phosphorylation (Leigh syndrome); *phenylketonuria and gout.

TEXT BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Nelson,D.L.andCox,,M. Lehninger	Principles of Biochemistry	Macmillan Higher Education	2021 & 8 th Edn
2	U. Satyanarayana, U. Chakrapani	Biochemistry,	Elsevier	2021 & 6 th Edn
3	A.C. Deb	Fundamentals of Biochemistry	New central book agency	2001
4	Donald Voet, Charlotte W. Pratt, Judith G. Voet	Principles of Biochemistry	Wiley; International Student Version	2012 & 4 th Edn
5	Jain, J.L, Sunjay Jain and Nitin Jain	Biochemistry	Chand and Company, New Delhi	2010

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Victor Rodwell ,David Bender , Kathleen Botham, Peter Kennelly, P.	Harper's Biochemistry	McGraw Hill	2018& 1 st edn
2	Jeremy M.Berg, John L.Tymoczko and Lubertstryer	Biochemistry	W H Freeman & Co. ,	2002

Course Designer:

Dr. Rachana Sharma

***Link Provided for the Highlighted Content Offered in Blended Mode**

Sl. No	Topics	Video Link
Unit I: Introduction to Biomolecules and Carbohydrates		
1	Introduction to Biomolecules Structure and Function of Carbohydrates-cellulose, dextrin, chondroitin sulphate	https://www.youtube.com/watch?v=FgfkNBZaVTI https://www.youtube.com/watch?v=8UyHLl0jc-A https://www.youtube.com/watch?v=Yd3-AR_hDgk
Unit II : Proteins & Vitamins		
2	Unit II- Introduction to proteins & amino acids Proteins and their importance Importance of vitamins in life. Biological importance, classification, general properties.	https://www.youtube.com/watch?v=78QUeXVKiJ4 https://www.youtube.com/watch?v=5BBYBRWzsLA https://www.youtube.com/watch?v=rhwk3-uuUis https://www.youtube.com/watch?v=OOXLym4XD0
Unit III : Lipids & Nucleic acids		
3	Unit III- Lipids- triglycerides, Lipoproteins. β -oxidation of lipids Lipids types and importance	https://www.youtube.com/watch?v=BVxeeiR7JB0 https://www.youtube.com/watch?v=J6z77QGsYQc https://www.youtube.com/watch?v=5BBYBRWzsLA
Unit IV: Enzymes		
4	UNIT II- MM equation, LB plot, Mechanism based inhibitors	https://www.youtube.com/watch?v=y43pIHUtteM https://www.youtube.com/watch?v=jJUoQMLMV2E
Unit V : Bioenergetics & metabolic disorders		
5	Unit V- Metabolism: Catabolism & Anabolism Hemolytic anemia phenylketonuria	https://www.youtube.com/watch?v=HrYRMknYHrk https://www.youtube.com/watch?v=wTrmGhCogRk https://www.youtube.com/watch?v=XwJ-mCp-TZ0 https://www.youtube.com/watch?v=Lf4irlyN1Ee https://www.youtube.com/watch?v=UZFOdUP4UTY

Module No.	Topic	CLO level	No. of periods	Content delivery	Learning methods
Unit I - Introduction to Biomolecules & Carbohydrates					
1.	Biomolecules introduction	CLO1	1	Lecture – Chalk and Talk / Group reading	Participatory Learning
2.	Carbohydrates: Introduction & Classifications	CLO1	1	Displays	Experiential Learning
3.	Carbohydrate Structure	CLO1 CLO2	1	OER	Problem-based Learning
4.	Biological functions of biomolecules	CLO1 CLO2	1	Lecture – Chalk and Talk / Group reading	Participatory Learning
5.	Monosaccharides,	CLO1 CLO2	1	Displays	Experiential Learning
6.	Disaccharides,	CLO1 CLO2	1	PPT / OER	Participatory Learning
7.	Oligosaccharides	CLO1 CLO2	1	Chalk and talk/ Picture	Problem-based Learning
8.	Polysaccharides	CLO1 CLO2	1	Lecture – Chalk and Talk / Group reading	Participatory Learning
9.	Starch, Glycogen	CLO1 CLO2	1	Spotters/ Chalk and talk	Experiential Learning
10.	Cellulose, Chitin,	CLO1 CLO2	1	PPT / OER	Experiential Learning
11.	Hyaluronic acid,	CLO1 CLO2	1	Virtual lab	Problem-based Learning
12.	Molecular interactions in biomolecules	CLO1 CLO2	1	Lecture – Chalk and Talk / Group reading	Participatory Learning
Unit II: Proteins & Vitamins					
13.	Vitamins & their importance	CLO2 CLO3 CLO4	1	Lecture	Problem-based Learning
14.	Water soluble & fat soluble vitamins	CLO2 CLO3 CLO4	1	Research article reading	Problem-based Learning

15.	Amino acids structure and properties	CLO2 CLO3 CLO4	1	Research article reading	Problem-based Learning
16.	Classification of amino acids	CLO2 CLO3 CLO4	1	Video / Observation	Experiential Learning
17.	physical and chemical properties	CLO2 CLO3 CLO4	1	Interaction on topics and Assignment	Participatory Learning
18.	Proteins: Biological importance,	CLO2 CLO3 CLO4	1	PPT	Participatory Learning
19.	Classification & general properties.	CLO2 CLO3 CLO4	1	Demonstration	Experiential Learning
20.	Primary structure-	CLO2 CLO3 CLO4	1	Brainstorming	Participatory Learning
21.	Human Insulin,	CLO2 CLO3 CLO4	1	PPTFlipped Classroom	Problem-based Learning
22.	Secondary structure – keratin	CLO2 CLO3 CLO4	1	PPT	Problem-based Learning
23.	tertiary structure- myoglobin	CLO2 CLO3 CLO4	1	Video / Observation	Experiential Learning
24.	quaternary structure- Hemoglobin	CLO2 CLO3 CLO4	1	Research article reading	Experiential
Unit – III: Lipids & Nucleic acids					
25.	Lipids- Biological significance, nomenclature	CLO2 CLO3 CLO4	1	ORE / PPT	Participatory Learning
26.	classification of lipids	CLO2 CLO3 CLO4	1	Lecture PPT	Participatory Learning
27.	Simple lipids- Fatty acids and their properties	CLO2 CLO3 CLO4	1	Video / Observation	Experiential Learning
28.	Triglycerides, waxes, steroids prostaglandins.	CLO2 CLO3 CLO4	1	Video / Observation	Experiential Learning
29.	Compound lipids: Phospholipids, sphingolipids	CLO2 CLO3 CLO4	1	Lecture PPT	Participatory Learning
30.	Glycolipids & Lipoproteins	CLO2 CLO3 CLO4	1	Lecture PPT	Participatory Learning

31.	β -oxidation of lipids,	CLO2 CLO3 CLO4	1	Seminar / PPT	Participatory Learning
32.	Nucleic acids introduction	CLO2 CLO3	1	Demonstration	Experiential Learning
33.	Nucleoside & nucleotide	CLO2 CLO3	1	Lecture PPT	Participatory Learning
34.	DNA model & Types of DNA	CLO4 CLO5	1	Demonstration	Experiential Learning
35.	RNA significance and structure, Types of RNA	CLO2 CLO3 CLO4	1	Lecture PPT	Participatory
Unit – IV: Enzymes					
36.	Enzymes – properties	CLO1 CLO2	1	PPT / OER	Participatory Learning
37.	classes of enzymes, enzyme reaction,	CLO1 CLO2	1	Lecture / Seminar	Participatory Learning
38.	theories of enzyme reaction	CLO1 CLO2	1	PPT	Problem-based Learning
39.	MM equation, LB plot	CLO1 CLO2	1	Video / Observation	Experiential Learning
40.	factors affecting enzyme reaction,	CLO2 CLO3	1	PPT	Problem-based Learning
41.	enzyme units, enzyme assay	CLO2 CLO3	1	Lecture / Seminar	Participatory Learning
42.	Coenzyme, apo- and holo-enzymes.	CLO2 CLO3 CLO4	1	PPT	Problem-based Learning
43.	Cofactors, and prosthetic group, Isoenzymes	CLO2 CLO3 CLO4	1	Lecture / Seminar	Participatory Learning
44.	Enzyme inhibition-competitive, uncompetitive, non-competitive	CLO2 CLO3 CLO4	1	Spotters / Lecture	Experiential Learning
45.	irreversible inhibition.	CLO2 CLO3 CLO4	1	OER	Participatory Learning
46.	Mechanism based inhibitors	CLO2 CLO3 CLO4	1	Lecture / OER	Experiential
Unit-V: Bioenergetics & Metabolic disorders					
47.	Metabolism: introduction	CLO3 CLO4	1	Research article reading	Experiential Learning
48.	Catabolism & anabolism	CLO3 CLO4	1	PPT	Participatory Learning
49.	Energy metabolic pathways- Glycolysis	CLO3 CLO4	1	Video / Observation	Experiential Learning
50.	Kreb's cycle,	CLO3 CLO4	1	Video / Observation	Experiential Learning

51.	Oxidative phosphorylation & Substrate level phosphorylation	CLO3 CLO4	1	Video / Observation	Participatory Learning
52.	Gluconeogenesis	CLO3 CLO4	1	PPT, Socratic	Problem-based Learning
53.	Pentose phosphate pathway	CLO3 CLO4	1	PPT	Participatory Learning
54.	Metabolic disorders introduction	CLO3 CLO4	1	PPT	Problem-based Learning
55.	Hemolytic anemia	CLO3 CLO4	1	Video / Observation	Experiential Learning
56.	Kreb's Cycle: (neurological impairments)	CLO3 CLO4	1	PPT	Participatory Learning
57.	Oxidative Phosphorylation (Leigh syndrome)	CLO3 CLO4	1	Video / Observation	Experiential Learning
58.	Phenylketonuria and Gout	CLO3 CLO4	1	PPT	Participatory Learning

Name of the course	BT25A01-BIOCHEMISTRY
Name of the Faculty	Dr Rachana Sharma
Participatory Learning	40 %
Experiential Learning	40 %
Problem-based Learning	20 %

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDITS
BT25AP1	BIOCHEMISTRY PRACTICAL	PRACTICAL	-	-	60	2

Preamble

- To facilitate the students to evaluate the methods of biomolecules estimations, separation techniques and biochemical analysis
- To enable the students to Learn to make standard solutions
- Gain knowledge in usage of separation techniques
- Apply the knowledge of understanding volumetric, colorimetric and spectrophotometric analysis

Course Learning Outcomes

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

CLO	CLO Statement	Knowledge Level
CLO1	Apply laboratory safety rules and handle biochemical materials responsibly.	K1
CLO2	Prepare and standardize solutions for biochemical experiments.	K2
CLO3	Identify and quantify biomolecules using standard biochemical methods.	K3
CLO4	Interpret experimental data to assess nutritional and biochemical content.	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	M	M	M
CLO2	S	S	M	M	S
CLO3	S	S	M	S	S
CLO4	S	M	S	M	M

S- Strong; M-Medium

BT25AP1- BIOCHEMISTRY PRACTICAL (60hrs)

BIOCHEMISTRY

1. Laboratory rules and regulations –Safety principles and Handling
2. Preparation and standardization of solutions
3. Qualitative Analysis of Carbohydrates – Glucose, Fructose, Sucrose, Starch
4. Qualitative Analysis of Amino acid – Glycine, Tyrosine, Cysteine, Tryptophan, Proline, glutamic acid
5. Estimation of proteins-Lowry's method. Also estimate the amount of protein in the food sample provided.
6. Estimation of total free amino acids – Ninhydrin Method
7. Estimation of Glucose (Dinitrosalicylic acid method)
8. Quantification of Vitamin C and report the amount of Vit C in given citrate fruit/drink.
9. Analysis of Oils - Acid Number

TEXT BOOKS:

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	Geethalakshmi, Sundararama, Anitha Arumugam	Lab in Cell Biology, Microbiology and Bioinstrumentation: Laboratory Manual	Amazon Asia-Pacific Holdings Private Limited	2017
2.	Deepak Shrivastava	Practical Handbook of Biochemistry: Lab Manual	Notion Press	2020
3.	Sadasivam, S. and Manickam, A.	Biochemical methods	New Age International Publishers.	2018 & 3 rd Edn
4.	David Plummer	An Introduction to Practical Biochemistry	McGraw-Hill Inc.,US	3rd Edn

REFERENCE BOOKS:

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	N.A. Khan &K.N.Singh	Laboratory Manual of Biochemistry	Daya Publishing House	2014
2.	Abhijit Paintal, Chinmoy Goswami, Rabindra Narain	Handbook of Bioinstrumentation	Dominant Publishers & Distributors	2011
3.	Pingoud, A and Urbanke, C.	Biochemical Methods: A Concise Guide for Students and Researchers	Wiley-VCH.	2010 &1 st Edn

Course Designers:

Dr. Rachana Sharma

Dr. Kiruba R

BACHELOR OF SCIENCE IN BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS) &
LEARNING OUTCOMES - BASED CURRICULUM FRAMEWORK (LOCF)
SCHEME & SYLLABUS OF EXAMINATION
2025-2028 BATCH
SEMESTER II

SEM	Part	Course Code	Title of the Course	Course Type	Instruction hours/week	Contact hours	Tutorial Hours	Duration of Examination	Examination Marks			Credits
									CA	ESE	TOTAL	
II	I	TAM2502/ HIN2502/ FRE2502	Tamil Paper II/ Hindi Paper II / French Paper II	L	6	88	2	3	25	75	100	3
	II	ENG2502	English paper II	E	5	73	2	3	25	75	100	3
	III	BT25C02	Microbiology	CC	5	73	2	3	25	75	100	4
		BT25CP2	Microbiology Practical	CC	4	60	-	3	15 [§]	35 [§]	50	2
	III	BT25A02/ CE24A02/ PS24A02	Bioinstrumentation/ Chemistry for Biologists -II/ Physics Paper-II	GE	4	58	2	3	20 [€]	55 [€]	75	3
				GE	5	73	2	3	20 [€]	55 [€]	75	4
				GE	4	58	2	3	20 [€]	55 [€]	75	4
		BT25AP2/ CE23AP1/ PS23AP1	Bioinstrumentation Practical / Chemistry Practical for Biologists/ Physics Practical	GE	4	60	-	3	15 [§]	35 [§]	50	2
				GE	3	45	-	3	15 [§]	35 [§]	50	2
				GE	3	45	-	3	15 [§]	35 [§]	50	2
	IV	NM25UHR	Universal Human Values and Human Rights	AECC	2	30	-	-	100	-	100	2
		NME25B2/ NME25A2*	Basic Tamil II / Advanced Tamil II	AEC	-	-	-	-	100	-	100	Gr.
I-II	VI	NM25GAW	General Awareness	AEC	SS	-	-	-	100	-	100	Gr.
I-II	VI	COM25SER	Community Services 30 Hours	GC	-	-	-	-	-	-	-	-
I-V	VI	24BONL1 24BONL2 24BONL3	Online Course I Online Course II Online Course III	ACC	-	-	-	-	-	-	-	-

L: Language, CC: Core Courses, GE: Generic Elective, E: English, AECC: Ability Enhancement Compulsory Courses

AEC: Ability Enhancing Course, GC: General Courses, ACC: Additional Credit Courses Gr.: Grade

CA: Continuous Assessment ESE - End Semester Examination

€: CA conducted for 25 and converted into 20, ESE conducted for 75 and converted into 55

§: CA conducted for 25 and converted into 15, ESE conducted for 75 and converted into 35

***After class hours**

QUESTION PAPER PATTERN

For Core and Allied theory paper (First 3 Units)

CA Question from each unit comprising of

One question with a weightage of 2 Marks : $2 \times 3 = 6$

One question with a weightage of 5 Marks (Internal Choice at the same CLO level) : $5 \times 3 = 15$

One question with a weightage of 8 Marks (Internal Choice at the same CLO level) : $8 \times 3 = 24$

Total : 45 Marks

End Semester Examination – Question Paper Pattern and Distribution of Marks

ESE Question Paper Pattern for Core and Allied Course: $5 \times 15 = 75$ Marks

Question from each unit comprising of One question with a weightage of 2 Marks: $2 \times 5 = 10$

One question with a weightage of 5 Marks (Internal Choice at the same CLO level): $5 \times 5 = 25$

One question with a weightage of 8 Marks (Internal Choice at the same CLO level): $8 \times 5 = 40$

Attendance component in CA

From the academic year 2024-25 and onwards marks allotted for attendance component in CA is modified as

91-100% attendance: 3 Marks

81-90% attendance: 2 Marks

75-80% attendance: 1 Marks

Continuous Internal Assessment Pattern

Theory

CIA Test : 5 marks (Conducted for 45 marks after 50 days)

Model Exam : 7 marks (Conducted for 75 marks after 85 days (Each Unit 15 Marks))

Seminar/Assignment/Quiz: 5 marks

Class Participation : 5 marks

Attendance : 3 marks

Total : 25 Marks

Practical

Lab Performance - 7 marks

Regularity - 5 marks

Model Exam - 10 marks

Attendance - 3 marks

Total - 25 marks

Evaluation pattern for ESE Practical

The End Semester Examination will be conducted for a maximum of 75 marks with a maximum 15 marks for the record and other submissions if any.

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
BT25C02	MICROBIOLOGY	THEORY	73	2	-	4

Preamble

- To study the structure and function of microbial cells, enumerate different types of microbes, analyze their physiology, evaluate microbial growth, and assess the industrial applications of microorganisms.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Discuss the types, and functions of microorganisms.	K1
CLO2	Understand the different types of culture media and staining methods, and basic techniques for isolation and maintenance of microbes.	K2
CLO3	Demonstrate knowledge and practical skills in maintaining microbial growth, nutrition, and factors affecting them.	K3
CLO4	Analyse the applications of microbes in health, environment, industry and research	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO 1	S	M	S	S	M
CLO 2	S	M	L	M	M
CLO 3	M	L	M	L	M
CLO 4	S	M	L	M	M

S- Strong; M-Medium; L-Low

MICROBIOLOGY -BT25C02-73 HRS

Unit I: Introduction to Microscopy

(14 hrs)

Historical developments in microbiology History of Rishi Charak and microorganisms. Definition and scope of microbiology, Microscopy: Light Microscope: Simple; Compound Microscopes–Dark field, light field, phase contrast, Fluorescent Microscopes, Electron microscope and Confocal Microscope.

Unit II: Media and Culture Techniques

(14 hrs)

Microbiological Media: Types, preparation, methods of sterilization; enumeration of microorganisms in soil, water and air; isolation of microorganisms from environment; pure culture techniques, maintenance and Preservation; Staining: stains and types of staining-Lactophenol Cotton Blue Staining, Calcoflour staining Staining, Leishmann Staining, Gram staining, Capsule staining.

Unit III: Microbial nutrition, growth and control

(15 hrs)

Structure of bacterial cell, Growth and reproduction of bacteria. Nutrients, nutritional types of microorganisms, Autotrophic microbes, Chemotrophic microbes, Photosynthetic microbes, aerobic microbes, anaerobic microbes, Bacterial Growth, Measurement –Direct and Indirect. Bacterial growth- bacterial growth curve asynchronous growth, synchronous growth, limitation of microbial growth, Fermentative microbes.

Unit IV: Biology and Economic importance of Microbes

(15 hrs)

Biology and economic importance of Soil borne bacteria- *Rhizobium* sp, *Azospirillum*. Algae:*Spirulina*, *Cyanobacteria* Food borne- *Staphylococcus aureus*, *Clostridium* sp, *Escherichia coli*, *Pseudomonas* sp. Fungal Species: *Aspergillus* sp, *Candida* sp, *Fusarium* sp, *Pleurotus* sp. Plant viruses: NPV. Mammalian viruses: SARS-CoV-2 virus (COVID- 19). Ayurvedic view of the cause of diseases.

Unit V: Industrial Microbiology

(15 hrs)

Introduction to microbes-based enzyme production; Enzymes used in detergents, textile and leather industries. Production of amylase and protease. Impact on Society, Business, Government and People - Introduction to 5.0. Development of microbial sensors for environmental monitoring and biomedical applications. Microalgae based technologies for waste water treatment. AI-Driven Microbial Diagnostics in Poultry Diseases

Reference Links

S.No	Topics	Video Link
Unit I: Introduction to Microscopy		
1	Microscopy	https://www.youtube.com/watch?v=GBKkcB175H8
Unit II: Media and Culture Techniques		
2	Staining: stains and types of staining.	https://www.youtube.com/watch?v=i8BvkKQbiqE&t=16s
Unit III: Microbial nutrition, growth, and control		
3	Bacterial Growth, Measurement	https://www.youtube.com/watch?v=mpHpZwDXHBE
Unit IV: Biology and Economic Importance of Microbes		
4	Food borne- <i>Staphylococcus aureus</i> , <i>Salmonella</i> sp, <i>Clostridium</i> sp, <i>Escherichia coli</i> , <i>Bacillus subtilis</i> , <i>Pseudomonas</i> sp	https://www.youtube.com/watch?v=-lca4oaR9w
Unit V: Industrial Microbiology		
5	Enzymes used in detergents, textile and leather industries.	https://www.youtube.com/watch?v=gWVg4SF0RuA

Text Book

S. No.	Authors	Title of the book	Publishers	Year & Edition
1.	Michael, J. Pelczar. Jr, E. C. S Chan, Noel R. Krieg	Pelczar Microbiology	McGraw Hill	2020 7 th Edn
2.	Madigan Michael T. Martinko John M. Bender Kelly S. Buckley Daniel, H. Stahl David A.	Brock's Biology of Microorganisms	Pearson	2017, 14 th Edn
3.	Joanne Willey & Kathleen Sandman & Dorothy Wood	Prescott's Microbiology,	McGraw Hill	2020 11 th Edn
4.	Simon Baker, Jane Nicklin, Caroline Griffiths	BIOS Instant Notes in Microbiology	Taylor & Francis	2011 7 th Edn
5.	P. Kaliraj & T. Devi. Higher Education for Industry 4.0 and Transformation to Education 5.0			

Books for Reference

S. No	Authors	Title of the book	Publishers	Year & Edition
1.	Madigan, M.T., Martinko, J.M & Parker, J.	Brock's Biology of Microorganisms	Prentice Hall	2019 15 th Edn
2.	Moat Albert. G, Foster. John, W. Speetor. & Michel P	Microbial Physiology	Wiley Liss Publishers.	2011 4 th Edn
3.	Das, H.K.	TextBook of Biotechnology	Wiley Dreamtech India Pvt. Ltd	2017 5 th Edn

Course Designer

1. Dr. G. Archana

Pedagogy

- PowerPoint Presentations, Group Discussion, Seminar, Quiz Assignment, Experience Discussion

Course Content and Presentation Schedule

Module No.	Topic	CLO level	No. of hours	Content delivery method	Learning Methods
Unit – I-Introduction to Microscopy - (14 Hrs)					
1.	Historical developments in microbiology.	CLO1, CLO2	2	Lecture – Chalk and Talk / Group reading.	Participatory Learning, Experiential Learning
2.	History of Rishi Charak and microorganisms.	CLO1, CLO2, CLO3	1	Chalk and talk/ Picture	Participatory Learning
3.	Definition and scope of microbiology,	CLO2 CLO3	2	Chalk and talk/ Picture	Participatory Learning, Experiential Learning
4.	Microscopy:	CLO2, CLO3, CLO4	1	Virtual lab	Problem-based Learning, Participatory Learning
5.	Light Microscope: Simple	CLO3, CLO4	1	Virtual lab, Demonstration	Problem-based Learning
6.	Compound Microscopes–Dark field,	CLO3, CLO4	1	Virtual lab	Experiential Learning
7.	light field, phase contrast,	CLO3, CLO4	2	Demonstration	Experiential Learning
8.	Fluorescent Microscopes,	CLO3, CLO4	2	Field observations and observation of renewable organic Material	Problem-based Learning, Participatory Learning
9.	Electron microscope	CLO2, CLO3, CLO4	1	Demonstration	Experiential Learning
10.	and Confocal Microscope.	CLO3	1	Practical session demonstration	Experiential Learning
Unit – II-Media and Culture Techniques - (14 Hrs)					
11.	Microbiological Media:	CLO1, CLO2	1	Demonstration	Experiential Learning
12.	Types,	CLO1, CLO2, CLO3	1	PPT / OER	Participatory Learning

13.	preparation, methods of sterilization;	CLO1, CLO2, CLO3	1	Chalk and talk/ Picture	Participatory Learning
14.	enumeration of microorganisms in soil,	CLO2, CLO3	1	Chalk and talk/ Picture	Participatory Learning
15.	water and	CLO2, CLO4	1	Demonstration	Experiential Learning
16.	air;	CLO2, CLO3, CLO4	1	Virtual lab	Problem-based Learning
17.	isolation of microorganisms from environment;	CLO2, CLO3	1	OER/PPT	Experiential Learning
18.	pure culture techniques, maintenance and Preservation;	CLO3, CLO4	2	Virtual lab, Demonstration	Problem-based Learning, Experiential Learning
19.	Staining: stains and types of staining-	CLO3, CLO4	1	Lecture	Participatory Learning
20.	Lactophenol Cotton Blue Staining,	CLO3, CLO4	2	Demonstration	Participatory Learning
21.	Calcoflour staining Staining,	CLO2, CLO3, CLO4	1	Demonstration	Experiential Learning
22.	Leishmann Staining, Gram staining, Capsule staining.	CLO3	1	Demonstration	Experiential Learning
Unit – III-Microbial nutrition, growth and control -(15 Hrs)					
23.	Structure of bacterial cell,	CLO1, CLO2	1	Lecture – Chalk and Talk / Group reading	Participatory Learning
24.	Growth and reproduction of bacteria.	CLO1, CLO2, CLO3	2	PPT / OER	Experiential Learning
25.	nutritional types of microorganisms,	CLO2, CLO3	2	Video Lecture and Discussion https://www.youtube.com/watch?v=3A9w_PUGd8Q	Participatory Learning, Problem-based Learning

26.	Autotrophic microbes,	CLO2, CLO3, CLO4	1	Book/ Article review	Experiential Learning
27.	Chemotrophic microbes,	CLO2, CLO3	1	OER	Problem-based Learning
28.	Photosynthetic microbes,	CLO3, CLO4	1	Lecture – Chalk and Talk / Group reading	Problem-based Learning
29.	aerobic microbes,	CLO3, CLO4	1	PPT	Experiential Learning
30.	anaerobic microbes,	CLO3, CLO4	1	Lecture	Participatory Learning
31.	Bacterial Growth,	CLO3, CLO4	1	Peer teaching	Participatory Learning
32.	Measurement – Direct and Indirect.	CLO4	1	Lecture	Experiential Learning
33.	Bacterial growth-bacterial growth curve asynchronous growth,	CLO2, CLO3, CLO4	1	Peer teaching	Participatory Learning
34.	synchronous growth,	CLO2, CLO3, CLO4	1	Peer teaching	Participatory Learning
35.	limitation of microbial growth, Fermentative microbes.	CLO2, CLO3, CLO4	1	Peer teaching	Participatory Learning

Unit – IV-Biology and Economic importance of Microbes -(15 Hrs)

36.	Biology	CLO1, CLO2	1	Lecture – Chalk and Talk / Group reading	Participatory Learning
37.	and economic importance of Soil borne bacteria-	CLO1, CLO2, CLO3	1	Flipped classroom /PPT / OER	Experiential Learning
38.	<i>Rhizobium sp</i> ,	CLO1, CLO2, CLO3	1	Chalk and talk/ Picture	Participatory Learning
39.	<i>Azospirillum</i> .	CLO2, CLO3	1	Video Lecture and Discussion https://www.youtube.com/watch?v=VnxV	Experiential Learning

				<u>FgWK64U</u>	
40.	Algae:Spirulina,	CLO2, CLO4	1	Lecture – Chalk and Talk / Group reading	Experiential Learning
41.	Cyanobacteria	CLO2, CLO3, CLO4	1	Virtual lab	Problem-based Learning
42.	Food borne- Staphylococcus aureus,	CLO2, CLO3	1	Student seminar	Participatory Learning
43.	Biology and Economic Importance of Food borne- <i>Staphylococcus aureus</i>	CLO3, CLO4	1	One- minute presentati on	Participatory Learning
44.	<i>Clostridium sp</i> , <i>Escherichia coli</i> , <i>Pseudomonas sp.</i>	CLO1, CLO3	1	Virtual lab	Experiential Learning
45.	Fungal Species: <i>Aspergillus sp</i> , <i>Candida sp</i> ,	CLO3, CLO4	1	Lecture	Experiential Learning
46.	<i>Fusarium sp</i> , <i>Pleurotus sp.</i>	CLO3, CLO4	1	Field observations	Problem-based Learning
47.	Plant viruses: NPV.	CLO4	2	Lecture	Participatory Learning, Problem-based Learning
48.	Mammalian viruses: SARS- CoV-2 virus (COVID- 19).	CLO3, CLO4	1	Simulation	Experiential Learning
49.	Ayurvedic view of the cause of diseases.	CLO2, CLO3	1	Demonstration	Experiential Learning
Unit – V-Industrial Microbiology- (15 Hrs)					
50.	Introduction to microbes- based enzyme production;	CLO1, CLO2	2	Lecture – Chalk and Talk / Group reading	Participatory Learning
51.	Enzymes used in detergents,	CLO1, CLO2, CLO3	2	Chalk and talk/ Picture	Participatory Learning
52.	textile and	CLO2, CLO4	1	Demonstration	Experiential Learning

53.	leather industries.	CLO2, CLO3, CLO4	1	Demonstration	Experiential Learning
54.	Production of amylase and	CLO2, CLO3	1	Flipped Class room	Experiential Learning
55.	protease.	CLO3, CLO4	1	Virtual lab, Demonstration	Problem-based Learning
56.	Impact on Society, Business, Government and People - Introduction to 5.0.	CLO3, CLO4	2	Virtual lab	Experiential Learning, Participatory Learning
57.	Development of microbial sensors for environmental monitoring and	CLO3, CLO4	3	Field observations and observation of renewable organic material	Problem-based Learning, Participatory Learning
58.	biomedical applications.	CLO2, CLO3, CLO4	1	Book/ Article review	Experiential Learning
59.	Microalgae based technologies for waste water treatment. AI- Driven Microbial Diagnostics in Poultry Diseases	CLO2, CLO3	1	Lecture	Problem-based Learning

S.NO	LEARNING METHODS	PERCENTAGE
1	Participatory Learning	40%
2	Experiential Learning	40%
3	Problem Based Learning	20%

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
BT25A02	BIOINSTRUMENTATION	THEORY	58	2	-	3

Preamble

- To provide a foundational understanding of bioinstrumentation, including the working principles of various bioanalytical instruments and their applications in biotechnology and also focuses on familiarizing students with essential safety protocols involved in using these instruments.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Identify the principles and methodologies of various bioinstrumentation techniques.	K1
CLO2	Describe the applications of bioinstrumentation in different fields of bioscience.	K2
CLO3	Apply practical skills in operating instruments used in biological and medical contexts.	K3
CLO4	Analyze and interpret experimental techniques and results related to bioinstrumentation in research.	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	M	M	M
CLO2	M	M	M	L	S
CLO3	S	M	M	M	S
CLO4	M	M	S	S	S

S- Strong; M-Medium; L-Low

BIOINSTRUMENTATION - BT25A02- 58 hrs

Unit I: Laboratory techniques

(12 Hrs)

Biosafety in laboratories: - General safety measures, Chemical and Biological hazards. Theory, Principle, Working and Applications of - pH meter, Weighing balance, Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator. Buffers for biological experiments.

Unit II : Chromatography Techniques

(12 Hrs)

Theory, Principle, Apparatus, Methods and Applications of Paper Chromatography, TLC, HPTLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, Gas Chromatography and HPLC.

Unit III: Electrophoretic techniques

(11 Hrs)

Theory, Principle, Apparatus, Methods and Applications of Paper Electrophoresis, Agarose Gel electrophoresis, PAGE-Native and SDS. Blotting- Principles, types, Steps involved Southern, Western and Northern Blotting.

Unit IV: Colorimetric analysis and Spectroscopy

(11 Hrs)

Colorimetric Analysis: Lambert's law, Beer's law, basic principles and working of Colorimeter. Principle, working, instrumentation and applications of UV/Vis spectroscopy, IR spectroscopy, Atomic Absorption Spectroscopy, NMR spectroscopy and Mass spectroscopy.

Unit V: Radio-isotopic Techniques Image analysis

(12 Hrs)

Introduction, basic principles, types, procedure and applications of Geiger Muller Counter; Scintillation counting - solid, liquid, gas; Gamma counter and Image analysis; MRI Scan.

Reference Links

S.No.	Topics	Video Link
Unit I: Laboratory techniques		
1	Biosafety in laboratories	https://www.youtube.com/watch?v=Wyn4WpxS90
2	Working and Applications of - pH meter	https://www.youtube.com/watch?v=zJTQLce-WC8
Unit II: Chromatography Techniques		
3	HPTLC	https://www.youtube.com/watch?v=KO16ndWHcpk
4	Ion Exchange Chromatography	https://www.youtube.com/watch?v=wFpLgDceBhk
Unit III: Electrophoretic techniques		
5	Western blotting	https://www.youtube.com/watch?v=Ll_7z4YS2Ak
6	Southern blotting	https://www.youtube.com/watch?v=qsy5t0y7Zl4
Unit IV: Colorimetric analysis and Spectroscopy		
7	Basic principles and working of Colorimeter	https://www.youtube.com/watch?v=2MW-qc1ABss
8	IR spectroscopy	https://www.youtube.com/watch?v=WTmj_9VT5oE
Unit V: Radio-isotopic Techniques Image analysis		
9	Procedure and applications of Geiger Muller Counter	https://www.youtube.com/watch?v=ieEeFKrFBIg

Text Book

S. No.	Authors	Title of the book	Publishers	Year and Edition
1.	Reilly, M.J.	Bioinstrumentation	CBS Publishers & Distributors	2018 1 st Edn
2.	Priyanka Pandey	Text Book on Bioinstrumentation	Walnut Publication	2023 1 st Edn
4	Rana, S.V.S	Bio Techniques. Theory and Practices	Rastogi Publications, Meerut	2012 3 rd Edn

Books for Reference

S. No.	Authors	Title of the book	Publishers	Year and Edition
1.	Khandpur Sabari, R.S	Handbook of Analytical Instruments	McGraw Hill	2015 3 rd Edn
2.	Dinesh Kumar Chatanta & Prahlad Singh Mehra	Instrumental Methods of Analysis in Biotechnology	I K International Publishing House Pvt. Ltd; First Edition	2012 1 st Edn
3.	Nelu Grinberg & Sonia Rodriguez	Ewings Analytical Instrumentation Handbook	CRC Press	2019 4 th Edn

Course Designer

1. Dr Shalini G

Pedagogy

- PowerPoint Presentations, Group Discussion, Seminar, Quiz Assignment, Experience Discussion

Course Content and Presentation Schedule

Module No.	Topic	CLO level	No. of hours	Content delivery method	Learning Methods
Unit I: Laboratory techniques - (12 Hrs)					
1	Biosafety in laboratories: -	CLO1, CLO2	1	Lecture	Participatory Learning
2	General safety measures,	CLO1, CLO2	1	PPT	Participatory Learning
3	Chemical and	CLO1, CLO2	1	Lecture	Participatory Learning
4	Biological hazards.	CLO1, CLO2	1	PPT	Experiential Learning
5	Theory, Principle, Working and Applications of - pH meter,	CLO1, CLO2	1	PPT	Participatory Learning
6	Weighing balance,	CLO1, CLO3	1	Virtual lab	Problem-based Learning
7	Centrifuge-Preparative,	CLO1, CLO3	1	PPT	Participatory Learning
8	Analytical and ultra,	CLO1, CLO3, CLO4	1	Lecture and PPT	Experiential Learning
9	Laminar Air Flow,	CLO1, CLO3	1	PPT	Participatory Learning
10	Autoclave,	CLO1, CLO3	1	Lecture	Experiential Learning
11	Hot Air Oven and Incubator.	CLO1, CLO3	1	PPT and discussion	Experiential Learning
12	Buffers for biological experiments.	CLO1, CLO2, CLO3	1	PPT	Problem-based Learning
Unit II: Chromatography Techniques - (12 Hrs)					
13	Theory, Principle,	CLO1, CLO2	1	Discussion	Problem-based Learning
14	Apparatus,	CLO2, CLO3	1	PPT	Problem-based Learning
15	Methods and	CLO2, CLO3	1	PPT	Problem-based Learning
16	Applications of Paper Chromatography,	CLO2, CLO4	1	Lecture and PPT	Participatory Learning

17	TLC,	CLO2, CLO3	1	Lecture and PPT	Participatory Learning
18	HPTLC,	CLO2, CLO3	1	Virtual lab	Experiential Learning
19	Gel Filtration Chromatography,	CLO2, CLO1	1	Lecture	Participatory Learning
20	Ion Exchange Chromatography,	CLO2, CLO3	1	Virtual lab	Participatory Learning
21	Affinity Chromatography,	CLO2, CLO3	1	Virtual lab	Problem-based Learning
22	Gas Chromatography and	CLO2, CLO4	1	Lecture and PPT	Participatory Learning
23	HPLC	CLO1, CLO2	2	Discussion	Experiential Learning
Unit III: Electrophoretic techniques - (11 Hrs)					
24	Theory, Principle	CLO1, CLO2	1	Demonstratio n	Experiential Learning
25	Apparatus, Methods and Applications of Paper Electrophoresis,	CLO2, CLO3	1	Lecture	Problem-based Learning
26	Agarose Gel electrophoresis,	CLO1, CLO2, CLO3	3	Lecture	Participatory Learning
27	PAGE-Native and	CLO3, CLO4	1	Demonstratio n	Experiential Learning
28	SDS.	CLO3, CLO4	1	PPT	Participatory Learning
29	Blotting- Principles,	CLO3, CLO4	1	Lecture and PPT	Experiential Learning
30	types, Steps involved Southern,	CLO3, CLO4	1	PPT	Experiential Learning
31	Western and	CLO3, CLO4	1	Research article reading	Experiential Learning
32	Northern Blotting.	CLO3, CLO4	1	PPT	Problem-based Learning
Unit IV: Colorimetric analysis and Spectroscopy - (11 Hrs)					
33	Colorimetric Analysis:	CLO1, CLO4	1	PPT, Socrative	Participatory Learning

34	Lambert's law, Beer's law	CLO1, CLO4	1	PPT	Experiential Learning
35	basic principles and working of Colorimeter.	CLO2, CLO3, CLO4	1	Lecture	Problem-based Learning
36	Principle, working,	CLO2, CLO3, CLO4	1	Research article reading	Experiential Learning
37	instrumentation and applications of UV/Vis spectroscopy,	CLO2, CLO4	1	Brainstorming	Participatory Learning
38	IR spectroscopy,	CLO2, CLO3, CLO4	2	Observation	Experiential Learning
39	Atomic Absorption Spectroscopy,	CLO2, CLO4	1	OER	Participatory Learning
40	NMR spectroscopy and	CLO1, CLO2, CLO4	1	PPT	Problem-based Learning
41	Mass spectroscopy	CLO2, CLO3, CLO4	2	Lecture	Participatory Learning
Unit V: Radio-isotopic Techniques Image analysis - (12 Hrs)					
42	Introduction, basic principles, types,	CLO1, CLO2	1	PPT	Problem-based Learning
43	procedure and applications of Geiger Muller Counter;	CLO2, CLO3	2	OER	Experiential Learning
44	Scintillation counting – solid,	CLO1, CLO2	2	Seminar	Participatory Learning
45	Liquid	CLO2, CLO3	1	Virtual lab	Experiential Learning
46	gas;	CLO2, CLO3	1	PPT	Participatory Learning
47	Gamma counter and	CLO1, CLO 2	2	Lecture	Participatory Learning
48	Image analysis;	CLO2, CLO3, CLO4	2	Research article reading	Problem-based Learning
49	MRI Scan	CLO2, CLO3, CLO4	1	PPT	Problem-based Learning

SNO	LEARNING METHODS	PERCENTAGE
1	Participatory Learning	40%
2	Experiential Learning	40%
3	Problem Based Learning	20%

COURSE CODE	COURSE TITLE	CATEGORY	L		T	P	CREDIT
BT25CP2	MICROBIOLOGY PRACTICAL	PRACTICAL	-		-	60	2

Preamble

- To Introduce fundamental microbiological techniques including sterilization, media preparation, and aseptic handling. To train in the isolation, enumeration, and maintenance of microorganisms from diverse sources. To provide experience in staining, motility, and biochemical tests for microbial identification. To develop skills in growth analysis, antimicrobial sensitivity testing, and fungal characterization.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Recall and describe fundamental microbiological techniques including sterilization and media preparation.	K1
CLO2	Apply isolation and pure culture methods to obtain microorganisms from various sources.	K2
CLO3	Demonstrate staining, motility, and biochemical assays to analyze microbial characteristics.	K3
CLO4	Evaluate microbial growth patterns, antimicrobial sensitivity, and fungal morphology for interpretation of results.	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO 5
CLO1	S	S	S	S	S
CLO2	M	M	M	M	M
CLO3	M	M	M	M	M
CLO4	S	S	S	S	S

S- Strong; M-Medium; L-Low

MICROBIOLOGY PRACTICAL- BT25CP2-60 HRS

1. Microbiological techniques–Sterilization techniques, Media preparation
2. Isolation and enumeration of microbes (bacteria & fungi) from soil.
3. Pure culture methods-pour plate, spread plate, streak plate method.
4. Identification of Bacteria: Staining methods–simple and Gram's staining.
5. Motility test: Hanging drop technique.
6. Biochemical Identification–IMViC–test.
7. Hydrolysis test -Starch and Casein.
8. Growth curve of bacteria
9. Anti-microbial sensitivity test–Disc diffusion test.
10. Fungal identification: Lactophenol cotton blue staining and KOH mounting (morphology)

Text Book

S. No	Authors	Title of the book	Publishers	Year & Edition
1.	Roy, A.K & Prasad, M. M.	Laboratory Manual of Microbiology: Practical ManualSeries: 05	New India Publishing Agency	2010 1 st Edn
2.	Cappuccino	Microbiology: A Laboratory Manual	Pearson Education India	2014 3 rd Edn
3.	Amita Jain, Jyotsna Agarwal, Vimala Venkatesh	Microbiology Practical Manual	CBS Publishers & Distributors Pvt. Ltd.	2018 1 st Edn

Books for Reference

S. No	Authors	Title of the book	Publishers	Year & Edition
1.	Dr. H. Abdul Jaffer Ali	Microbiology Laboratory Manual	Vijay Nicole Imprints	2017 1 st Edn
2.	Saravanan, R., Dhachinamoorthi, D., & Prasad, M M.	A Handbook of Practical Microbiology	Lap Lambert Academic Publishing	2019 1 st Edn
3.	Dass	Microbiology practical manual	CBS Publication.	2020 1 st Edn

Course designers

1. Mrs. R Kiruba

2. Dr G Archana

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
BT25AP2	BIOINSTRUMENTATION PRACTICAL	PRACTICAL	-	-	60	2

Preamble

- To familiarize students with laboratory safety principles and good handling practices while ensuring they develop a strong foundation in essential experimental skills and also to provide hands-on experience in spectrophotometric and chromatographic analyses

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Explain the principles and methodologies of various bioinstrumentation techniques.	K1
CLO2	Apply bioinstrumentation techniques in biological and medical sample analysis.	K2
CLO3	Analyze experimental data and results obtained using bioinstrumentation tools.	K3
CLO4	Evaluate the appropriate bioinstrumentation approaches for research applications.	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO 5
CLO1	S	S	M	M	M
CLO2	S	S	M	M	S
CLO3	S	S	M	S	S
CLO4	S	M	S	M	M

S- Strong; M-Medium; L-Low

BIOINSTRUMENTATION PRACTICAL - BT25AP2- 60 HRS

1. Laboratory rules and regulations –Safety principles and Handling
2. pH measurement of samples using pH meter
3. Preparation of buffer-Phosphate Buffer
4. Centrifugation-Separation of organelles using Centrifugation
5. Paper Chromatography- Separation of plant pigments
6. Spectrophotometric method -Estimation of chlorophyll content
7. Thin Layer Chromatography for separation of amino acids
8. Analysis of Phytochemicals using HPLC (demo)

Text Book

S.No.	Authors	Title of the book	Publishers	Year & Edition
1.	Geethalakshmi Sundararama & Anitha Arumugam	Lab in Cell Biology, Microbiology and Bioinstrumentation: Laboratory Manual	Amazon Asia-Pacific Holdings Private Limited	2017 1 st Edn.
2.	Deepak Shrivastava	Practical Handbook of Biochemistry: Lab Manual	Notion Press	2020 2 nd Edn.
3.	Sadasivam S & Manickam A.	Biochemical methods	New Age International Publishers.	2018 3 rd Edn.

Books for Reference

S.No.	Authors	Title of the book	Publishers	Year and Edition
1.	Khan, N.A., & Singh, K.N.	Laboratory Manual of Biochemistry	Daya Publishing House	2014 1 st Edn
2.	Abhijit Paintal, Chinmoy Goswami & Rabindra Narain	Handbook of Bioinstrumentation	Dominant Publishers & Distributors	2011 1 st Edn
3.	Pingoud. A., & Urbanke, C.	Biochemical Methods: A Concise Guide for Students and Researchers	Wiley-VCH.	2010 1 st Edn

Course Designers

1. Dr. G. Shalini
2. Dr. Rachana Sharma