



PSGR
Krishnammal College for Women



PSGR KRISHNAMMAL COLLEGE FOR WOMEN
COIMBATORE-641004
College of Excellence
Autonomous and Affiliated to Bharathiar University
(Accredited with 'A++' Grade by NAAC with CGPA 3.71 (IV Cycle),
(Ranked 4th in NIRF 2023)

CHOICE BASED CREDIT SYSTEM
&
OUTCOME BASED EDUCATION SYLLABUS

M.Sc. BIOTECHNOLOGY

SEMESTER - I & II

BATCH 2023-25

PROGRAMME LEARNING OUTCOMES (PLO's)

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

PLO1: Apply the theoretical and practical skills gained in the multidisciplinary field of Biotechnology to solve real world problems, or crack a competitive exam for higher studies or to perform well in a job interview.

PLO2: Gain an in-depth understanding to design and perform experiments, analyze and interpret experimental data in biotechnology and related areas.

PLO3: Acquire the ability to write well structured reviews, scientific publications and communicate scientific results to the general public and subject experts by oral presentations or posters.

PLO4: Understand the safety procedures in handling chemicals, laboratory equipment, biological materials and genetically modified organisms.

PLO5: Acquire the ability to carry out research independently or in groups in multidisciplinary projects.

PROGRAMME SPECIFIC OUTCOME (PSO's)

The students at the time of graduation will

PSO1: Comprehend Biotechnology and other multidisciplinary areas prescribed in the syllabus.

PSO2: Understand the structure and functions of microbial, animal and plant cells.

PSO3: Develop skills for the design of new products.

PSO4: Acquire higher order thinking skills.

PSO5: Acquire knowledge in the current trends to meet the future challenges in the Biotech, Genomics and Pharmaceutical industries.

**CHOICE BASED CREDIT SYSTEM & OUTCOME BASED EDUCATION
SYLLABUS & SCHEME OF EXAMINATION**

MASTER OF SCIENCE BIOTECHNOLOGY – 2023-2025 BATCH

Applicable to students admitted during the academic year 2023-2024 onwards (I Sem)

SEM	Subject Code	Title of the Paper	Instruction hours/week	Contact hours	Tutorial	Duration of Examination	Examination Marks			Credits
							CA	ESE	TOTAL	
I	MBY2301	Paper-I Cell and Molecular Biology	5	73	2	3	25	75	100	4
	MBY2302	Paper-II Biochemistry	5	73	2	3	25	75	100	4
	MBY2303	Paper-III Microbiology	4	58	2	3	25	75	100	4
	MBY2304	Paper IV-Bioinformatics	4	58	2	3	25	75	100	4
	MBY23P1	Practical-I Biochemistry and Microbiology	6	90	-	6	25	75	100	4
	MBY23P2	Practical-II Cell & Molecular Biology and Bioinformatics	6	90	-	6	25	75	100	4

CA - Continuous Assessment

ESE - End Semester Examination

QUESTION PAPER PATTERN

CIA Test	-	5	Conducted for 45 marks after 50 days
Model Exam	-	7	Conducted for 75 marks after 85 days (Q.P. Pattern (2,5,8) Each Unit 15 Marks)
Seminar/Assignment/Quiz	-	5	
Class Participation	-	5	
Attendance	-	3	
		25	+ ESE 75 Marks

CIA Question Paper Pattern: 1 x 45 = 45 Marks

One question from each unit with each question comprising of

Section A	-	3 x 2 = 6
Section B	-	3 x 5 = 15 (either or – same CLO Level)
Section C	-	3 x 8 = 24 (either or – same CLO Level)
Total		45

Model Question Paper Pattern: Conducted for 75 marks

(Q.P. Pattern (2,5,8) Each Unit 15 Marks)

Section A	-	5 x 2 = 10
Section B	-	5 x 5 = 25 (either or – same CLO Level)
Section C	-	5 x 8 = 40 (either or – same CLO Level)
Total		75

Practical (for 25 Marks)

Lab Performance	-	7 marks
Regularity	-	5 marks
Model Exam	-	10 marks
Attendance	-	3 marks
Total	-	25 marks

ESE Practical Pattern

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 NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2301	PAPER-I CELL & MOLECULAR BIOLOGY	CORE THEORY	73	2	-	4

Objectives

To facilitate the students to

- Gain a comprehensive understanding of the cellular and molecular functions of cell organelles, including their role in cell-to-cell interaction, gene regulation, and cellular signaling.
- Acquire the skills of molecular biology and how they are applied in different disciplines.
- Understand the principles and molecular mechanisms involved in cellular differentiation, morphogenesis, growth, and cell potency.

COURSE OUTCOMES

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Summarize about the various intracellular organelles.	K2
CLO2	Explain about the mechanism and regulation of intracellular transport in cellular organelles.	K3
CLO3	Outline about DNA damage and evaluate different types of repair mechanisms.	K4
CLO4	Justify the importance of Transcription, Post Transcriptional Modification, Translation and Post Translational modification.	K5
CLO5	Report about proto-oncogenes, oncogenes and tumor suppressor genes.	K6

Mapping with CLOs

CLOs	PLO1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	S	M	S	S	S
CLO2	S	M	S	S	M
CLO3	S	S	S	S	S
CLO4	S	M	S	S	M
CLO5	S	M	S	S	S

M-Medium S-Strong

SYLLABUS

UNIT - I Cell Organization and Cell Cycle

15 hrs

Structure of prokaryotic and eukaryotic cells. Structural organization and function of intracellular organelles (Nucleus, Endoplasmic Reticulum, Golgi complex, Mitochondria, Chloroplast, Lysosomes, Peroxisomes and Vacuoles), Cytoskeletons. Chromatin organization and packaging. Cell cycle and its regulation, Prokaryotic and Eukaryotic cell cycle. Cell cycle check points-WEE1, CHK1, CHK2. Cyclins (D1,D2,B1,A1) and Cyclin Dependent Kinases (CDKA, CDK B)protein kinases-Tyrosine kinase, MAPK Kinase. Phosphatases – CDC25

UNIT - II Structure of membrane system, Cellular transport and trafficking

14 hrs

Lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, and ion pumps. Intracellular protein sorting- Molecular Mechanism and regulation of intracellular transport in mitochondria, chloroplast, endoplasmic reticulum and nucleus. Electrical properties of membranes. Intracellular vesicular trafficking from endoplasmic reticulum through Golgi apparatus to lysosomes/cell exterior.

UNIT - III DNA repair & Recombination

15 hrs

DNA damage and repair mechanism (Mismatch correction, Base excision repair, Nucleotide excision repair, Direct repair, Photoreactivation, Error prone Translesion DNA synthesis, SOS repair). Chemically induced mutation - Base analogs, Nitrous acid, Acridines, Alkylating and hydroxylating agents. DNA Recombination - Homologous and non-homologous, Site specific recombination. Chi sequences in prokaryotes, Gene targeting, Gene disruption, FLP/FRT and Cre/Lox recombination.

UNIT – IV Replication, Transcription, Translation and Regulation of gene expression

15 hrs

DNA Replication-Types, Prokaryotic and Eukaryotic replication. Transcription-Prokaryotic and Eukaryotic. Translation-Prokaryotes and Eukaryotes, Post Translational modifications. Regulation of gene expression - Operon concept, *lac*, *trp*, *ara*, *his*, and *gal* operons. Regulatory proteins, DNA binding Motifs: Zinc fingers, Helix turn Helix, Homeodomain. Regulation in eukaryotes - Control by promoter, enhancer and silencers.Cis-trans elements, DNA methylation and chromatin remodeling in gene expression. Environmental regulation of gene expression.

UNIT – V Oncogenes, Mutations and Transposable elements

14 hrs

Mutations, proto-oncogenes, oncogenes and tumour suppressor genes, physical, chemical and biological mutagens, types of mutations, intra-genic and inter-genic suppression, transpositions- transposable genetic elements in prokaryotes and eukaryotes, role of transposons in genome, viral and cellular oncogenes, tumor suppressor genes: structure, function and mechanism of action, activation and suppression of tumor suppressor genes, oncogenes as transcriptional activators.

REFERENCE BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Watson, J. D.	Molecular Biology of the Gene	Pearson Education. 7 th Edition	2017
2.	Krebs, J.C., Goldstein, E.S., and Kilpatrick, S.T	Lewin's Genes XII	Jones and Bartlett Publishers. 12 th Edition	2017
3.	Karp, G., Iwasa, J and Marshall, W	Karp's Cell and Molecular Biology	Wiley Plus. 9 th Edition	2019

TEXT BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Bruce Alberts , Alexander Johnson , Julian Lewis , David Morgan , Martin Raff, Keith Roberts, Peter Walter	Molecular Biology of the Cell	Garland Science. 6 th Edition	2014
2.	Geoffrey M. Cooper, Robert E. Hausman	The Cell: A Molecular Approach	Sinauer Associates is an imprint of Oxford University Press. 7 th Edition	2015

Course Designer:
Dr.Archana G

MBY2301 - CELL AND MOLECULAR BIOLOGY

Module No.	Topic	No. of periods	Content delivery methods	CLO'S
UNIT I				
1	Structure of prokaryotic and eukaryotic cells. Structural organization and function of intracellular organelles (Nucleus, Endoplasmic Reticulum, Golgi complex, Mitochondria, Chloroplast, Lysosomes, Peroxisomes and Vacuoles)	5	Lecture and PPT (e-books)	CLO1, CLO3, CLO5
2	Cell cycle check points-WEE1, CHK1, CHK2. Cyclins (D1, D2, B1, A1) and Cyclin Dependent Kinases (CDKA, CDK B) protein kinases- Tyrosine kinase, MAPK Kinase. Phosphatases – CDC25	5	Video lecture and Discussion: https://www.youtube.com/watch?v=UOKGSGNLZkEhttps://www.youtube.com/watch?v=foR2tZHj5Eohttps://www.youtube.com/watch?v=8-cub2zRQoAhttps://www.youtube.com/watch?v=Cn23hJulUQ	CLO1, CLO2, CLO5
3	Cytoskeletons. Chromatin organization and packaging.	4	Lecture and quiz (Kahoot)	CLO1, CLO4, CLO5
4	Cell cycle and its regulation, Prokaryotic and Eukaryotic cell cycle.	1	Lecture and seminar (journal discussion)	CLO1, CLO2, CLO5
UNIT II				
5	Lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, and ion pumps.	5	Lecture and e-book (Gutenberg)	CLO1, CLO2, CLO4, CLO5
6	Regulation of intracellular transport in mitochondria, chloroplast, endoplasmic reticulum and nucleus.	5	Lecture and discussion (MOOC)	CLO1, CLO4, CLO5
7	Intracellular protein sorting-Molecular Mechanism and Electrical properties of membranes.	2	Lecture and Quiz (Quizlet)	CLO1, CLO3, CLO5
8	Intracellular vesicular trafficking from endoplasmic reticulum through Golgi apparatus to lysosomes /cell exterior.	3	Discussion Journal search and discussion: Review Intracellular sorting and transport of proteins, Catherine van Vliet et al, Progress in Biophysics & Molecular Biology 83(2003)1–45	CLO1, CLO4, CLO5

UNIT III

9	DNA damage and repair mechanism (Mismatch correction, Base excision repair, Nucleotide excision repair, Direct repair, Photoreactivation)	6	Lecture and PPT	CLO1, CLO3, CLO4, CLO5
10	Error prone Translesion DNA synthesis, SOS repair).Chemically induced mutation-Base analogs, Nitrous acid,Acridines,Alkylating and Hydroxylating agents.	6	Lecture and discussion (National Digital Library of India)	CLO1, CLO2, CLO4
11	DNA Recombination - Homologous and non-homologous, Site specific recombination. Chi sequences in prokaryotes, Gene targeting, Gene disruption, FLP/FRT and Cre/Lox recombination.	3	Discussion Seminar and assignment : Alberts-Molecular Biology of The Cell 4 th Ed (e-book)	CLO1, CLO3, CLO5

UNIT IV

12	DNA Replication-Types, Prokaryotic and Eukaryotic replication. Transcription-Prokaryotic and Eukaryotic. Translation -Prokaryotes and Eukaryotes, Post Translational modifications.	5	Lecture and Video learning	CLO1, CLO3, CLO5
13	Regulation of gene expression - Operon concept, <i>lac</i> , <i>trp</i> , <i>ara</i> , <i>his</i> , and <i>gal</i> operons. Regulatory proteins.	5	Lecture and Sketchboard	CLO1, CLO2, CLO4
14	DNA binding Motifs: Zinc fingers, Helix turn Helix, Homeodomain.	2	Lecture and PPT(Canva)	CLO1, CLO3, CLO5
15	Regulation in eukaryotes - Control by promoter, enhancer and silencers. Cis -trans elements, DNA methylation and chromatin remodeling in gene expression. Environmental regulation of gene expression.	3	Discussion Article reading and discussion: Cooper GM. The Cell: A Molecular Approach. 2 nd edition. Sunderland (MA): Sinauer Associates ; 2000. Regulation of Transcription in Eukaryotes. Available from: https://www.ncbi.nlm.nih.gov/books/NBK9904/	CLO1, CLO2, CLO4

UNIT V

16	Mutations, proto-oncogenes, oncogenes and tumour suppressor genes, physical, chemical and biological mutagens, types of mutations, intra-genic and inter-genic suppression	4	Lecture and Quiz (Socratic)	CLO1, CLO3, CLO5
17	Transpositions-transposable genetic elements In prokaryotes and eukaryotes.	3	Lecture and Mentimeter	CLO1, CLO4, CLO5

18	Role of transposons in genome, viral and cellular oncogenes.	3	Discussion Video discussion: https://www.youtube.com/watch?v=ws2skV2Vt9A	CLO1, CLO2, CLO5
19	Tumor suppressor genes: structure, function and mechanism of action, activation and suppression of tumor suppressor genes, oncogenes as transcriptional activators.	3	Lecture and assessment (Quizizz)	CLO1, CLO3, CLO5

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2302	PAPER-II BIOCHEMISTRY	CORE THEORY	73	2	-	4

Objectives

- To learn about the structure of simple sugars and their role in living organisms.
- To understand the different functions of biomolecules, such as sugars, lipids, amino acids, and proteins.
- To analyze the structures of different biomolecules and how they interact with each other.
- To study the pathways involved in sugar utilization and metabolism.

COURSE OUTCOMES

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Discuss about the classification and properties of biological macromolecules.	K2
CLO2	Illustrate the structure of different biological macromolecules.	K3
CLO3	Differentiate the biological role of various types of macromolecules.	K4
CLO4	Distinguish the different macromolecular biosynthetic and catabolic pathways.	K5
CLO5	Report about the regulation of metabolic pathways.	K6

Mapping with CLOs

CLOs	PLO1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	S	S	M	S	S
CLO2	S	S	M	S	M
CLO3	S	S	M	S	S
CLO4	S	S	M	S	M
CLO5	S	S	M	S	S

M-Medium S-Strong

SYLLABUS

Unit - I Carbohydrate and Metabolism

15 hrs

Classification, structure & properties of Monosaccharides. Disaccharides – Maltose, Cellobiose, Lactose and Sucrose. Polysaccharides: Storage homoglycan – Starch, Glycogen & Dextran. Structural homoglycan - Cellulose & Chitin. Glycosaminoglycans – Proteoglycans, Peptidoglycan, Lectins and Glycoprotein. Carbohydrate metabolism: Glycolysis, TCA cycle & its regulation, Pentose phosphate pathway, Glycogenesis, Glycogenolysis.

Unit - II Lipids Classification and Metabolism

15 hrs

Classification of lipids – Simple & Complex. Structure, properties and functions of Fatty acids, Triacylglycerols, Glycerophospholipids, Sphingolipids, Waxes, Steroids, Cholesterol, Phytosterols and Eicosanoids. Biological role of various types of Glycolipids and Lipoproteins. Self-assembly of lipids, Micelle formation. Lipid metabolism: β -oxidation of saturated and unsaturated fatty acids, Biosynthesis of Triacylglycerols, Glycerophospholipids and Cholesterol.

Unit - III Amino acids and Proteins

14 hrs

Classification, structure and properties of amino acids. Peptide bond - Structure and properties. Ramachandran plot, Protein structure – Primary, secondary (α -helix, β -sheets, turns & loops), tertiary and quaternary. Fibrous proteins: Keratin, Collagen & Fibroin. Globular proteins, Protein Denaturation & Renaturation, Protein folding & Stability, Molecular chaperones. Amino acid and Protein metabolism: Biosynthesis of aromatic amino acids, glycine and threonine. Protein metabolism.

Unit - IV Enzymes – Kinetics & Specificity

15 hrs

Nomenclature and classification of enzymes. Enzyme catalysis – Specificity of enzymes, Active site, Coenzyme's & cofactors. Enzyme kinetics – Factors affecting reaction rate, Michaelis-Menten equation, Kinetic constants, Determination of V_{max} & K_m . Enzyme inhibition – Reversible (Competitive, Non-competitive and Uncompetitive), Irreversible enzyme inhibition. Protein & non-protein enzymes (ribozymes, DNazymes), Zymogens, Abzymes, Isoenzymes. Allosteric enzymes and their properties,

Unit - V Nucleic acids

14 hrs

Structures of Purines & Pyrimidines, Nucleosides, Nucleotides, Nucleic acids – Classes & Properties. Chemical difference between RNA and DNA structure. Nucleic acid Metabolism: Biosynthesis of purine and pyrimidine nucleotides - Denovo and Salvage pathways. Catabolism of purines and pyrimidines.

REFERENCE BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Berg, J.M., Stryer, L., Tymoczko, J and Gatto, G.	Biochemistry	W.H. Freeman and Company, New York. USA. 9 th Edition	2019
2.	Rodwell, V.W., Bender, D., Botham, K.M., Kennelly, P.J, and Weil, P.A.	Harper's Illustrated Biochemistry	McGraw-Hill Education, New York, USA. 31 st Edition)	2018
3.	Voet, D., Voet, J.G, and Pratt, C.W.	Voet's Principles of Biochemistry	John Wiley & Sons, New York, USA. 5 th Edition.	2018

TEXT BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Roger L. Miesfeld Megan M. McEvoy	Biochemistry	W. W. Norton & Company. 1 st Edition	2017
2.	David L. Nelson, Michael Cox	Lehninger Principles of Biochemistry	WH Freeman. 7 th Edition	2017

Course Designer:
Dr.Archana G

MBY2302- BIOCHEMISTRY

Module No.	Topic	No. of periods	Content delivery methods	CLO'S
UNIT I				
1	Classification, structure & properties of Monosaccharides. Disaccharides – Maltose, Cellobiose, Lactose and Sucrose.	3	Discussion	CLO1, CLO2, CLO3
2	Polysaccharides: Storage homoglycan – Starch, Glycogen & Dextran. Structural homoglycan - Cellulose & Chitin.	4	Lecture & Quiz https://create.kahoot.it/	CLO1, CLO2, CLO3
3	Glycosaminoglycans – Proteoglycans, Peptidoglycan, Lectins and Glycoprotein.	4	Lecture	CLO1, CLO2, CLO3
4	Carbohydrate metabolism: Glycolysis, TCA cycle & its regulation, Pentose phosphate pathway, Glycogenesis, Glycogenolysis.	4	https://youtu.be/8qij1m7XUhk Seminar and quiz	CLO4, CLO5
UNIT II				
5	Classification of lipids – Simple & Complex. Structure, properties and functions of Fatty acids, Triacylglycerols, Glycerophospholipids.	2	Group Seminar- Flipped classroom	CLO1, CLO2, CLO3
6	Sphingolipids, Waxes, Steroids, Cholesterol, Phytosterols and Eicosanoids.	3	Lecture and assessment (Quizalize)	CLO1, CLO2, CLO3
7	Biological role of various types of Glycolipids and Lipoproteins. Self-assembly of lipids, Micelle formation.	2	Discussion	CLO3
8	Lipid metabolism: β -oxidation of saturated and unsaturated fatty acids, Biosynthesis of Triacylglycerols, Glycerophospholipids and Cholesterol.	4	Demonstration https://youtu.be/ppqpUVaasNc	CLO4, CLO5
UNIT III				
9	Classification, structure and properties of amino acids. Peptide bond - Structure and properties. Ramachandran plot.	2	Interaction on topics and Assignment https://youtu.be/rUlt8Xws_3Q	CLO1, CLO2, CLO3
10	Protein structure – Primary, secondary (α -helix, β -sheets, turns & loops), tertiary and quaternary.	2	Flipped Classroom https://youtu.be/Q88TAt350iE	CLO2
11	Fibrous proteins: Keratin, Collagen & Fibroin. Globular proteins.	2	Discussion	CLO1, CLO2, CLO3
12	Protein Denaturation & Renaturation, Protein folding & Stability, Molecular chaperones	2	Lecture	CLO3
13	Amino acid and Protein metabolism: Metabolism of aromatic amino acids, glycine and threonine.	3	Lecture	CLO4, CLO5

	Protein metabolism.			
UNIT IV				
14	Nomenclature and classification of enzymes. Enzyme catalysis – Specificity of enzymes, Active site, Co-enzyme's & cofactors.	2	Discussion	CLO1, CLO2, CLO3
15	Enzyme kinetics – Factors affecting reaction rate, Michaelis-Menten equation, Kinetic constants, Determination of V_{max} & K_m .	2	Lecture & Quiz https://create.kahoot.it/	CLO1, CLO3
16	Enzyme inhibition – Reversible (Competitive, Non-competitive and Uncompetitive), Irreversible enzyme inhibition.	3	Demonstration https://youtu.be/afvo3OaTiyU	CLO1, CLO3
17	Protein & non-protein enzymes (ribozymes, DNAzymes), Zymogens, Abzymes, Isoenzymes. Allosteric enzymes and their properties, Immobilization of enzymes and their applications. .	4	Lecture	CLO1, CLO2, CLO3
UNIT V				
18	Structures of Purines & Pyrimidines, Nucleosides, Nucleotides, Nucleic acids – Classes & Properties. Chemical difference between RNA and DNA structure	2	Discussion https://youtu.be/JQByjprj_mA	CLO1, CLO2, CLO3
19	DNA – double helical structure, Structural forms of DNA - DNA-A, B, Z, Circular & Supercoiled DNA, Denaturation & Renaturation of DNA.	3	Lecture https://youtu.be/bWaXJfyXfcQ	CLO1, CLO2, CLO3
20	Different types of RNA – mRNA, rRNA, tRNA, small RNA, snRNA, miRNA, Micro RNA, Silencing RNA (siRNA) & Long noncoding RNA (lnc RNA).	3	Lecture and assessment (Quizalize)	CLO1, CLO2, CLO3
21	Nucleic acid Metabolism: Biosynthesis of purine and pyrimidine nucleotides - De novo and Salvage pathways. Catabolism of purines and pyrimidines.	4	Lecture and assessment (Kahoot)	CLO4, CLO5

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2303	PAPER-III MICROBIOLOGY	CORE THEORY	58	2	-	4

Objectives

- To learn about the structure and function of microbial cells, including their different parts and how they work together.
- To identify and classify different types of microbes, including bacteria, archaea, fungi, protozoa, and viruses.
- To understand the physiology of microbes, such as their growth requirements, metabolism, and genetics.
- To assess the use of microbes in different industries, such as food production, bioremediation, and biotechnology.

COURSE OUTCOMES

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Describe the features of the different groups of microorganisms.	K2
CLO2	Examine the chemical & physical methods of sterilization. Predict the appropriate level of biosafety required for working with different microbes.	K3
CLO3	Distinguish the importance of a diverse group of microorganisms.	K4
CLO4	Evaluate the useful and harmful effects of microorganisms. Recommend control measures for various microbial diseases.	K5
CLO5	Report about the mode of action of various antimicrobial agents.	K6

Mapping with CLOs

CLOs	PLO1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	S	S	S	M	S
CLO2	S	S	S	M	M
CLO3	S	S	S	M	S
CLO4	S	S	S	S	M
CLO5	S	S	S	S	S

M-Medium S-Strong

SYLLABUS

UNIT I MICROBIAL NUTRITION AND GROWTH

12 hrs

Solid and liquid Media preparation, Culture Media and its types. Nutritional classification of microorganisms. Factors affecting microbial growth – temperature, atmosphere, pH, hydrostatic pressure and radiation. Phases of growth curve, Growth measurement techniques. Bacterial culture methods: Pure culture techniques – tube dilution, pour plate, spread and streak plate methods. Anaerobic culture methods – wright's tube, roll tube, McIntosh - Fildes anaerobic jar, Gaspak, Anaerobic chamber (glove box). Microscopy: Types and applications of Light, Phase contrast, Fluorescent, Confocal and Electron Microscopy. Microscopic identification: Simple, Negative & Differential staining (Gram staining, Acid fast staining).

UNIT II MICROBIAL GROWTH CONTROL

12 hrs

Physical methods of sterilization – Heat (Dry & Moist), Pasteurization, Filtration, Radiation, Dessication, Low Temperature, High Pressure, Osmotic Pressure & Tyndallization. Chemical methods of sterilization (Phenols, Halogens, Alcohols, Detergents, Aldehydes, Gaseous agents). Phenol coefficient test – Sterility testing. Biosafety and levels of biosafety, Types of microbiological safety cabinets, GLP.

UNIT III MICROBIAL DIVERSITY

11 hrs

Bacteria: Acetic acid bacteria, Cyanobacteria, Propionic acid bacteria, Pseudomonads, and Mycoplasma. Archaea: Halophiles, Methanogens, Hyperthermophilic archaea, Thermoplasm, Extremophiles and unculturable microbes. Virus and bacteriophages. Sub-viral particles – Viroids and Prions.

UNIT IV HOST-MICROBES INTERACTION

12 hrs

Normal microflora, Microbiome, Prebiotics and Probiotics, Host-pathogen interaction, Microbial communication system, Bacterial Quorum sensing and biofilm formation. Microbial fuel cells, Pathogenicity islands and their role in bacterial virulence. Types of toxins -Exo-Endo & Entero. Microbial diseases: Causative agent, symptoms and control measures of diseases caused by Bacteria – Strep & Staph infections, Typhoid, Cholera, Bacillary dysentery & Tuberculosis. Virus - AIDS, Hepatitis, Influenza, SARS, MERS and Covid-19. Fungi - Candidiasis & Mucormycosis. Protozoa - Malaria.

UNIT V ANTIMICROBIAL AGENTS

11 hrs

Minimal inhibitory concentration (MIC), Microbial Drug resistance. Mode of action of Antibacterial drugs – Penicillin, Cephalosporins, Streptomycin, Tetracyclines, Quinolones and Rifampicin. Antifungal drugs – Nystatin, Griseofulvin and Cycloheximide. Antiviral drugs - Acycloguanosine (acyclic nucleoside), Antiretroviral drugs and Remdesivir. Multi drug resistance and its impact. Strategies to combat multi drug resistance.

REFERENCE BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Tortora, G., Funke, B., Case, C., Weber, D, and Bair, W.	Microbiology – An Introduction	Pearson Education Inc, London, UK . 13th Edition	2020
2.	Murray, P., Rosenthal, K and Pfaller, M.	Medical Microbiology	Elsevier, Netherlands. 9th Edition.	2020
3.	Pommerville, C.J.	Fundamentals of Microbiology	Jones and Bartlett Publishers Inc, Massachusetts, USA. 12th Edition	2022

TEXT BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Nina Parker , Mark Schneegurt , Anh-Hue Thi Tu, Brian M. Forster , Philip Lister	Microbiology	ASM Press. 1 st Edition	2017
2.	Gerard Tortora , Berdell Funke , Christine Case , Derek Weber, Warner Bair III	Microbiology: An Introduction	Addison-Wesley. 13 th Edition	2018

Course Designer:
Dr.Archana G

MBY2303-PAPER-III MICROBIOLOGY

Module No.	Topic	No. of periods	Content Delivery Methods	CLO'S
UNIT I				
1	Solid and liquid Media preparation, Culture Media and its types. Nutritional classification of microorganisms. Factors affecting microbial growth—temperature , atmosphere, pH, hydrostatic pressure and radiation. Confocal and Electron Microscopy. Microscopic identification: Simple, Negative & Differential staining (Gram staining, Acid fast staining).	4	Lecture & PPT presentation	CLO1
2	Phases of growth curve, Growth measurement techniques. Bacterial culture methods: Pure culture techniques –tube dilution, pourplate, spread and streak plate methods.	2	Seminar, PPT & Discussion	CLO1, CLO3
3	Anaerobic culture methods – wright's tube, roll tube, McIntosh- Fildes anaerobic jar, Gaspak, Anaerobic chamber (glovebox). Microscopy: Types and applications of Light, Phase contrast, Fluorescent,	4	Video Lecture and Discussion https://youtu.be/kBzR644riSI https://youtu.be/qt8VrEKEois	CLO4, CLO2
4	Confocal and Electron Microscopy. Microscopic identification: Simple, Negative & Differential staining (Gram staining, Acid fast staining).	2	Journal Article Presentation & Discussion	CLO1, CLO5, CLO3
UNIT II				
5	Physical methods of sterilization – Heat (Dry & Moist), Pasteurization, Filtration, Radiation, Dessication, Low Temperature, High Pressure, Osmotic Pressure & Tyndallization.	3	Lecture, PPT presentation	CLO1, CLO2
6	Chemical methods of sterilization (Phenols, Halogens, Alcohols, Detergents, Aldehydes, Gaseous agents)	3	Lecture, PPT & Quiz (Kahoot, Quizlet, Mentimeter etc)	CLO5, CLO4
7	Aldehydes, Gaseous agents, Phenol coefficient test–Sterility testing.	3	Video Lecture and Discussion: https://youtu.be/QacnDdGa5U https://youtu.be/v2BKCo8o85Y	CLO1, CLO2, CLO4
8	Biosafety and levels of biosafety, Types of microbiological safety cabinets, GLP. Flow rate, pressure, pH.	3	Journal Presentation Video-Lecture and Discussion https://youtu.be/2gxTcaAP1PI	CLO1, CLO3, CLO5
UNIT III				
9	Acetic acid bacteria, Cyanobacteria, Propionic acid bacteria, Pseudomonads, and Mycoplasma	2	Video Lecture and Discussion https://youtu.be/bjJtQkkGZ	CLO2, CLO3, CLO4

			zhttps://youtu.be/HyjJB1SMDz8	
10	Archaea: Halophiles, Methanogens. Hyperthermophilic archaea.	3	Lecture, PPT & Discussion, Quiz (Kahoot, Quizlet, Mentimeter etc)	CLO2, CLO3.CLO4
11	Thermoplasm, Extremophiles and unculturable microbes. Virus and bacteriophages.	3	Journal Presentation & Discussion	CLO2, CLO3.CLO4, CLO5
12	Sub-viral particles –Viroids and Prions	3	Seminar,PPT	CLO4, CLO5
UNIT IV				
13	Normal micro flora, Microbiome, Prebiotics and Probiotics, Host-pathogen interaction. Fungi-Candidiasis & Mucormycosis. Protozoa -Malaria.	3	Seminar	CLO1, CLO3.CLO2, CLO5
14	Bacterial Quorum sensing and biofilm formation, Microbial communication system, Microbial fuel cells, Pathogenicity islands and their role in bacterial virulence	3	Lecture & Quiz (Quizlet, Mentimeter)	CLO1, CLO3.CLO4, CLO5
15	Types of toxins- Exo-Endo & Entero. Microbial diseases: Causative agent, symptoms and control measures of diseases caused by Bacteria–Strep & Staph infections, Typhoid, Cholera, Bacillary dysentery & Tuberculosis	3	Video Lecture and Discussion https://youtu.be/ozhhfVLbBCI https://youtu.be/UKV8Zn7x0wM	CLO2, CLO4.CLO1, CLO5
16	Virus- AIDS, Hepatitis, Influenza, SARS, MERS and Covid-19. Fungi – Candidiasis & Mucormycosis. Protozoa– Malaria	3	Journal Article Presentation & Discussion	CLO1, CLO3.CLO2, CLO5
UNIT V				
17	Minimal inhibitory concentration (MIC), Microbial Drug resistance	2	Seminar	CLO3, CLO1, CLO5
18	Mode of action of Antibacterial drugs– Penicillin, Cephalosporins, Streptomycin, Tetracyclines, Quinolones and Rifampicin.	3	Lecture & Quiz (Kahoot, Quizlet, Mentimeter etc)	CLO1, CLO4, CLO5
19	Antifungal drugs–Nystatin, Griseofulvin and Cycloheximide. Antiviral drugs - Acycloguanosine (acyclic nucleoside)	3	Journal Presentation & Discussion Video Lecture and Discussion https://youtu.be/KpHXmTi-AXk https://youtu.be/I9SiDPFMM3Y	CLO2, CLO3, CLO5
20	Antiretroviral drugs and Remdesivir. Multi drug resistance And its impact. Strategies to combat multi drug resistance.	3	Journal Presentation & Discussion	CLO3. CLO4, CLO5

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2304	PAPER-IV BIOINFORMATICS	CORE THEORY	58	2	-	4

Objectives

- To familiarize students how to use bioinformatics tools to analyze biological data.
- To develop the skills they need to analyse protein structures,
- To identify potential druggable sites
- To screen large datasets of compounds for potential drug candidates and ADME studies
- To test the hypothesis statistically using R-program

COURSE OUTCOMES

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the principle and application of databases and retrieve data.	K2
CLO2	Acquire the concepts and application of Phylogenetic analysis.	K6
CLO3	Differentiate the various analysis methods for structure prediction and validation.	K4
CLO4	Apply the concept of drug-receptor interactions and ADME studies	K3
CLO5	Test hypothesis statistically for experimental data using R-program	K5

Mapping with CLOs

CLOs	PLO1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	S	S	M	S	S
CLO2	M	M	S	M	M
CLO3	S	S	S	S	S
CLO4	M	M	S	S	M
CLO5	S	S	S	M	S

M-Medium S-Strong

SYLLABUS

Unit 1: Introduction to Bioinformatics

12 hrs

Overview of bioinformatics and its applications in biotechnology, Introduction to different types of biological databases, such as Primary - nucleotide databases (GenBank, EMBL, DDBJ), protein sequence databases (UniProt, TrEMBL, PIR), Secondary-structural databases (PDB, MMDB), domain and motif database (Prosite, BLOCKS) and Derived database- Structure database (SCOP, CATH), Gene expression database (GEO), metabolic pathway (KEGG), Specialised database (TGI), Gene prediction tools– GENSCAN, GENEMARK. Sequence alignment algorithms: pairwise (BLAST) and multiple sequence alignment (CLUSTALW).

Unit 2: Molecular Phylogenetics and Evolution

12 hrs

Introduction to phylogenetic trees and their significance in evolutionary biology, Types of phylogenetic trees: rooted and unrooted trees, Tree-building methods: distance-based, parsimony, and maximum likelihood, Evaluation of tree topologies: bootstrap analysis and support values. Phylogenetic reconstruction for different molecular data: DNA sequences, protein sequences, and whole genomes.

Unit 3: Proteomics and Systems Biology

11 hrs

Protein structure prediction and modeling, function prediction and annotation, Protein-protein interactions (STRING) and networks, Integration of genomics, proteomics, and other -omics data. Biological pathway and network analysis, Systems biology approaches to understanding complex biological processes.

Unit 4: Structural Bioinformatics and Drug Discovery

11 hrs

Computational drug discovery approaches, including virtual screening and molecular docking, Predictive models for drug-target interactions and ADMET (absorption, distribution, metabolism, excretion, and toxicity) properties. Structure-based drug discovery and molecular dynamics simulations, ADME and Drug likeness, Gene ontology and functional enrichment analysis.

Unit 5: Computing Using R Programming

12 hrs

R programming- Introduction and packages. Basic operations with R programming, Overview – Variable, Data types, Operators, Useful Function, Data frames, working with images and strings, Library functions, Bioconductor, Large datasets, statistics, applications. Case Study: Microarray data analysis using Bioconductor package.

REFERENCE BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Andreas D. Baxevanis, Gary D. Bader, David S. Wishart	Bioinformatics	John Wiley & Sons	2020
2.	Namita Mendiratta, Parag Rastogi and S.C. Rastogi	Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery	PHI Learning	2022
3.	Pevsner J	Bioinformatics and Functional Genomics	Wiley-Blackwell, UK. 3rd Edition.	2015
4.	Hadley Wickham and Garrett Grolemund	R for Data Science	O'Reilly Media	2016

TEXT BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Poptsova, M.S	Genome Analysis: Current Procedures and Applications	Caister Academic Press, UK.	2014
2.	Pevsner J	Bioinformatics and Functional Genomics	Wiley-Blackwell, UK. 3rd Edition	2015

Course Designer:
Dr. V. Bhuvaneshwari
Mrs. R. Kiruba

MBY2304- PAPER-IV-BIOINFORMATICS

Module No.	Topic	No. of periods	Content delivery methods	CLO'S
UNIT I				
1	Overview of bioinformatics and its applications in biotechnology.	1	Lecture, Discussion, Quiz (Quizlet)	CLO1
2	Introduction to different types of biological databases, such as Primary - nucleotide databases (GenBank, EMBL, DDBJ), protein sequence databases (UniProt, TrEMBL, PIR).	3	video lecturing and Flipped classroom https://www.youtube.com/watch?v=JmKD5SnQtFE https://www.youtube.com/watch?v=rDhElW5ox6w	CLO1
3	Secondary-structural databases (PDB, MMDB), domain and motif database (Prosite, BLOCKS) and Derived database- Structure database (SCOP, CATH).	3	Demonstration and Quiz (kahoot)	CLO1
4	Gene expression database (GEO), metabolic pathway (KEGG), Specialised database (TGI), Gene prediction tools – GENSCAN, GENEMARK.	3	Lecture PPTs and Hands on https://www.youtube.com/watch?v=reKfZ5x-vcM	CLO1
5	Sequence alignment algorithms: pairwise (BLAST) and multiple sequence alignment (CLUSTALW).	2	Demonstration, Quiz (Socrative) and Discussion	CLO1
UNIT II				
6	Introduction to phylogenetic trees and their significance in evolutionary biology.	3	PPTs-Video https://www.youtube.com/watch?v=zRcluAdUjUk	CLO2
7	Types of phylogenetic trees: rooted and unrooted trees.	2	Lecture-Quiz (kahoot)	CLO2
8	Tree-building methods: distance-based, parsimony, and maximum likelihood.	2	Lecture- PPTs	CLO2
9	Evaluation of tree topologies: bootstrap analysis and support values.	2	Seminar-Quiz (Socrative)	CLO2
10	Phylogenetic reconstruction for different molecular data: DNA sequences, protein sequences, and whole genomes.	3	PPTs -Discussion	CLO2
UNIT III				
11	Protein structure prediction and modelling function prediction and annotation.	3	Lecture and Quiz (google forms) https://www.youtube.com/watch?v=8XS0cqxD5XU	CLO3
12	Protein-protein interactions (STRING) and networks.	2	Demonstration and discussion	CLO3
13	Integration of genomics, proteomics, and other - omics data.	3	PPTs and lecture, Think-pair-share group activity	CLO3
14	Biological pathway and network analysis, Systems biology approaches to understanding complex biological processes.	3	PPTs and video https://www.youtube.com/watch?v=PqH8yR97DUY	CLO3
UNIT IV				

15	Computational drug discovery approaches, including virtual screening and molecular docking.	3	PPTs-Quiz (Quizizz)	CLO4
16	Predictive models for drug-target interactions and ADMET (absorption, distribution, metabolism, excretion, and toxicity) properties	3	Demonstration-PPTs, Pro-con grid	CLO4
17	Structure-based drug discovery and molecular dynamics simulations	3	Lecture and hands-on	CLO4
18	ADME and Drug likeness, Gene ontology and functional enrichment analysis.	2	Case study and Lecture	CLO4
UNIT V				
19	R programming- Introduction and packages.	1	PPT and Quiz (Quizizz)	CLO5
20	Basic operations with R programming, Overview – Variable, Data types, Operators, Useful Function, Data frames, working with images and strings, Library functions.	5	Video Lecture and Demonstration https://www.youtube.com/watch?v=_V8eKsto3Ug https://www.tutorialspoint.com/execute_r_online.php	CLO5
21	Bioconductor, Large datasets, statistics, applications.	3	Demonstration and Hand-on	CLO5
22	Case Study: Microarray data analysis using Bioconductor package.	3	Video lecturing and Group discussion https://www.youtube.com/watch?v=TKDoL-yvcTI	CLO5

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY23P1	CORE PRACTICAL - 1 BIOCHEMISTRY AND MICROBIOLOGY	CORE PRACTICALS	-	-	90	4

Objectives

- To familiarize students with the basic techniques to estimate and quantify the biomolecules
- To develop students' skills in microbes isolation, identification and analyze its antimicrobial activity
- To inculcate the research attitude in the minds of the students by developing their analytical skills

COURSE OUTCOMES

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Identify different microorganisms using basic microbiological techniques, such as Gram staining and biochemical tests.	K2
CLO2	To test the effects of different environmental factors and its effect on growth of microorganisms	K3
CLO3	Evaluate the method for detecting and quantifying a biomolecule in a sample and method for isolating and purifying a microorganism from a sample.	K4
CLO4	Justify the ability to monitor and adjust a processing of bioproduct to give a desired output and optimize kinetic parameters such as temperature, pressure, media composition etc.	K5
CLO5	To solve a real-world problem, such as the development of a new vaccine, new drug or the diagnosis of a disease and prevention of foodborne illness.	K6

Mapping with CLOs

CLOs	PLO1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	S	S	S	M	S
CLO2	S	S	S	M	M
CLO3	S	S	S	M	S
CLO4	S	S	S	M	M
CLO5	S	S	S	M	S

M-Medium S-Strong

LIST OF EXPERIMENTS

Biochemistry

1. Separation of the amino acids - Glycine, Tyrosine and Leucine by Thin Layer Chromatography.
2. Separation of plant pigments and dyes -Paper chromatography
3. Generation of the titration curve for the amino acid glycine.
4. Colorimetric estimation of maltose by 3,5-dinitrosalicylic acid method and construction of Maltose Standard Curve.
5. Colorimetric estimation of protein by Folin's Lowry method and construction of Protein Standard Curve.
6. Effect of substrate concentration on the activity of alpha amylase and determination of K_m and V_{max} of alpha-amylase.
7. Qualitative analysis of phytochemicals from plants
8. Quantification of 1. Total phenols 2. Flavanoids
9. Antioxidant activity

Microbiology

1. Isolation and enumeration of bacteria and fungi from sludge/solid waste
2. IMVIC test
3. Hydrolysis test –starch, casein and lipid
4. Study of bacterial growth curve by turbidimetry.
5. Staining- Simple, Gram and spore staining
6. Milk quality analysis - MBRT Test
7. Determination of Minimum inhibitory concentration.
8. Determination of the susceptibility of bacteria against different antibiotic agents.
9. Molecular Identification of Bacteria - PCR

REFERENCE BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Sadasivam, S. and Manickam, A.	Biochemical methods	New Age International Publishers. 3 rd Edition	2018
2.	Pingoud, A and Urbanke, C.	Biochemical Methods: A Concise Guide for Students and Researchers	Wiley-VCH. 1 st Edition	2010
3.	Cappuccino, J. G., & Welsh, C.	Microbiology: A Laboratory Manual.	Benjamin-Cummings Publishing Company	2016
4.	Collins, C. H., Lyne, P. M., Grange, J. M., & Falkinham III, J.	Collins and Lyne's Microbiological Methods	Arnolds. 8 th Edition	2004

TEXT BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	R. Saravanan , D. Dhachinamoorthi , CH. MM. Prasada Rao	A Handbook of Practical Microbiology	LAP LAMBERT Academic Publishing. 1 st Edition	2019
2.	György Hegyi, József Kardos, Mihály Kovács, András Málnási-Csizmadia, László Nyitray, Gábor Pál, László Radnai, Attila Reményi, and István Venekei	Introduction to Practical Biochemistry	Eötvös Loránd University. 1 st Edition	2013

Course Designer:**Dr. V. Bhuvaneshwari****Dr. G. Anbarasi****Dr.R.Kiruba**

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY23P2	CORE PRACTICAL- II CELL & MOLECULAR BIOLOGY AND BIOINFORMATICS	CORE PRACTICALS	-	-	90	4

Objectives

- To isolate and differentiate various cell organelles and to visualize them using staining techniques
- To Understand molecular techniques for separating genetic material from organisms
- To develop students' skills in using bioinformatics tools to analyze biological data.
- To use bioinformatics tools to analyze protein structures, to identify potential druggable sites, to screen large datasets of compounds for potential drug candidates.

COURSE OUTCOMES

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Identify the basic structure and function of different plant and animal cells and different types of cells using a microscope.	K2
CLO2	Design an experiment to isolate and differentiate different cell organelles, and to identify the effects of a particular treatment on a plant or animal cell	K3
CLO3	Analyze the methods for identifying chemical structure as lead molecules	K4
CLO4	Justify the Application of the principles of bioinformatics to solve a real-world problem in drug discovery and development, such as identifying a new drug target for a particular disease.	K5
CLO5	Identify basic experimental design principles in solving biological questions.	K6

Mapping with CLOs

CLOs	PLO1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	S	S	M	M	S
CLO2	S	S	M	M	M
CLO3	S	S	S	S	S
CLO4	S	S	S	S	M
CLO5	S	S	S	S	S

M-Medium S-Strong

LIST OF EXPERIMENTS

CELL & MOLECULAR BIOLOGY

1. Visualization of the different stages of Mitosis in Onion Root Tips using light microscope.
2. Visualization of different stages of meiosis in plants.
3. Determination of the number of cells in a suspension, using Hemocytometer.
4. Isolation of Genomic DNA from *E.coli*.
5. Isolation of Genomic DNA from plants-CTAB method
6. Isolation of Plasmid DNA.
7. Isolation of RNA-Trizol method
8. Quantification of DNA –Spectrophotometer/nano drop

BIOINFORMATICS

Biological databases and Sequence alignment

1. Sequence database – NCBI, GenBank, EMBL, Swiss-Prot, ExPASy proteomics tools
2. Structural database – PDB
3. Gene prediction tools – GENSCAN, GENEMARK
4. Primer Designing concepts – Primer3 (tool)
5. Pairwise sequence alignment- BLAST and FASTA
6. Multiple sequence alignment – Omega, MEGABLAST

Macromolecular Structure Prediction and Validation

7. Homology Modeling –SWISS-MODEL
8. Fold recognition and threading
9. Model validation using ProSA, WhatCheck, Errat and ProCheck
10. Structure visualization- RasMol and PyMol

Chemical structure and ADME rules

11. Small molecule building, using CHEMSKETCH
12. Chemical database – PubChem and DrugBank
13. File formats and conversion – Open Babel, SMILES
14. Drug properties, Toxicity, Drug likeness, Lipinski's rule of five- SWISSADME tool

Molecular Docking and analysis

15. Active site prediction (CASP, PDBSum)
16. Structure-based drug design and Ligand based drug design
17. Molecular docking
18. Drug-Receptor interaction - PyMol

REFERENCE BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Cappuccino, J. G., & Welsh, C.	Current Protocols in Cell Biology	Wiley Publication. 1 st Edition	2019
2	Carson, S and Miller, H.B.	Molecular Biology Techniques	Academic Press. 4 th Edition	2019
3	Rastogi, S.C, Rastogi, P and Mendiratta, N	Bioinformatics: methods and applications - Genomics, Proteomics and Drug discovery.	PHI Learning Pvt Ltd, India. 5 th Edition	2022
4	Baxevanis, A. D. & Ouellette, B. F.	Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins.	John Wiley and Sons, USA. 3 rd Edition	2004

TEXT BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1	Maniatis, T	Molecular Cloning – A Laboratory Manual	Cold Spring Harbor Laboratory. 3 rd Edition	2001
2	Michael Agostino	Practical Bioinformatics	Garland Science. 1 st Edition	2012
3	Janusz M. Bujnicki	Practical Bioinformatics	Springer. 1 st Edition	2004

Course Designer:

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Dr. V. Bhuvaneshwari



**PSGR
Krishnammal College for Women**



DEPARTMENT OF BIOTECHNOLOGY

**CHOICE BASED CREDIT SYSTEM
&
OUTCOME BASED EDUCATION SYLLABUS**

M.Sc. BIOTECHNOLOGY

SEMESTER II

BATCH 2023-25

PSGR KRISHNAMMAL COLLEGE FOR WOMEN

COIMBATORE-641004

College of Excellence

Autonomous and Affiliated to Bharathiar University

(Accredited with 'A+' Grade by NAAC with CGPA 3.71 (IV Cycle),

(Ranked 4th in NIRF 2023)

PROGRAMME LEARNING OUTCOMES (PLO's)

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

PLO1: Apply the theoretical and practical skills gained in the multidisciplinary field of Biotechnology to solve real world problems, or crack a competitive exam for higher studies or to perform well in a job interview.

PLO2: Gain an in-depth understanding to design and perform experiments, analyze and interpret experimental data in biotechnology and related areas.

PLO3: Acquire the ability to write well structured reviews, scientific publications and communicate scientific results to the general public and subject experts by oral presentations or posters.

PLO4: Understand the safety procedures in handling chemicals, laboratory equipment, biological materials and genetically modified organisms.

PLO5: Acquire the ability to carry out research independently or in groups in multidisciplinary projects.

PROGRAMME SPECIFIC OUTCOME (PSO's)

The students at the time of graduation will

PSO1: Comprehend Biotechnology and other multidisciplinary areas prescribed in the syllabus.

PSO2: Understand the structure and functions of microbial, animal and plant cells.

PSO3: Develop skills for the design of new products.

PSO4: Acquire higher order thinking skills.

PSO5: Acquire knowledge in the current trends to meet the future challenges in the Biotech, Genomics and Pharmaceutical industries.



CHOICE BASED CREDIT SYSTEM & OUTCOME BASED EDUCATION

SYLLABUS & SCHEME OF EXAMINATION

MASTER OF SCIENCE BIOTECHNOLOGY – 2023-2025 BATCH

Applicable to students admitted during the academic year 2023-2024 onwards (II Sem)

SEM	Subject Code	Title of the Paper	Instruction hours/ week	Contact hours	Tutorial	Duration of Examination	Examination Marks			Credits
							CA	ESE	Total	
II	MBY2305	Paper-V Immunotechnology	4	58	2	3	25	75	100	4
	MBY2306	Paper-VI Animal Biotechnology	3	43	2	3	25	75	100	4
	MBY2307	Paper-VII Environmental Biotechnology	3	43	2	3	25	75	100	3
	MBY2308 /MBY2309	Paper VIII- Elective I -Nano Biotechnology/ Elective II- Food Biotechnology	3	43	2	3	25	75	100	4
	MTH23A6	Interdisciplinary Course – Statistics for Life Science	4	60	-	3	-	100	100	2
II/III	MBY23CE/ MBY23S1	Coursera- Advanced Neurobiology I & II/ Special Course- Research Methodology	3	45	-	-/3	100/-	-/100	100	3
II	MBY23P3	Practical-III Immunotechnology and Animal Biotechnology	5	75	-	6	25	75	100	4
	MBY23P4	Practical-IV Environmental, Nano and Food Biotechnology	5	75	-	6	25	75	100	4

QUESTION PAPER PATTERN

CIA Question Paper Pattern: Conducted for 45 Marks

One question from each unit with each question comprising of

Section A	–	3 x 2 = 6
Section B	–	3 x 5 = 15 (either or – same CLO Level)
Section C	–	3 x 8 = 24 (either or – same CLO Level)
Total		45

Model Question Paper Pattern: Conducted for 75 marks

(Q.P. Pattern (2,5,8) Each Unit 15 Marks)

Section A	–	5 x 2 = 10
Section B	–	5 x 5 = 25 (either or – same CLO Level)
Section C	–	5 x 8 = 40 (either or – same CLO Level)
Total		75

ESE Pattern

Section A	: 5 x 2 = 10
Section B	: 5 x 5 = 25 (either or – same CLO Level)
Section C	: 5 x 8 = 40 (either or – same CLO Level)

Total 75

Internal component for Theory

CIA Test	-	5	Conducted for 45 marks after 50 days
Model Exam	-	7	Conducted for 75 marks (Q.P. Pattern (2,5,8) Each Unit 15 Marks)
Seminar/Assignment/Quiz	-	5	
Class Participation	-	5	
Attendance	-	3	
		25	+ ESE 75 Marks = 100 Marks

Interdisciplinary Course:

Section A: 5 questions (Internal choice)	:25 marks
Section B: 5 questions (Internal choice)	:75 marks
Total	:100 marks

Internal component for Practicals (for 25 Marks)

Lab Performance	- 7 marks
Regularity	- 5 marks
Model Exam	- 10 marks
Attendance	- 3 marks
Total	- 25 marks

ESE Practicals Pattern

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 NO	COURSE NAME	CATEGORY	L	T	P	CREDITS
MBY2305	PAPER V IMMUNOTECHNOLOGY	CORE THEORY	58	2	-	4

Learning Objectives:

- To gain knowledge on the types of immunity and the structure & functions of immunoglobulins.
- To analyze the methods involved in antibody production
- To understand the various detection methods of antigen-antibody interaction.
- To impart knowledge in vaccine development
- To assess about hypersensitivity and autoimmune disorders

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Examine the fundamental concepts of immunology.	K2
CLO2	Compare the major techniques to assess Antigen-Antibody interactions.	K3
CLO3	Assess the different methods involved in antibody production and antibody engineering.	K4
CLO4	Elaborate on the vaccine technology for infectious disease.	K5
CLO5	Explain about the types of hypersensitivity and autoimmune diseases and their treatment.	K6

Mapping with Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	M	S	L	M	S
CLO2	S	S	M	S	S
CLO3	M	S	S	S	S
CLO4	S	S	S	S	S
CLO5	L	S	S	S	S

S- Strong; M-Medium; L-Low

IMMUNOTECHNOLOGY

SYLLABUS

Unit I Cells and Organs of Immune system

12 h

History and scope of immunology. Types of Immunity: Passive, Active and Acquired immunity. Humoral, Cell Mediated immunity. Cells and organs of immune response and their functions. Antigens - Types, haptens, epitopes and Factors influencing antigenicity. Antibody – Structure, types, properties and functions. Immunoglobulin gene rearrangements.

Unit II Antigen Antibody Reactions

11 h

Antigen – Antibody interaction, affinity, cross reactivity, specificity, epitope mapping; Agglutination reactions-Blood grouping, haemagglutination and Precipitation reactions. Immunoassays – Immunodiffusion and Immunoelectrophoresis, RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, Surface plasmon resonance, Biosensor assays for assessing ligand –receptor interaction.

Unit III New Generation Antibodies

12 h

Antibody engineering; Hybridoma and monoclonal antibody (mAb) techniques, Production of murine hybridoma, Production of mAbs in cultures and animal (Ascites), Purification of mAbs. Characterization of mAbs/ and Labeling of antibodies. Phage display libraries; Antibodies as in vitro and in vivo probes.

Unit IV Vaccine Technology

12 h

Rational vaccine design based on clinical requirements: Active immunization, live, killed, attenuated, Subunit vaccines; Recombinant DNA and protein-based vaccines, plant-based vaccines and reverse vaccinology; Peptide vaccines, conjugate vaccines; Passive Immunization; Antibody, Transfusion of immuno- competent cells, Stem cell therapy, Cell based vaccines. COVID-19 Vaccines- types, immune response, safety and efficacy, the role of COVID-19 vaccines in preventing COVID-19 and its complications.

Unit V Hypersensitivity, Autoimmunity and Transplantation

11h

Hypersensitivity– Mechanism and Types. Autoimmune disorders - Type I diabetes, Rheumatoid arthritis, Systemic lupus erythematosus, Ulcerative colitis. Tumor immunology: tumor antigens, oncogenes, immune responses, detection of cancers and therapy- chemotherapy and radiation therapy. Transplantation Immunology.

REFERENCE BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Abbas,A.K., Lichtman, A. H., & Pillai, S.	Basic Immunology: Functions and Disorders of the Immune System	Elsevier Publishers, Amsterdam, Netherlands.	2019 (6 th Edition)
2.	Janeway CA, Travers P, Walport M, et al.	Immunobiology: the immune system in health and disease	10th ed. New York: Garland Science	2016
3.	Punt, J., Stranford, S., Jones, P & Owen, J.A.	Kuby Immunology	W. H. Freeman, NY. USA	2018 (8 th Edition)

TEXT BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Abbas AK, Lichtman AH, Pillai	Cellular and molecular immunology.9th ed. Philadelphia	Elsevier	2022
2.	Paul, W. E.	Fundamental Immunology	Lippincott Williams and Wilkins, USA	2012 (7 th Edition)
3.	Delves, P.J., Martin S.J., Burton, D.R and Roitt I.M.	Roitt's Essential Immunology	Wiley-Blackwell Publishers, USA	2017 (13 th Edition)

Course Designer:

Mrs. R. Kiruba

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDITS
MBY2306	PAPER VI- ANIMAL BIOTECHNOLOGY	CORE THEORY	43	2	-	4

Learning Objectives:

- To make the students understand the basic and Scientific knowledge on the emerging field of Animal Biotechnology
- To provide relevant information about the cell culture requirements,
- To analyze the types and methods of cell culture propagation, growth, maintenance, monitoring analysis and safety precautions
- To gain knowledge in theoretical skills in the maintenance, manipulation and cytotoxic evaluation of animal cell and tissue culture
- To assess transgenic animal, IVF and stem cell technology

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Generalize the overall concept about Animal Tissue Culture	K2
CLO2	Compute the Media preparation and types of culture	K3
CLO3	Estimate the Cell types and differentiation portfolio	K4
CLO4	Summarize the recent innovations on IVF and development	K5
CLO5	Manage the concept on Transgenic Animals and applications	K6

Mapping with Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	M	M	M
CLO2	S	S	M	S	M
CLO3	S	S	S	S	S
CLO4	S	M	L	S	S
CLO5	M	M	S	S	L

S- Strong; M-Medium; L-Low

ANIMAL BIOTECHNOLOGY

SYLLABUS

Unit I Animal cell culture

8h

Animal cell culture Laboratory-Design and layout, Equipment and materials. Structure, organization and physiology of animal cells. History, Scope and applications of animal cell culture- Advantages and limitations. Types of animal cell culture. Biology of cultured cells Culture vessels and substrate. Ethical implications of animal biotechnology, Biosafety and regulatory issues.

Unit II Culture media

8h

Preparation and sterilization of media and supplements, Physiochemical properties of medium. Balanced salt solution, culture media biochemical ingredients and types of media. Selection of medium and serum. Serum free media. Role of Antibiotics and its types in media Contaminations in animal cell culture.

Unit III Tissue culture and Tissue engineering

9h

Basic techniques of animal cell culture *in vitro*, disaggregation of tissue and primary culture, subculture and establishment of cell line, Cloning and selection, Cell separation, Characterization, Differentiation, Transformation and immortalization, Scale-up and cell synchronization, FACS. Measurement of cell death – apoptosis and its determination. Introduction and Applications of 3 D Bioprinting, Xenotransplantation.

Unit IV Cytotoxicity and IVF

9h

Cytotoxicity: Viability, toxicity and MTT Assay. Cryopreservation and cell banks. Organotypic culture and histotypic culture, tissue engineering and its application. Stem cell culture and its application.

In vitro fertilization (IVF), Embryo transfer and test tube babies. Transgenic Animals: Production Methodology-Embryonic Stem Cell method, Microinjection method.

Unit V Transgenic animals and Applications

9h

Transgenic animals in live- stock improvement. Cell culture-based vaccine. Somatic cell genetics. Genetically humanized animal models for personalized medicine, approaches primary targets of human gene therapy (muscular dystrophy, and sickle cell anemia) therapeutic Applications Alteplase and Tenecteplase (Tissue plasminogen activator -tPA), Osigraft/Eptotermin alfa (bone morphogenetic protein) Hormones -Insulin, glucagon, gonadotropins.

REFERENCE BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Rajesh Kumar Yadav	Animal Biotechnology and Genetic Engineering.	1st Edition Oxford Book Company	2021
2.	Ranga, M. M	Animal Biotechnology	Agrobios India Publishers, India	2018 (3 rd Edition)
3.	A. K. Srivastava	Animal Biotechnology	Oxford and IBH Publishing Company Pvt. Limited	2018

TEXT BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1	Portner, R	Animal Cell Biotechnology: Methods and Protocols	Humana Publishers, New York, United States	2016 (3 rd Edition)
2.	R. Ian Freshney	Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications.	Wiley-Blackwell 7th edition	2016
3.	Satyanarayana U.	Biotechnology	Books and Allied (p) Ltd.	2005

Course Designer:

Dr. D.S. Ranjith Santhosh Kumar

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDITS
MBY2307	PAPER VII- ENVIRONMENTAL BIOTECHNOLOGY	CORE THEORY	43	2	-	3

Learning Objectives

- To Understand the constitution of biogeography and the effects of environmental stress
- To gain knowledge about environmental hazards and disasters.
- To analyze the methods involved in pollution control.
- To know about pollution detection methods.
- To appreciate the importance of biotechnology in environmental aspects.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Describe about the various types of ecosystems	K2
CLO2	Report about Environmental pollution and its remediation measures.	K3
CLO3	Outline the Environmental hazards and disaster	K4
CLO4	Appraise the pollution detection and control methods	K5
CLO5	Propose the role of biotechnology in environmental measures	K6

Mapping with Programme Outcomes

CLOs	PLO1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	S	S	M	M	S
CLO2	S	S	M	M	S
CLO3	S	S	M	M	M
CLO4	S	S	M	M	M
CLO5	S	S	M	M	S

M-Medium - Strong

ENVIRONMENTAL BIOTECHNOLOGY

SYLLABUS

Unit I: Biogeography and Environmental problems

9 h

Biogeochemical cycles in ecological systems – Carbon, Phosphorus and Nitrogen cycles. Limiting factors, Energy transfer. Concept of ecosystems and ecosystem management. Response of microbes, plants and animals to environmental stresses. Environmental problems- ozone depletion, greenhouse effect, Carbon effects, water, air and soil pollution, and land degradation. environmental impact assessment and Sustainability.

Unit II: Biofuels Production and environmental hazards

8 h

Biofuels – a general introduction, Plant derived fuels, Biogas, Landfill gas, Biohydrogen. Composting process and techniques, Use of composted materials. Types of environmental hazards and Disasters. Natural - volcanic eruption, earthquakes, landslides, cyclones, lightning, hailstorms.

Unit III: Pollution and Management Systems

9 h

Sewage and waste water treatment and solid waste management, Chemical measure of water pollution, Conventional biological treatment, Role of macrophytes and macrophytes in water treatment. Recent approaches to biological wastewater treatment. Use of biological techniques in controlling air pollution. Removal of chlorinated hydrocarbons from air. Hazardous Waste Management and Waste Handling rules. Biobleaching

Unit IV: Pollution Detection Methods

8 h

Pollution Detection Methods-Biotechnological methods of pollution detection: Genotoxicity, Plant test system- algal bioassay. DNA gene probe, PCR based detection system for Shigella, Salmonella in water. Techniques in pollution detection - Remote sensing, Bioindicators and Biosensors for detection of pollution. Types of Biosensors – Enzyme electrode, Optical biosensors, H₂O₂ biosensor, Microbial biosensor.

Unit V: Bioresources and Environmental Management

9 h

Genetically Engineered Microorganisms (GEMs) in environment, Role of Environmental Biotechnology in management of environmental problems, Bioremediation: Advantages and Disadvantages, In situ and ex-situ bioremediation, slurry bioremediation. Bioremediation of contaminated ground water and phytoremediation of soil metals. Microbiology of degradation of xenobiotics. Biofertilizers, Biomining and Soil enzymes. agencies for pollution control.

Case Study- any two relevant studies.

REFERENCE BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Davis, M. L and Masten, S.J.	Principles of Environmental Engineering & Science.	McGraw Hill, UK. 4 th Edition	2019
2.	Mihelcic, J.R and Zimmerman, J.B.	Environmental Engineering: Fundamentals, Sustainability, and Design.	Wiley-Blackwell, UK. 3 rd Edition	2021
3.	Wright, R and Boorse, D	Environmental Science: Toward a Sustainable Future.	Pearson, USA. 13 th Edition	2016

TEXT BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Roger WrubelP, SheldonKrimsky	Agricultural Biotechnology and the Environment	University of Illinois Press. 1st Edition	1996
2.	P. Bajpai , R. Kondo	Biotechnology for Environmental Protection in the Pulp and Paper Industry	Springer. 2nd Edition	2011

Course Designer:

Dr. P. Suganya

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDITS
MBY2308	ELECTIVE – I NANO BIOTECHNOLOGY	ELECTIVE THEORY	43	2	-	4

Learning Objectives:

- To apply the basics of nanobiology, able to differentiate particles at macro, micro and nano level
- To know how to synthesize nanoparticles on a laboratory scale
- To understand the characterization techniques involved in nanotechnology
- To assess the properties of biological nano-objects
- To apply the nanomaterials for various biological applications

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Describe about the various types of nanoparticles and able to differentiate particles at macro, micro and nano level	K2
CLO2	Synthesis the nanoparticles on a laboratory scale	K3
CLO3	Outline the characterization techniques involved in nanotechnology	K4
CLO4	Distinguish the properties of different biological nano-objects	K5
CLO5	Apply the nanomaterials for various biological applications	K6

Mapping with Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	M	M	M	L
CLO2	M	M	M	M	S
CLO3	M	L	S	M	S
CLO4	S	S	S	M	M
CLO5	S	S	S	M	S

M-Medium S- Strong L-Low

NANO BIOTECHNOLOGY

SYLLABUS

Unit I: Introduction to Nanobiology and Nanomaterials

9 h

Nanobiology: Concepts. Classification of Nanostructures, Bionanoparticles and nanocomposites, Types of biomaterials and biodegradable polymers, Nano-thin films: Chitosan thin film, Nanodevices (nanorobots), Nanotubes: Microtubules assembly and its importance, Nano shells- Dendrimers: Liposomes, Nanofibers: Collagen, nanocomposites.

Unit II: Synthesis of Nanomaterials

8 h

Synthesis of nanomaterials - Physical approaches, Chemical approaches, Biological approaches-plant, bacteria, fungi mediated method. Bottom-up approach- Sol-Gel synthesis, Physical vapor deposition, top-down approach -ball milling, microfabrication.

Unit III: Characterization Techniques for Nanomaterials

9 h

Physical and chemical properties of nanoparticles. Characterization– UV-Vis spectroscopy, particle size analyzer, Zeta potential, FTIR, XRD, EDS, Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC). Electron Microscopy-Scanning Electron Microscopy (SEM), HRTransmission Electron Microscopy (TEM). Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM).

Unit IV: Biological Nano-objects

8 h

DNA-based Nanostructures, Mastering the complex DNA nanostructure, DNA tweezers, DNA actuators, DNA scissors, Protein-based Nanostructures, Lipid-based Nanostructures, Self assembly, Micelles, Application of biological nano-objects.

Unit V: Applications of nanomaterials in various fields

9 h

Nanobiotechnology in medicine Surgical supplements, Application in Diagnostic equipment, Tissue engineering with a focus on wound healing, Cancer treatment, Drug designing, Drug delivery, Photocatalysis of dye and heavy metal removal, Application in Cosmetics, food and agriculture. Biosensors.

REFERENCE BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Kulkarni	Nanotechnology: Principles and Practice	3rd edition, Springer	2015
2.	Ehud Gazit	Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology	2nd Edition, Imperial College Press, London, United Kingdom	2006
3.	David E Reisner, Joseph D Bronzino	Bionanotechnology: Global Prospects	1st Edition, CRC Press, Florida, United States	2019

TEXT BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Parthasarathy BK	Introduction to Nanotechnology	Isha Publication, India	2007
2.	Elisabeth Papazoglou, Aravind Parthasarathy,	Bionanotechnology	1st Edition, Morgan and Claypool Publishers, United States	2007

Course Designer:

Dr. V. Bhuvaneshwari

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDITS
MBY2309	ELECTIVE – II FOOD BIOTECHNOLOGY	ELECTIVE THEORY	43	2	-	4

Learning Objectives

- To gain knowledge on the basic principles of food science and technology,
- To analyze the various detection methods of microbes in food samples
- To apply the techniques used in food processing and preservation.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Distinguish the basic constituents of food.	K3
CLO2	Elaborate on the standards of identity, purity and methodology for analysis of different categories of food.	K5
CLO3	Evaluate the various food preservation methods.	K5
CLO4	Explain about the role of enzymes used in the food industry.	K5
CLO5	Examine the methods of detecting different bacteria in food samples.	K6

Mapping with Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	M	S	S
CLO2	S	S	M	S	S
CLO3	S	S	M	S	S
CLO4	S	S	M	S	S
CLO5	S	S	M	S	S

S- Strong; M-Medium; L-Low

FOOD BIOTECHNOLOGY

SYLLABUS

Unit I Introduction to Food Science and technology

8h

Basics of chemistry of food constituents- carbohydrates, proteins, lipids, vitamins, minerals, water (different forms of water present in foods and their effect on quality and preservation of foods). Minor constituents affecting texture, colour, taste and odour. Food allergens and mechanism. Strain improvement for flavour. Food microbiology, Food biochemistry. Food additives, General food composition and effect of food constituents on food quality.

Unit II Standards for food analysis

8h

Standards of identity, purity and methodology for analysis of Cereals, legumes, oil seeds and their products. Fruits, vegetables, tubers and their products. Tea, coffee, cocoa, chocolate, spices, and condiments. Milk and milk products. Meat, fish and poultry products. Miscellaneous foods e.g. fermented products. Food constituents in grains like gluten.

Unit III Food processing and preservation

9h

Introduction to food processing of various foods - dairy, bakery, brewing, fruit and vegetable products, plantation products, and nutraceuticals. Principles of food preservation by Dehydration, Thermal treatments like pasteurization, sterilization, canning, retorting etc. Low temperature i.e. chilling and freezing. Chemical preservation/ bio-preservation. Traditional methods like salting/ syruling, pickling, and fermentation. Non thermal processes like MAP, irradiation, high pressure processing, Hurdle technology.

Unit IV Industrial Food Products

9h

Fermentative production of enzymes used in the food industry, solid state fermentation, recovery of enzymes from natural sources, cheese making and whey processing, impact of enzyme technology (bioethanol, protein hydrolysates, bioactive peptides), enzymatic processing of fruit juices. Role of enzymes in baking, meat and meat processing, comparative methods of toxicity test in (novel) foods, biosensors, enzymatic approach to tailor made fats, catabolic processes and oxygen-dependent reactions in food, use of lipases and reactions in organic solvents and two phases.

Unit V Fermented foods and Regulations

9h

Applications of immunological techniques in the food industry. Detection methods for *E. coli*, Staphylococci, Yersinia, Campylobacter, *B. cereus*, *Clostridium botulinum* & Salmonella from food samples. Newer processing technology, Pesticide residues, Newer sources of ingredients, Nutraceuticals. Use of Antibiotics & Hormones in Food Processing & Agricultural Practices. Farmers producers Organisation (FPO), Quality analysis of food products, Hazard analysis and Critical control point (HACCP), Food biotechnology Government regulatory agency.

REFERENCE BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Keith H. Steinkraus.	Industrialization of Indigenous Fermented Foods.	CRC Press, USA	2004
2.	ByongH.Lee.	Fundamentals of Food Biotechnology.	Wiley-Blackwell, UK	2015
3.	Smith, J.S; and Hui. Y.H	Food Processing Principles & Applications	Wiley-Blackwell, UK	2013 (1 st Edition)

TEXT BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Frazier, W.C., Westhoff, D.C; and Vanitha, N. M.	Food Microbiology	McGraw Hill Education, New York, USA.	2017 (5 th Edition)
2.	Srilakshmi, B.	Food Science	New Age International Private Limited, New Delhi	2015 (6 th Edition)
3.	Sun, D.W.	Emerging Technologies for Food Processing	Academic Press, USA	2014 (2 nd Edition)

Course Designer:

Dr. P. Suganya

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDITS
MBY23P3	CORE PRACTICAL – III IMMUNOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY	CORE PRACTICALS	-	-	75	4

Learning Objectives

- To familiarize students with the basic principles of immunotechnological methods, animal cell culture and biostatistics.
- To develop students' skills to perform immunotechnological methods, animal cell culture, and biostatistics.
- To evaluate the method for detect and quantify the antigen, antibody concentration, toxicity analysis and analyze it using biostatistics method
- To design and perform immunological experiments, animal cell culture techniques and biostatistics to test specific hypotheses.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the basic principles of immunotechnological methods, animal cell culture and biostatistics.	K2
CLO2	Test and apply the immunotechnological methods, animal cell culture, and biostatistics.	K3
CLO3	Evaluate the method for detecting and quantifying the antigen	K4
CLO4	Justify the principles and applications of immunological techniques	K5
CLO5	Understand the real-world problem and solve using immunological experiments	K6

Mapping with Programme Outcomes

CLOs	PLO1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	M	S	S	M	S
CLO2	S	S	M	S	S
CLO3	S	S	M	S	S
CLO4	S	S	S	S	S
CLO5	S	S	M	S	S

S-Strong M-Medium

LIST OF EXPERIMENTS

IMMUNOTECHNOLOGY

1. Determination of the blood group of the given sample.
2. Preparation of serum from blood.
3. Blood smear staining by using Leishman stain
4. Single radial immunodiffusion.
5. Ouchterlony double diffusion.
6. Rocket Immunoelectrophoresis for determination of concentration of antigen in unknown sample.
7. Micro-hemagglutination test.
8. Determination of antibody titer by precipitation assay.
9. WIDAL test for typhoid
10. ELISA test (demo)
11. Western blotting (demo)

ANIMAL BIOTECHNOLOGY

1. Isolation of animal DNA from liver
2. Preparation of reagents and media for cell culture.
3. Primary culture technique chicken embryo fibroblasts.
4. Secondary culture of chicken embryo fibroblast.
5. Qualification of cells by trypan blue exclusion dye.
6. Isolation and cultivation of lymphocytes.
7. Study on effect of toxic chemicals on cultured mammalian cells -MTT assay.
8. Cryopreservation of cell primary cultures and Revival of cells.

REFERENCE BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Jenkins, N	Animal Cell Biotechnology: Methods and Protocols.	Humana press, New Jersey	1999
2.	Vashist, S.K. & Luong, J.H.T.	Handbook of Immunoassay Technologies: Approaches, Performances, and Applications	Academic Press	2018 (1 st Edition)

TEXT BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Frank C. Hay	Practical Immunology	Garland Science	5th Edition 2018
2.	R. Ian Freshney	Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications.	Wiley-Blackwell 7th edition	2016

Course Designer:

Mrs. R. Kiruba

Dr. D.S. Ranjith Santhosh Kumar

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDITS
MBY23P4	CORE PRACTICAL- IV ENVIRONMENTAL, NANO AND FOOD BIOTECHNOLOGY	CORE PRACTICALS	-	-	75	4

Learning Objectives

- To identify the basic methods involved in environmental, nano and food products
- To design an experiment to assess the environmental, nano and food samples
- To analyze the methods for identifying the quality of environmental, nano and food sample
- To justify the application of environmental, nano and food biotechnology
- To identify basic experimental design principles in preparation of environmental, nano and food products

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Identify the basic methods involved in environmental, nano and food products	K2
CLO2	Design an experiment to assess the environmental, nano and food samples	K3
CLO3	Analyze the methods for identifying the quality of environmental, nano and food samples	K4
CLO4	Justify the application of environmental, nano and food biotechnology	K5
CLO5	Identify basic experimental design principles in preparation of environmental, nano and food products	K6

Mapping with Programme Outcomes

CLOs	PLO1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	S	S	M	M	L
CLO2	S	S	M	M	M
CLO3	S	S	S	S	S
CLO4	S	S	S	S	M
CLO5	S	S	S	S	S

S- Strong M-Medium L-Low

LIST OF EXPERIMENTS

ENVIRONMENTAL BIOTECHNOLOGY

1. Water quality testing:
 - a) pH
 - b) Turbidity
 - c) TDS
 - d) Residual chlorine
 - e) Hardness
 - f) free CO₂
2. MPN method of water analysis
3. Estimation of biological oxygen demand in water/sewage samples
4. Determination of optimum concentration of coagulant in water using Jar test.
5. Preparation of Biofertilizer

NANO BIOTECHNOLOGY

1. Synthesize copper oxide nanoparticles by sol-gel method
2. Synthesize Zinc oxide nanoparticles by microwave method
3. Synthesize Silver Nanoparticles by biogenic methods
4. Synthesize Nanoemulsion using magnetic stirrer and Ultra sonicator
5. Determination of surface plasmon resonance using UV-visible spectroscopy
6. Photocatalysis of dye by Nanoparticles
7. Determination of average size and charge of nanoparticles using Particle Size Analyzer (Demo)

FOOD BIOTECHNOLOGY

1. Detection of Food adulteration
2. Determination of moisture content from food sample
3. Application of enzymes in Fruit processing
4. Determination of peroxide value of oil
5. Determination of ascorbic acid content from fruits
6. Microbiological analysis of food
7. Detection of pesticides using HPLC method (Demo)

REFERENCE BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Hauser, B	Drinking water chemistry: a laboratory manual.	CRC Press	2018
2.	Poinern, G.E.J	A Laboratory Course in Nanoscience and Nanotechnology	CRC Press	2014
3	Nielsen, S.S	Food analysis laboratory manual	New York, NY, USA: Kluwer Academic/Plenum Publishers.	2003

TEXT BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Winkelmann, Kurt	Practical Aspects of Creating an Interdisciplinary Nanotechnology Laboratory Course for Freshmen	Journal of Nano Education 1.1	2009
2.	Patra, J.K., Das, G., Das, S.K. and Thatoi, H	A Practical Guide to Environmental Biotechnology	Springer	2020
3.	Pomeranz, Y	Food analysis: theory and practice.	Springer Science & Business Media.	2013

Course Designer:

Dr. V. Bhuvaneshwari

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDITS
MBY23S1	SPECIAL COURSE-RESEARCH METHODOLOGY	SPECIAL COURSE THEORY	45	-	-	3

Learning Objectives

To facilitate the students to

- Gain the skill in selecting appropriate research project, design of experiments, methods, and techniques that align with the research objectives.
- To understand the concepts in Bioethics
- To examine the biosafety and risk assessment of products derived from recombinant DNA research
- To distinguish National and International biosafety regulations.
- To justify the concept of research ethics and responsible conduct in research

Course Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Summarize the components of a research review, report and manuscript.	K5
CLO2	Understand the Concepts in Bioethics	K3
CLO3	Examine the biosafety and risk assessment of products derived from recombinant DNA research	K4
CLO4	Distinguish National and International biosafety regulations.	K2
CLO5	Justify the concept of research ethics.	K6

Mapping with CLOs

CLOs	PLO1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	S	S	S	S	S
CLO2	S	S	S	S	M
CLO3	S	S	S	S	S
CLO4	S	S	M	S	M
CLO5	S	S	M	S	S

M-Medium S- Strong

RESEARCH METHODOLOGY

SYLLABUS

UNIT - I Introduction to Research

9 h

Definition, Basic and Applied research, Interdisciplinary research. Literature Review - Research reading, Discriminative reading, consulting source material, Reference cards. Primary and Secondary literature. Literature citation, Components of a research report, Use of tables and figures, Preparation of photographs and microphotographs, Formatting and requirements for manuscript preparation, Biological abstract, Review, Monographs, Peer reviewed journals, Plagiarism software, e-resources, Digital library, Electronic research tools, Bibliography software. Internet - Worldwide Web - Search Engines - their functions. Boolean searching - File formats.

UNIT - II Bioethics

9 h

Introduction, ethical conflicts in biological sciences - interference with nature. Bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research – cloning and stem cell research, Human and animal experimentation, animal rights/welfare, Agricultural biotechnology - Genetically engineered food, environmental risk, labeling and public opinion. Sharing benefits and protecting future generations - Protection of environment and biodiversity –biopiracy

UNIT - III Biosafety

9 h

Biosafety and Biosecurity - introduction; historical background; primary containment for biohazards, GRAS organisms, Definition of GMOs & LMOs, principles of safety assessment of transgenic plants – sequential steps in risk assessment. Environmental risk assessment and food and feed safety assessment, risk assessment of transgenic crops Vs cisgenic plants or products derived from RNAi, genome editing tools.

UNIT - IV National & International biosafety regulations

9 h

International regulations – Cartagena protocol, OECD consensus documents and Codex Alimentarius, Indian regulations – EPA act and rules, guidance documents, regulatory framework – RCGM, GEAC, IBSC and other regulatory bodies; Draft bill of Biotechnology Regulatory authority of India - containments – Biosafety levels and category of rDNA experiments; field trials – biosafety research trials – standard operating procedures - guidelines of state governments; GM labeling – Food Safety and Standards Authority of India (FSSAI).

UNIT - V Research Ethics and Responsible Conduct in Research

9 h

Brief history and analytical basis of research ethics, responsible conduct in research (Honesty in Science: Integrity, Authorship, Conflicts of Interest, Privacy and Confidentiality, Informed Consent, Risk/Benefit Assessment), The legal regulation of research ethics in India (From UGC, MHRD and other governing agencies), Regulatory requirements relevant to international research.

REFERENCE BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Sibi, G.	Intellectual property rights, Bioethics, Biosafety and Entrepreneurship in Biotechnology.	Wiley India Pvt Ltd	2021
2.	Uzochukwu, S.	Biosafety and Bioethics in Biotechnology.	Taylor and Francis Ltd, UK	2022
3.	Gurumani, N.	Research Methodology: for Biological Science	MJP Publishers, India	2019

TEXT BOOKS

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Campbell, A.V.	Bioethics -The basics.	Routledge	2018
2.	John W. Creswell , J. David Creswell	Research Design: Qualitative, Quantitative, and Mixed Methods Approaches	SAGE Publications, 5 th Edition	2018

Course Designer:

Dr. V. Bhuvaneshwari