



**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)

(Ranked 4rd in NIRF 2023)

SEMESTER I-IV

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

M.Sc. BIOTECHNOLOGY

BATCH 2022-24

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 – 2022-2024 BATCH**

Applicable to students admitted during the academic year 2022-2023 onwards (I and II Sem)

SEM	Subject Code	Title of the Paper	Instruction hours/week	Contact hours	Tutorial	Duration of Examination	Examination Marks			Credits
							CA	ESE	TOTAL	
I	MBY2201	Paper-I Biochemistry	5	56	4	3	50	50	100	4
	MBY2202	Paper-II Microbiology	4	56	4	3	50	50	100	4
	MBY2203	Paper-III Cell and Molecular Biology	5	56	4	3	50	50	100	4
	MBY2204	Paper-IV Plant and Animal Biotechnology	4	56	4	3	50	50	100	4
	MBY21P1	Practical-I Biochemistry and Microbiology	6	60	-	6	50	50	100	4
	MBY21P2	Practical-II Cell & Molecular Biology & Plant and Animal Biotechnology	6	60	-	6	50	50	100	4
	MBY2205	Paper-V Immunology	4	56	4	3	50	50	100	4
	MBY2206	Paper-VI Genetic Engineering	4	56	4	3	50	50	100	4

II	MBY2207	Paper-VII Genomics and Proteomics	4	56	4	3	50	50	100	4
	MBY2208/ MBY2209	Elective-I Food Biotechnology /Bioinstrumentation	4	56	4	3	50	50	100	4
	MBY22A1	Inter Disciplinary Course - Molecular Diagnostics	4	56	4	3	-	100	100	4
	MBY21P3	Practical-III Immunology & Molecular Diagnostics	5	60	..	6	50	50	100	4
	MBY21P4	Practical-IV Genetic Engineering & Genomics & Proteomics	5	60	..	6	50	50	100	4

COURSE NO	COURSE NAME	CATEGORY	L	TP	CREDIT
MBY2201	BIOCHEMISTRY	THEORY	56	4	4

Preamble

To introduce students to the structure and classification of carbohydrates, lipids, amino acids, and proteins. To gain knowledge about metabolism of Carbohydrates, Lipids, Proteins and Nucleic acid.

Course Learning 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 Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4
CLO1	H	H	M	H
CLO2	H	H	M	H
CLO3	H	H	M	H
CLO4	H	H	M	H
CLO5	H	H	M	H

H- High; M-Medium; L-Low

Biochemistry MBY2201 (56 hrs) Credits: 4

Unit - I Carbohydrates

11hrs

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

11hrs

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 & Proteins

11hrs

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:** Metabolism of aromatic amino acids, glycine and threonine. Protein metabolism.

Unit - IV Enzymes – Kinetics & Specificity

11hrs

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, Immobilization of enzymes and their applications.

Unit - V Nucleic acids

12hrs

Structures of Purines & Pyrimidines, Nucleosides, Nucleotides, Nucleic acids – Classes & Properties. Chemical difference between RNA and DNA structure. DNA – double helical structure, Structural forms of DNA - DNA-A, B, Z, Circular & Supercoiled DNA, Denaturation & Renaturation of DNA. Different types of RNA – mRNA, rRNA, tRNA, small RNA, snRNA, miRNA, Micro RNA, Silencing RNA (siRNA) & Long noncoding RNA (lnc RNA). **Nucleic acid Metabolism:** Biosynthesis of purine and pyrimidine nucleotides - Denovo and Salvage pathways. Catabolism of purines and pyrimidines.

Text Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Garrett, R.H, and Grisham, C.M	Biochemistry	Cengage Learning, Boston, USA.	2017 (6 th Edition)
2.	Nelson, D.L, and Cox, M.M	Lehninger Principles of Biochemistry	W.H. Freeman and Company, New York. USA	2017 (7 th Edition)
3.	Satyanarayana, U, and Chakrapani, U	Biochemistry	Elsevier Health Sciences, New Delhi, India	2021 (6 th Edition)

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	2019 (9 th Edition)
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	2018 (31 st Edition).
3.	Voet, D., Voet, J.G, and Pratt, C.W.	Voet's Principles of Biochemistry	John Wiley & Sons, New York, USA	2018 (5 th Edition).

Course Designer:

1. Dr. V. Usha

COURSE NO	COURSE NAME	CATEGORY	L	TP	CREDIT
MBY2202	MICROBIOLOGY	THEORY	56	4	4

Preamble

To introduce students to microbial nutrition, growth and growth control methods. To understand the aetiology, symptoms and prevention of microbial diseases.

Course Learning Outcomes

On the successful completion of the course, 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 Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4
CLO1	H	H	H	M
CLO2	H	H	H	M
CLO3	H	H	H	M
CLO4	H	H	H	H
CLO5	H	H	H	H

H- High; M-Medium; L-Low

Microbiology MBY2202 (56 hrs)**Credits: 4****Unit - I Microbial characteristics****12hrs**

Organization and function of prokaryotic and eukaryotic cells. Distinguishing features of various groups of micro-organisms: Bacteria, molds, yeasts, algae, protozoa & viruses.

Microbial nutrition and growth: 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**11hrs**

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**11hrs**

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**11hrs**

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**11hrs**

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.

Text Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Pelczer, M.J., Chan, E.C.S, and Krieg, N.R.	Microbiology	McGraw Hill Education (India) Pvt Ltd, New Delhi, India	2014 (5 th Edition)
2.	Willey, J., Sandman, K and Wood, D.	Prescott's Microbiology	McGraw-Hill, New York, USA	2020 (11 th Edition)
3.	Anantha Narayanan, R and Jayaram Panicker, C.K.	Text Book of Microbiology	Universities Press, Hyderabad, India	2020 (11 th Edition)

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	2020 (13 th Global Edition)
2.	Murray, P., Rosenthal, K and Pfaller, M.	Medical Microbiology	Elsevier, Netherlands.	2020 (9 th Edition).
3.	Pommerville, C.J.	Fundamentals of Microbiology	Jones and Bartlett Publishers Inc, Massachusetts, USA.	2022 (12 th Edition).

Course Designer:

1. Dr. V. Usha

COURSE NO	COURSE NAME	CATEGORY	L	TP	CREDIT
MBY2203	CELL & MOLECULAR BIOLOGY	THEORY	56	4	4

Preamble

To gain in-depth knowledge on the structure and functions of cellular organelles and to understand Replication, Transcription and Translation in detail.

Course Learning 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 Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4
CLO1	H	M	H	H
CLO2	H	M	H	H
CLO3	H	H	H	H
CLO4	H	M	H	H
CLO5	H	M	H	H

H- High; M-Medium; L-Low

UNIT - I Cell Organization and cell cycle

12hrs

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, Cell cycle check points, Cyclins and protein kinases.

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

11hrs

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

11hrs

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 10hrs

DNA Replication, Types. Transcription, Operon concept, *lac*, *trp*, *ara*, *his*, and *gal* operons. Post Transcriptional modification, Translation and Post Translational modification. Regulation of gene expression in prokaryotes - Regulatory proteins, DNA binding Motifs: Zinc finger, 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. RNAi and gene silencing.

UNIT – V Oncogenes, Mutations and Transposable elements

12hrs

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.

Text Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Alberts, B.	Molecular Biology of the Cell	Garland Science Publication	2017 (6 th Edition)
2.	Cooper, G.M.	The Cell: A Molecular Approach	Oxford University Press, UK	2018 (8 th Edition)
3.	Krishnaiya, G.R.	A Textbook of Microbial Genetics & Molecular Biology	Blue Rose Publishers	2019 (1 st Edition)

Reference Books

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

Course Designers:

1. Dr. G. Archana
2. Dr. V. Usha

COURSE NO	COURSE NAME	CATEGORY	L	TP	CREDIT
MBY2204	PLANT & ANIMAL BIOTECHNOLOGY	THEORY	56	4	4

Preamble

To understand the types and applications of plant and animal tissue culture in detail.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Distinguish the media requirements for different types of plant tissue culture.	K2
CLO2	Explain about the different methods of gene transfer to plants.	K3
CLO3	Evaluate the different methods of maintaining animal cell cultures.	K4
CLO4	Justify the usefulness of PCR based markers like RFLP, RAPD, STS, SSR, AFLP, SNP.	K5
CLO5	Report about the applications of Transgenic plants and animals.	K6

Mapping with Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4
CLO1	H	H	H	H
CLO2	H	H	H	H
CLO3	H	H	H	H
CLO4	H	M	M	H
CLO5	H	M	M	M

H- High; M-Medium; L-Low

Plant & Animal Biotechnology-MBY2204 (56 hrs)

Credits: 4

UNIT - I Plant Tissue Culture

11hrs

Plant tissue culture media and its types. Hairy root culture, Callus and Cell suspension culture, Organogenesis, Protoplast Culture, Production of haploids, Somaclonal variations, Embryo culture and embryo rescue. Production and processes for enhancing secondary metabolites from cell suspension cultures. Mass multiplication of commercially important crops. Elicitor, Precursor treatment for production, product recovery, scaleup process and products. Virus indexing and genetic fidelity of micropropagated crops.

UNIT - II Genetic engineering of plants

10 hrs

Ti plasmid, Ti plasmid derived vector systems, Ri plasmids. Methods of gene transfer to plants – Calcium phosphate, Biolistics, Gene Gun, Direct gene transfer, *Agrobacterium tumefaciens* mediated gene transfer, Particle bombardment, Electroporation and Microinjection. Manipulation of gene expression in plants. Production of marker free transgenic plants.

UNIT - III Animal Cell culture

12hrs

Types, primary culture, established culture; suspension and adherent culture, organ culture, embryo culture, three-dimensional culture and tissue engineering, feeder layers. Requirements of culture media for animal cell culture - Complete and incomplete medium, Cell Trypsinization, Cell count using trypan blue dye, Freezing medium, Cryopreservation. Biology and characterization of cultured cells, tissue typing, cell – cell interaction. Measuring parameters of growth. Measurement of cell death – apoptosis and its determination.

UNIT - IV Molecular mapping and marker assisted selection

11hrs

Molecular markers - hybridization and PCR based markers, RFLP, RAPD, STS, SSR, AFLP, SNP markers. DNA fingerprinting-principles and applications. Introduction to mapping of genes/QTLs. Marker-assisted selection - Strategies for introducing genes of biotic and abiotic stress resistance in plants. Genetic basis for disease resistance in animals. Molecular diagnostics of pathogens in plants and animals. Detection of meat adulteration using DNA based methods.

UNIT - V Applications of plant and animal genetic engineering

12hrs

In Plants: Productivity and performance: herbicide resistance, insect resistance, virus resistance, fungal resistance, nematode resistance. Induction of abiotic stress and cold stress. Delay in fruit ripening, LEA protein, plantibodies. Edible vaccines - primary and secondary metabolite modification, biopolymers, plant-based enzyme engineering. In Animal: Transgenic animals, Genetically humanized animal models for personalized medicine approaches, Transgenic animals in live- stock improvement. Ethical implications of animal biotechnology, Biosafety and regulatory issues.

Text Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Chawla, H.S.	Introduction to Plant Biotechnology	CRC Press, Florida, United States.	2018 (3 rd Edition)
2.	Ranga, M. M.	Animal Biotechnology	Agrobios India Publishers, India	2018 (3 rd Edition)
3.	Glick, B.R. & Patten, C.L.	Molecular Biotechnology	Taylor & Francis Publishers, Abingdon, United Kingdom	2017 (5 th Edition)

Reference 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.	Ranzoni, A.M and Cvejic, A	Single-cell biology: resolving biological complexity, one cell at a time.	The Company of Biologists	2018
3.	Primrose, S.B. and Twyman, R. M.	Principles of Gene Manipulation and Genomics	John Wiley and Sons Ltd, United Kingdom	2016 (8 th Edition)

Course Designer:

1. Dr. G. Archana

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY21P1	CORE PRACTICAL- 1 BIOCHEMISTRY AND MICROBIOLOGY	PRACTICALS	-	-	60	4

List of Experiments

Biochemistry

1. Separation of the amino acids - Glycine, Tyrosine and Leucine by Thin Layer Chromatography.
2. Generation of the titration curve for the amino acid glycine.
3. Isolation of the enzyme β -amylase from sweet potato as a source of enzyme.
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. Effect of pH on the activity of alpha-amylase.
8. Effect of temperature on the activity of alpha-amylase.

Microbiology

1. Preparation of liquid and solid media for bacterial growth.
2. Culture techniques - Streak plate, Spread plate & Pour plate methods.
3. Counting of bacterial colony by serial dilution method.
4. Study of bacterial growth curve by turbidimetry.
5. Preparation of bacterial smear and Gram Staining.
6. Differential and Cytological staining techniques.
7. Determination of the susceptibility of bacteria against different antibiotic agents.

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	2018 (3 rd Edition)
2.	Pingoud, A and Urbanke, C.	Biochemical Methods: A Concise Guide for Students and Researchers	Wiley-VCH	2010 (1 st Edition)
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.	2004 (8 th Edition)

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY21P2	CORE PRACTICAL- II CELL & MOLECULAR BIOLOGY & PLANT & ANIMAL BIOTECHNOLOGY	PRACTICALS	-	-	60	4

List of Experiments

Cell Biology

1. Observation of Prokaryotic and Eukaryotic cell using a Light Microscope.
2. Isolation of Chloroplasts from spinach leaves.
3. Visualization of the different stages of Mitosis in Onion Root Tips using a light microscope.
4. Cell organisation and subcellular structure studies of prokaryotic and eukaryotic cells.
5. Lignin staining of the plant section and observation under the microscope.
6. Determination of the concentration of cells using a Hemocytometer.

Molecular Biology

1. Preparation of Buffer stocks (TBE, TE and TAE).
2. Plasmid DNA isolation (Mini prep) from *E. coli* by alkaline lysis method.
3. Agarose Gel Electrophoresis (AGE) of DNA.
4. Preparation of Competent cell from *E. coli* by Calcium Chloride method.
5. Setting up ligation reaction using T4 DNA ligase.
6. Transformation of *E. coli* cells with pUC19 plasmid DNA.

Plant Biotechnology

1. Basics of Plant Tissue Culture – Demonstration.
2. Production of Callus from carrot.
3. Isolation of DNA from onion.

Animal Biotechnology

1. Extraction of DNA from animal liver.
2. Isolation of RNA from *E. coli*.

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	2019 (1 st Edition)
2.	Slater, A., Scott, N.W. & Fowler, M.R.	Plant Biotechnology: The Genetic Manipulation of plants	Oxford University Press, Oxford, United Kingdom	2008 (2 nd Edition)
3.	Maniatis, T	Molecular Cloning – A Laboratory Manual	Cold Spring Harbor Laboratory	2001 (3 rd Edition)
4.	Carson, S and Miller, H.B.	Molecular BiologyTechniques	Academic Press	2019 (4 th Edition)

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2105	IMMUNOLOGY	THEORY	56	4	-	4

Preamble

To gain knowledge on how the immune system works, types of immunity and the structure & functions of immunoglobulins.

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.	K ₃ , K ₄
CLO2.	Compare the major components of immune response.	K ₄ , K ₅
CLO3.	Assess the different methods involved in antibody production and antibody engineering.	K ₅ , K ₆
CLO4.	Elaborate on the association of immune system with infectious disease.	K ₅ , K ₆
CLO5.	Explain about the types of autoimmune diseases and their treatment.	K ₄ , K ₅

Mapping with Programme Outcomes

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

H- High; M-Medium; L-Low

Immunology MBY2105 (56 hrs) Credits: 4

UNIT I Immunology: Fundamental concepts and overview of the immune system 11h

Components of innate and acquired immunity, phagocytosis, complement and inflammatory responses, pathogen recognition receptors (PRR) and pathogen associated molecular pattern (PAMP). Innate immune response, mucosal immunity, immunogens, haptens. Major Histocompatibility Complex: MHC genes, MHC and immune responsiveness and disease susceptibility. Organs of immune system: primary and secondary lymphoid organs. Humoral and Cell mediated immunity.

UNIT II Antigens and Antibodies 11h

Hematopoiesis and differentiation. Lymphocytes: Activation of B and T lymphocytes. Antigen processing and presentation - endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens. Immunoglobulins - Basic structure, classes & subclasses of immunoglobulins, Antigenic determinants, Multigene organization of immunoglobulin genes. Complement system – Mode of activation, Classical, alternate, lectin and mannose binding pathway.

UNIT III Immunogenetics 12h

MLR and HLA typing. Tissue transplantation, Bone marrow transplantation, organ transplants. Xeno transplantation from various species. Immunological basis of graft rejection. Clinical transplantation and immunosuppressive therapy. Hybridoma technology and Monoclonal antibodies, Immuno-diagnosis and Application of monoclonal antibodies in biomedical research, Human monoclonal antibodies and catalytic antibodies, Antibody engineering, Chimeric antibodies.

UNIT IV Immune response in health 10h

Hypersensitivity - types of hypersensitivity - immediate and delayed hypersensitivity, Hypersensitivity reactions- types I, II, III, and IV, symptoms, immunodiagnosis. Allergens, Allergy. Immunity to Infectious agents - Viral infections, bacterial infections, Parasite and fungal infections. Lymphokines and Cytokines – Structure and Functions. Interleukins and Interferons- Production, biological functions and assay methods.

UNIT V Autoimmunity and Immunomodulation 12h

Mechanism and role of CD4⁺ T cells, MHC and TCR in autoimmunity. Types of Autoimmune diseases – Hashimoto's disease, Systemic lupus erythematosus, Multiple sclerosis, Myasthenia gravis and their treatment. Immunomodulation (immunosuppression & immunostimulation). Immunotherapy, Lymphocyte migration, homing and trafficking, Antigen-induced lymphocyte proliferation, Granulysin mediated anti-microbial activity of T cells.

Text 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.	Coleman, W. B., & Tsongalis, G. J.	Molecular Diagnostics: for the Clinical Laboratorian.	Humana Press, NJ. USA	2010
3.	Punt, J., Stranford, S., Jones, P & Owen, J.A.	Kuby Immunology	W. H. Freeman, NY. USA	2018 (8 th Edition)

Reference Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Rifai, N., Horvath, A.R., and Wittwer, C.T.	Tietz Fundamentals of Clinical chemistry and Molecular diagnostics.	Humana Publishers, New York, United States.	2018 (8 th Edition)
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 Designers:

1. Dr. G. Archana
2. Dr. V. Usha

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2106	GENETIC ENGINEERING	THEORY	56	4	-	4

Preamble

To gain an in depth understanding of the various principles and tools in genetic engineering.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1.	Explain the basic prerequisites required to perform a genetic engineering experiment.	K ₄ , K ₅
CLO2.	Discuss about the different cloning and expression vectors.	K ₅ , K ₆
CLO3.	Compare the different types of PCR and the Nucleic acid sequencing methods.	K ₅ , K ₆
CLO4.	Examine the different protein-DNA interaction methods.	K ₄ , K ₅
CLO5.	Justify the importance of gene editing technologies.	K ₅ , K ₆

Mapping with Programme Outcomes

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

H- High; M-Medium; L-Low

Genetic Engineering MBY2106 (56 hrs) Credits: 4

UNIT I Introduction and tools for genetic engineering

11h

General requirements for performing a genetic engineering experiment. Restriction endonucleases and Methylases, DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase. Cohesive and blunt end ligation, linkers, adaptors, homopolymeric tailing. Labelling of DNA: Nick translation, Random priming, Radioactive and Non-radioactive probes. Hybridization techniques: Northern, Southern, Western, and Colony hybridization, Fluorescence in situ hybridization.

UNIT II Different types of vectors

12h

Plasmids, Bacteriophages, M13mp vectors, pUC19 and Bluescript vectors, Phagemids, Lambda vectors, Insertion and Replacement vectors, Cosmids, Artificial chromosome vectors (YACs, BACs). Principles for maximizing gene expression. Expression vectors: pMal, GST, pET-based vectors. Protein purification: His-tag, GST-tag, and MBP-tag. Intein-based vectors. Inclusion bodies: Methodologies to reduce formation of inclusion bodies. Mammalian expression and replicating vectors, Baculovirus and Pichia vector system, yeast vectors, and shuttle vectors.

UNIT III Types of PCR techniques and Nucleic acid sequencing

11h

Principles of PCR: Primer design, DNA polymerases. Types of PCR – Multiplex, Nested; Reverse-transcription PCR, Real time PCR, Touchdown PCR, Hot start PCR, Colony PCR, and Asymmetric PCR. Cloning of PCR products: T-vectors, Proof reading enzymes. PCR based site specific mutagenesis. PCR in molecular diagnostics: viral and bacterial detection. DNA Sequencing methods: Classical sequencing, Automated DNA sequencing, Next-generation sequencing, RNA sequencing.

UNIT IV Gene manipulation and protein-DNA interaction

11h

Insertion of foreign DNA into host cells - Transformation, Electroporation, Transfection. Construction of libraries. Isolation of mRNA and total RNA. Reverse transcriptase and cDNA synthesis. cDNA and Genomic libraries. Construction of microarrays – genomic arrays, cDNA arrays and oligo arrays. Study of protein-DNA interactions: electrophoretic mobility shift assay, DNase footprinting, methyl interference assay, chromatin immunoprecipitation, yeast two-hybrid system, phage display.

UNIT V Transgenic animals and genome editing technologies

11h

Introduction to methods of genetic manipulation in different model systems e.g. Fruit flies (*Drosophila*), Worms (*C. elegans*), Frogs (*Xenopus*), Fish (zebra fish) and Chick. Transgenics - Gene replacement, Gene targeting in animal cells, Creation of transgenic and knock-out mice, Disease model. Introduction to genome editing by TALENs & Zinc finger nucleases and CRISPR-CAS9 methods.

Text Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Green, M. R., & Sambrook, J.	Molecular Cloning: A Laboratory Manual.	Cold Spring Harbor Laboratory Press, USA.	2012 (4 th Edition)
2.	Brown, T. A.	Gene cloning and DNA Analysis an Introduction	Blackwell Publishers, USA.	2016 (7 th Edition)
3.	Desmond S.T. Nicholl	An introduction to Genetic Engineering	Cambridge University Press, UK	2012 (3 rd Edition)

Reference Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Glick, B. R., & Patten, C. L.	Molecular biotechnology: Principles and applications of recombinant DNA.	John Wiley & Sons, UK.	2017 (5 th Edition)
2.	Primrose, S.B., and Twyman, R.	Principles of Gene manipulation and Genomics.	Wiley-Blackwell Publishers, USA	2014 (7 th Edition)
3.	Rastogi, S., and Pathak, N.	Genetic Engineering (Oxford Higher Education)	Oxford University Press, UK	2009 (1 st Edition)

Course Designer:

1. Dr. V. Usha

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2107	GENOMICS AND PROTEOMICS	THEORY	56	4	-	4

Preamble

To explain topics related to Structural & Functional genomics and advanced proteomics technologies.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1.	Compare the organization of microbial, plant and human genome.	K ₅ , K ₆
CLO2.	Evaluate the methods and techniques used for gene mapping	K ₅ , K ₆
CLO3.	Assess comparative genomics strategies to track emerging diseases and design new drugs.	K ₄ , K ₅
CLO4.	Justify the importance of Proteomics technologies.	K ₅ , K ₆
CLO5.	Examine the different functional proteomics methods.	K ₄ , K ₅

Mapping with Programme Outcomes

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

H- High; M-Medium; L-Low

Genomics and Proteomics MBY2107 (56 hrs) Credits: 4

UNIT I Basics of genomics & Genome Organization and Structure 11h

Concept of Genomics, Structural Genomics, Functional Genomics, Transcriptomics, and Metabolomics. Human Genome Project, Genome sequencing projects for microbes, plants and animals. General structural features of Viral and Bacterial genomes. Organization of *E. coli* genome, Arabidopsis genome, Rice genome, Human genome, Chloroplast and Mitochondrial genomes.

UNIT II Genome mapping 11h

Genetic and physical maps, Markers for genetic mapping, Methods and techniques used for gene mapping, Physical mapping, Linkage analysis, Cytogenetic techniques, FISH technique in gene mapping, Somatic cell hybridization, Radiation hybrid maps, in situ hybridization, Comparative gene mapping.

UNIT III Comparative genomics 11h

Identification and Classification of organisms using molecular markers - 16S rRNA typing/sequencing, SNPs. Use of genomes to understand evolution of eukaryotes, track emerging diseases and design new drugs. Determining gene location in genome sequence. Orthologs, Homologs, Paralogs, Gene evolution, Protein evolution by exon shuffling.

UNIT IV Proteomics 12h

Proteomics technologies: Two-dimensional gel electrophoresis (2D-PAGE), Isoelectric focusing, Tryptic digestion of protein and peptide fingerprinting, Two-dimensional fluorescence difference in-gel electrophoresis (DIGE). Tandem FPLC, MALDI-TOF & Q-TOF Mass spectrometry, LC/MS-MS - Identification of proteins and modified proteins. Protein-protein interactions using Yeast two hybrid system, Protein micro array, Antibody arrays, Antigen arrays, General protein arrays, Protein chips, Post-translational modification analysis.

UNIT V Functional proteomics 11h

SAGE and differential display proteomics. Diagnostic proteomics: SELDI-TOF MS. Quantitative proteomics - Stable isotope labeling by amino acids in cell culture (SILAC), Isotope-coded affinity tag (ICAT), Isobaric tagging for relative and absolute quantitation (iTRAQ). Label-free proteomics. Protein-protein and protein-DNA interactions. Protein chips and Functional proteomics. Clinical and biomedical applications of Proteomics.

Text Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Pevsner, J.	Bioinformatics and Functional genomics.	Wiley-Blackwell Publishers, USA	2015 (3 rd Edition)
2.	Twyman, R.	Principles of Proteomics	Wiley-Blackwell Publishers, UK	2014 (2 nd Edition)
3.	Poptsova, M.S.	Genome Analysis: Current Procedures and Applications	Caister Academic Press, USA	2014 (1 st Edition)

Reference Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Field, D., and Davies, N.	Biocode: The New Age of Genomics.	Oxford University Press, UK	2015 (1 st Edition)
2.	Lesk, A.	Introduction to Genomics	Oxford University Press, UK	2017 (3 rd Edition)
3.	Veenstra, T.D., and Yates, J.R.	Proteomics for Biological discovery	Wiley-Blackwell Publishers, USA	2019 (2 nd Edition)

Course Designer:

1. Dr. V. Usha

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2108	ELECTIVE – I FOOD BIOTECHNOLOGY	THEORY	56	4	-	4

Preamble

To gain knowledge on the basic principles of food science and technology, detection methods of microbes in food samples and 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.	K ₃ , K ₄
CLO2.	Elaborate on the standards of identity, purity and methodology for analysis of different categories of food.	K ₅ , K ₆
CLO3.	Evaluate the various food preservation methods.	K ₅ , K ₆
CLO4.	Explain about the role of enzymes used in food industry.	K ₅ , K ₆
CLO5.	Examine the methods of detecting different bacteria in food samples.	K ₄ , K ₅

Mapping with Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	H	H	H	H	H
CLO2	H	H	H	H	H
CLO3	H	H	H	H	H
CLO4	H	H	H	H	H
CLO5	H	H	H	H	H

H- High; M-Medium; L-Low

Elective – I Food Biotechnology MBY2108 (56 hrs) Credits: 4

UNIT I Introduction to Food Science and technology 11h

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 microbiology, Food biochemistry. Food additives, General food composition and effect of food constituents on food quality.

UNIT II Standards for food analysis 11h

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.

UNIT III Food processing and preservation 11h

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/ syrumping, pickling, and fermentation. Non thermal processes like MAP, irradiation, high pressure processing, Hurdle technology.

UNIT IV Food biotechnology 12h

Fermentative production of enzymes used in 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 Biotechnology of fermented foods 11h

Applications of immunological techniques in 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.

Text 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.	Byong H.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)

Reference 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:

1. Dr. V. Usha

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2109	ELECTIVE – I BIOINSTRUMENTATION	THEORY	56	4	-	4

Preamble

To gain knowledge on Spectroscopy, Centrifugation, Chromatography and Electrophoretic techniques. To understand the biophysical and radioisotopic methods.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1.	Discuss about the different types of Spectroscopy in detail.	K ₅ , K ₆
CLO2.	Examine the conventional and advanced centrifugation techniques.	K ₄ , K ₅
CLO3.	Distinguish the principles and applications of different chromatographic techniques.	K ₄ , K ₅
CLO4.	Justify the usefulness of electrophoretic techniques involved in the isolation, separation and analysis of biomolecules.	K ₅ , K ₆
CLO5.	Compare the different methods of measurement of radioactivity.	K ₅ , K ₆

Mapping with Programme Outcomes

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

H- High; M-Medium; L-Low

Elective – I Bioinstrumentation MBY2109 (56 hrs) Credits: 4

UNIT I Colorimetry and Spectroscopy techniques 10h

Colorimetry - Basic principles, Color and absorption spectra, Beer and Lambert's law, Electromagnetic spectrum. Principle, instrumentation and applications of UV Visible spectroscopy, IR spectroscopy Fluorescence spectroscopy, Atomic absorption spectrophotometry, Flame emission spectrometry, Turbidimetry, Luminometry, NMR spectroscopy – 2D and 3D structure prediction, GC-MS, and LC- MS.

UNIT II Centrifugation 11h

Basic Principles - g and RPM value, Types of rotors, Types of centrifuges - Microcentrifuge, High speed centrifuge & Ultracentrifuges. Technique and Applications of preparative ultracentrifugation, differential and density gradient centrifugation. Analytical ultracentrifugation - Determination of molecular weight by sedimentation velocity & equilibrium methods.

UNIT III Chromatography 11h

Theory and Applications – Paper chromatography, TLC, HPTLC, Column chromatography, Ion-exchange chromatography, Affinity chromatography, Hydrophobic interaction chromatography, Gel filtration chromatography, FPLC, HPLC, and GLC.

UNIT IV Electrophoresis techniques 12h

Principle, instrumentation and applications of Paper electrophoresis, Agarose gel electrophoresis, Sodium dodecyl sulphate polyacrylamide gel (SDS-PAGE), Native PAGE, Pulse field gel electrophoresis, Capillary electrophoresis, Disc gel electrophoresis, Gradient gel electrophoresis - Urea-PAGE, Denaturing gels for RNA, Electrophoresis in DNA sequencing, Chemiluminescence and Phosphorimaging.

UNIT V Biophysical and Radio-isotopic methods 12h

Principles and applications of Protein crystallization and X-ray crystallography. Circular dichroism and optical rotatory dispersion. Radioactive Isotopes and half-life of isotopes, Types of radiation, Units of radioactivity, Measurement of radioactivity– Principle, instrumentation and applications of Solid and Liquid scintillation counter and Geiger-Muller counter, Cerenkov radiation, Autoradiography, Radiation Dosimetry, Biological Applications of radio isotopes, Safety aspects of radiation.

Text Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Hofmann, A. & Clokie, S.	Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology.	Cambridge University Press, Cambridge, United Kingdom.	2018 (8 th Edition)
2.	Sawhney and Singh.	Introductory Practical Biochemistry.	Narosa Publishing house, New Delhi.	2015 (11 th Edition)
3.	Sadasivam, S., and Manickam, A.	Biochemical methods.	New Age International Publishers, New Delhi.	2018 (3 rd Edition)

Reference Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	David Sheehan	Physical Biochemistry – Principles and Applications.	Wiley Blackwell, UK.	2013 (2 nd Edition)
2.	Rodney F. Boyer	Biochemistry Laboratory – Modern theory and Techniques	Pearson Education Inc, USA.	2012 (2 nd Edition)
3.	Alfred Pingoud and Claus Urbanke	Biochemical Methods: A Concise Guide for Students and Researchers	Wiley-VCH , UK.	2010 (1 st Edition)

Course Designers:

1. Dr. G. Archana
2. Dr. V. Usha

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY21A1	INTERDISCIPLINARY COURSE – MOLECULAR DIAGNOSTICS	THEORY	56	4	-	4

Preamble

To gain in-depth understanding of the methods of disease diagnosis and identification of microbial diseases. To discuss topics related to diagnostic immunology, vaccine technology and Molecular oncology.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1.	Distinguish culture based and non-culture based diagnostic methods.	K ₃ , K ₄
CLO2.	Evaluate the vaccine needs of new emerging diseases.	K ₅ , K ₆
CLO3.	Assess the different types of vaccines.	K ₄ , K ₅
CLO4.	Discuss in detail the different diagnostic immunological techniques.	K ₅ , K ₆
CLO5.	Predict the biomarkers for personalized onco-therapy of human diseases.	K ₅ , K ₆

Mapping with Programme Outcomes

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

H- High; M-Medium; L-Low

Molecular Diagnostics MBY21A1 (56 hrs) Credits: 4

UNIT I Methods of Disease Diagnosis

12h

Sample collection methods, transport and processing of samples, antibiogram - interpretation of results. Diagnostic methods – culture based methods: microscopy, microbial antigen. Non-culture based methods - PCR based microbial typing, Eubacterial identification based on 16s rRNA sequences, Amplified ribosomal DNA Restriction analysis (ARDRA), Culture independent analysis of bacteria - DGGE and T-RFLP. Molecular diagnosis of fungal pathogens based on 18s rRNA sequences, Detection of viral pathogens through PCR.

UNIT II Detection & Identification of microbial diseases

11h

Immunodiagnosis of infectious diseases, immuno screening of recombinant library. Disease specific vaccine design: HIV/AIDS vaccine; New emerging diseases and vaccine needs (Ebola, Zika, Corona). Detection and identity of microbial diseases: Direct detection and identification of pathogenic-organisms that are slow growing or currently lacking a system of in vitro cultivation as well as genotypic markers of microbial resistance to specific antibiotics. DNA sequencing of representative clones to detect mutation(s), PCR-SSCP to detect mutations.

UNIT III Vaccine technology

10h

Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology, peptide vaccines, conjugate vaccines, generation of immunoglobulin gene libraries, idiotypic vaccines and marker vaccines. Viral-like particles (VLPs), dendritic cell based vaccines, vaccine against cancer, T cell based vaccine, Edible vaccine, Therapeutic vaccine.

UNIT IV Diagnostic Immunology

11h

Immunological techniques: Blood groups - AB, Rh system Agglutination, Precipitation, Immuno-diffusion, Immunoelectrophoresis, Immunoblot and Immuno-fluorescent techniques, Comet assay, ELISPOT assay, ELISA - Competitive and noncompetitive, Direct, Indirect and Sandwich ELISA, Radioimmunoassay, Immunoelectron microscopy, FACS, Flow cytometry, Widal test, and Surface plasmon resonance. Biosensor assays for assessing ligand – receptor interaction.

UNIT V Molecular Oncology

12h

Detection of recognized genetic aberrations in clinical samples from cancer patients. Types of cancer-causing alterations revealed by next-generation sequencing of clinical isolates. Predictive biomarkers for personalized onco-therapy of human diseases such as chronic myeloid leukemia, colon, breast, lung cancer and melanoma as well as matching targeted therapies with patients and preventing toxicity of standard systemic therapies.

Text Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Chang-Hui Shen	Diagnostic Molecular Biology	Academic Press, USA.	2019
2.	Coleman, W. B., & Tsongalis, G. J.	Molecular Diagnostics: for the Clinical Laboratorian.	Humana Press, NJ. USA	2010
3.	Carini, C., Fidock, M., & van Gool, A.	Handbook of Biomarkers and Precision Medicine	CRC Press, USA	2019

Reference Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Rifai, N., Horvath, A.R., and Wittwer, C.T.	Tietz Fundamentals of Clinical chemistry and Molecular diagnostics.	Humana Publishers, New York, United States.	2018 (8 th Edition)
2.	Ford, M.	Medical Microbiology: Fundamentals of Biomedical Science	Oxford University Press, UK	2019 (3 rd Edition)
3.	McPherson, R.A., and Pincus, M.R	Henry's Clinical Diagnosis and Management by Laboratory Methods.	Elsevier Health Sciences, USA	2017

Course Designers:

1. Dr. G. Archana
2. Dr. V. Usha

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY21P3	CORE PRACTICAL- III IMMUNOLOGY AND MOLECULAR DIAGNOSTICS	PRACTICALS	-	-	60	4

List of Experiments

Immunology

1. Determination of the blood group of the given sample.
2. Preparation of serum from blood.
3. Microscopic analysis of immune cells by Giemsa stain.
4. Demonstration of latex agglutination test.
5. Isolation of lymphocytes from whole blood by density gradient centrifugation method.
6. Blood smear identification of leucocytes by Giemsa stain.
7. Single radial immunodiffusion.
8. Ouchterlony double diffusion.
9. Rocket Immunoelectrophoresis for determination of concentration of antigen in unknown sample.
10. Slide and Tube agglutination reaction.
11. Micro-hemagglutination test.
12. Determination of antibody titer by precipitation assay.

Molecular Diagnostics

1. Perform Widal test for detection of typhoid fever.
2. Dot Blot-ELISA
3. Western Blotting
4. Polymerase Chain Reaction and analysis by agarose gel electrophoresis

Reference Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Bisswanger, H.	Practical Enzymology	Wiley-VCH Publishers	2019 (4 th Edition)
2.	Vashist, S.K. & Luong, J.H.T.	Handbook of Immunoassay Technologies: Approaches, Performances, and Applications	Academic Press	2018 (1 st Edition)
3.	Coligan, J.E <i>et. al.</i>	Current Protocols in Immunology	John Wiley and Sons, USA.	2014
4.	Sam-Yellowe, T. Y.	Immunology: Overview and Laboratory Manual	Springer, USA	2021

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY21P4	CORE PRACTICAL- IV GENETIC ENGINEERING AND GENOMICS & PROTEOMICS	PRACTICALS	-	-	60	4

List of Experiments

Genetic Engineering

1. Restriction Enzyme digestion of plasmid DNA and size determination of the fragments.
2. Estimation of DNA using diphenylamine reagent.
3. Estimation of RNA using orcinol reagent.
4. Isolation of Genomic DNA from bacteria and agarose gel electrophoresis.
5. Spectrophotometric estimation of DNA and RNA.
6. Elution of DNA from agarose gels.
7. RFLP analysis of PCR product.
8. DNA amplification by RAPD.
9. Methylene blue DNA staining.
10. Analysis of DNA by Southern blotting technique.
11. Selection of recombinant clones by alpha complementation / insertional inactivation

Genomics

1. Real-time PCR (Demonstration)

Proteomics

1. Determination of the molecular weight of proteins by SDS PAGE
2. Analysis of protein by Western blotting technique.
3. Partial purification of protein by Ammonium sulphate precipitation and subsequent dissolving of precipitate in buffer.

Reference Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Green, M. R., & Sambrook, J.	Molecular cloning: A laboratory manual.	Cold Spring Harbor, NY, USA	2012
2.	Talwar, G. P., & Gupta, S.K.	A handbook of practical and clinical immunology.	CBS Publishers, New Delhi	2017
3.	Carson, S., Miller, H., Srougi, M., and Witherow, S.	Molecular Biology techniques – A classroom laboratory manual	Academic Press, USA	2019 (4 th Edition)
4.	Coligan, J.E et al.	Current Protocols in Immunology	Wiley Grand Publications	2014



**CHOICE BASED CREDIT SYSTEM & OUTCOME BASED EDUCATION
SYLLABUS & SCHEME OF EXAMINATION
MASTER OF SCIENCE BIOTECHNOLOGY – 2022-2024 BATCH**

Applicable to students admitted during the academic year 2022-2023 onwards (III Sem)

SEM	Subject Code	Title of the Paper	Instruction hours/ week	Contact hours	Tutorial	Duration of Examination	Examination Marks			Credits
							CA	ESE	TOTAL	
III	MBY2210	Paper-VIII Bioinformatics	5	73	2	3	50	50	100	4
	MBY2211	Paper-IX Bioprocess Technology	5	73	2	3	50	50	100	4
	MBY2212/ MBY2213	Elective II Environmental Biotechnology / Drug discovery and Development	4	58	2	3	50	50	100	4
	MBY22S1	Special Course- Research Methodology	2	30	-	3	-	100	100	2
	MNM22CS2	Cyber Security-II	2	30	-	-	100	-	100	Grade
	MBY22P5	Practical-V Bioprocess Technology & Environmental Biotechnology	6	90	..	6	50	50	100	4
	MBY22P6	Practical-VI Bioinformatics & Drug Discovery and Development	6	90	...	6	50	50	100	4
		Summer Internship*	-	-	-	-	-	-	50	Grade
		Comprehensive Exam	-	-	-	-	-	-	100	Grade

*Outside regular class hours

QUESTION PAPER PATTERN

CIA Test	:	10 Conducted for 60 marks, 3 units after 50 days
Model Exam	:	20 Conducted for 100 marks after 85 days (Q.P. Pattern (2,6,12) Each Unit 20 Marks)
Seminar/Assignment/Quiz	:	10
Class Participation	:	7
Attendance	:	3

50 + ESE 50 Marks (Conducted for 100 Marks)

CA Question Paper (First 3 Units)

Question from each unit comprising of

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

One question with a weightage of 6 Marks (Internal Choice at the same CLO level): $6 \times 3 = 18$

One question with a weightage of 12 Marks (Internal Choice at the same CLO level): $12 \times 3 = 36$

Total: 60 Marks

ESE Question Paper Pattern: 5 x 20 = 100 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 6 Marks (Internal Choice at the same CLO level): $6 \times 5 = 30$

One question with a weightage of 12 Marks (Internal Choice at the same CLO level): $12 \times 5 = 60$

Total: 100 Marks

Cyber Security II

Quiz : 60 Marks

Case Study: 20 Marks

Poster : 20 Marks

Open book exam for II PG, CIA Test Pattern: 4 (4 out of 6) x 15 Marks = 60 Marks

Open book examination to be provided for any one core course. Questions/problems to be solved by applying concepts. Questions with direct book answers to be avoided.

Special Course:

Section A 5 questions (Internal choice) :25 marks

Section B 5 questions (Internal choice) :75 marks

Total :100 marks

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2210	PAPER-VIII BIOINFORMATICS	CORE THEORY	73	2	-	4

Objectives

To facilitate the students to

- Understand about sequence alignment, annotation, and comparison to understand the structure and function of biological molecules.
- Gain the knowledge about the evolutionary history of organisms and the functional significance of genes.
- Develop skill in optimizing drug design and predicting the behavior of drugs in biological systems.

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.	K2
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

15 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

15 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

15 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

14 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

14 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
Dr. G. Shalini
Mrs R Kiruba

MBY2210- PAPER-VIII-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).	4	video lecturing and Flipped classroom https://www.youtube.com/watch?v=JmKD5SnQtFE https://www.youtube.com/watch?v=rDhEIW5ox6w	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.	4	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).	3	Demonstration, Quiz (Socratic) and Discussion	CLO1
UNIT II				
6	Introduction to phylogenetic trees and their significance in evolutionary biology.	4	PPTs-Video https://www.youtube.com/watch?v=zRcluAdUjUk	CLO2
7	Types of phylogenetic trees: rooted and unrooted trees.	3	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.	3	Seminar-Quiz (Socratic)	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.	4	Lecture and Quiz (google forms) https://www.youtube.com/watch?v=8XS0cqxD5XU	CLO3
12	Protein-protein interactions (STRING) and networks.	3	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.	5	PPTs and video https://www.youtube.com/watch?v=PqH8yR97DUY	CLO3

UNIT IV				
15	Computational drug discovery approaches, including virtual screening and molecular docking.	4	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.	4	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.	4	Demonstration and Hand-on	CLO5
22	Case Study: Microarray data analysis using Bioconductor package.	4	Video lecturing and Group discussion https://www.youtube.com/watch?v=TKDoL-yvcTI	CLO5

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2211	Paper-IX- BIOPROCESS TECHNOLOGY	CORE THEORY	73	2	-	4

Objectives

To facilitate the students to

- Learn the techniques of optimizing the conversion of renewable biomass into usable energy sources.
- Study the efficient and scalable processes for the production of high-quality pharmaceutical products.
- Acquire the knowledge about efficient production of enzymes with desired properties, such as high activity and stability.

Course Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Explain the factors that contribute in enhancement of cell and product formation during fermentation process.	K2
CLO2	Examine the kinetics of cell and product formation in batch, continuous and fed-batch cultures.	K3
CLO3	Outline about the rheological changes during fermentation process.	K4
CLO4	Evaluate the protocol for scale-up and harvesting from shake flask to bench top fermentor.	K5
CLO5	Report about the bioprocess paradigms including scale-down, bioprocess simulation and economics in biological manufacturing.	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	M	M	S	S
CLO4	S	M	M	S	M
CLO5	S	M	M	S	S

M-Medium S-Strong

Syllabus

Unit - I Introduction to Bioprocess technology 14 hrs

History and Scope of Bioprocess Technology: Isolation and screening of industrially important strains- primary and secondary screening. Strain improvement, mutation, selection of mutant and transformation processes. Significance and Types of Microbial biomass, microbial enzymes, recombinant products.

Unit - II Bioreactor types and upstream essentials 15 hrs

Bioreactors: Introduction to bioreactors - Aerobic and anaerobic fermentation; solid state and submerged fermentation; Types of Bioreactors: Batch, continuous and fed-batch (variants), Specialized bioreactors (fluidized bioreactors, photo bioreactors, immobilized cell reactors, airlift bioreactor, packed bed bioreactor); Gas fermentation. Design and construction of Bioreactors: Monitoring and control of bioreactor: Online and off line control, controlling systems: Temperature, flow rate, pressure, pH.

Unit - III Upstream process 15 hrs

Media formulation – sterilization – Air and media sterilization. Microbial kinetics: batch, fed-batch and continuous cultures, phases of batch growth. Kinetics of cell growth - Kinetics of mass and heat transfer. Product formation, substrate utilization, product inhibition kinetics, yield concept and productivity.

Unit - IV Downstream processing 15 hrs

Introduction, Cell distribution methods for intracellular products: foam separation, precipitation. Filtration – micro and ultrafiltration, Solvent extraction, Chromatographic separation - FPLC, HPLC, Gel-filtration chromatography, dialysis, centrifugation, distillation, drying, crystallization. Turbidity analysis and cell yield determination.

Unit - V Microbial products in pharmaceutical, food and agriculture industry 14 hrs

Whole cell immobilization, Protein immobilization and their industrial application. Industrial production of chemicals: Alcohol, Acids (citric, acetic and gluconic acid), Solvents (glycerol, acetone and butanol), Antibiotics (penicillin, streptomycin and tetracycline), Amino acids (Lysine and glutamic acid), Single cell protein, Use of microbes in mineral beneficiation and oil recovery, Bioconversion to food waste to useful products. Bacteriocins from lactic acid bacteria –production and applications in food preservation. Fermentation products available in market Effective Micro-Organisms- Dr Bacto's EM Effluent treatment plants (ETP), NEMIX® C.

Reference Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Bailey, J.S. & Ollis, D.F.	Biochemical Engineering Fundamentals.	McGraw - Hill, UK. 2 nd Edition	2017
2.	Panchal, C. J.	Yeast Strain Selection.	CRC Press, USA. 1 st Edition	2020.
3.	Kalaichelvan. P.T and Arul Pandi, I	Bioprocess Technology	MJP Publishers, India. 1 st Edition.	2021

Text Books

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Clemens Posten	Integrated Bioprocess Engineering	De Gruyter. 1 st Edition	2018
2.	Michael L. Shuler, Fikret Karagi, Matthew DeLisa	Bioprocess Engineering: Basic Concepts	Pearson. 3rd Edition	2017

Course Designer:

Dr.Archana G

MBY2211- BIOPROCESS TECHNOLOGY

Module No.	Topic	No. of periods	Content Delivery Methods	CLO'S
UNIT I				
1	Isolation and screening of industrially important strains- , mutation,	4	Lecture & PPT presentation	CLO1
2	Significance and Types of Microbial biomass, microbial enzymes, recombinant products.	3	Lecture & Discussion	CLO1, CLO3
3	Primary and secondary screening. Strain improvement	3	Video Lecture and Discussion https://youtu.be/YRXS_TBRyBQ	CLO4, CLO2
4	Selection of mutant and transformation processes.	3	Journal Article Presentation & Discussion	CLO1, CLO5, CLO3
UNIT II				
5	Bioreactors: Introduction to bioreactors - Aerobic and anaerobic fermentation; solid state and submerged fermentation,	4	Lecture, PPT presentation	CLO1, CLO2
6	Types of Bioreactors: Batch, continuous and fed-batch (variants)	4	Lecture, PPT & Quiz (Kahoot, Quizlet, Mentimeter etc)	CLO5, CLO4
7	Specialized bioreactors (fluidized bioreactors, photo bioreactors, immobilized cell reactors, airlift bioreactor, packed bed bioreactor);	4	Demonstration and Model making https://youtu.be/dvh2jPvAa-Q https://youtu.be/azdVSR7DBlg	CLO1, CLO2. CLO4
8	Gas fermentation. Design and construction of Bioreactors: Monitoring and control of bioreactor: Online and off line control, controlling systems: Temperature, flow rate, pressure, pH.	3	Journal Presentation Video Lecture and Discussion https://youtube.com/shorts/vQTPGO6WFko?feature=share	CLO1, CLO3. CLO5
UNIT III				
9	Media formulation – sterilization – Air and media sterilisation. Microbial kinetics: batch, fed-batch and continuous cultures, phases of batch growth.	4	Video Lecture and Discussion https://youtu.be/mUDXu pn2Dhk https://youtu.be/84-ZkUC_4VE	CLO2, CLO3. CLO4
10	Kinetics of cell growth - Kinetics of mass and heat transfer. Microbial kinetics: batch, fed-batch and continuous cultures.	6	Lecture, PPT & Discussion, Quiz (Kahoot, Quizlet, Mentimeter etc)	CLO2, CLO3. CLO4
11	Product formation, substrate utilization, product inhibition kinetics	3	Journal Presentation & Discussion	CLO2, CLO3. CLO4, CLO5
12	Yield concept and productivity.	2	Seminar, PPT	CLO4, CLO5

UNIT IV				
13	Introduction, Cell distribution methods for intracellular products: foam separation, precipitation.	4	Seminar	CLO1, CLO3. CLO2, CLO5
14	Filtration – micro and ultra filtration, Solvent extraction,	4	Lecture & Quiz (Quizlet, Mentimeter)	CLO1, CLO3. CLO4, CLO5
15	Chromatographic separation - FPLC, HPLC	2	Video Lecture and Discussion https://youtu.be/JYDsPC_hnmJc	CLO2, CLO4. CLO1, CLO5
	Gel-filtration chromatography,	2	Demonstration and Explanation	
16	Dialysis, centrifugation, distillation, drying, crystallization. Turbidity analysis and cell yield determination.	3	Journal Article Presentation & Discussion	CLO1, CLO3. CLO2, CLO5
UNIT V				
17	Whole cell immobilization, Protein immobilization and their industrial application. Industrial production of chemicals: Alcohol, Acids (citric, acetic and gluconic acid), Amino acids (Lysine and glutamic acid),	4	Seminar	CLO3, CLO1, CLO5
18	Solvents (glycerol, acetone and butanol), Antibiotics (penicillin, streptomycin and tetracycline),	4	Lecture & Quiz (Kahoot, Quizlet, Mentimeter etc)	CLO1, CLO4, CLO5
19	Bacteriocins from lactic acid bacteria –production and applications in food preservation. Fermentation products available in market Effective Micro-Organisms- Dr Bacto's EM Effluent treatment plants (ETP), NEMIX® C.	4	Journal Presentation & Discussion Video Lecture and Discussion https://youtube.com/shorts/nFRrKJPn2U?feature=share	CLO2, CLO3, CLO5
20	Single cell protein, Use of microbes in mineral beneficiation and oil recovery, Bioconversion to food waste to useful products.	3	Journal Presentation & Discussion	CLO3. CLO4, CLO5

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2212	ELECTIVE II - ENVIRONMENTAL BIOTECHNOLOGY	ELECTIVE THEORY	58	2	-	4

Objectives

To facilitate the students to

- Study the use of microorganisms, enzymes, and plants to degrade or transform contaminants into less harmful substances.
- Gain the knowledge on the biological processes such as composting, anaerobic digestion, and bioconversion to convert organic waste into valuable resources.
- Develop the skill in extracting the nutrients, metals, and energy from waste materials, contributing to a circular economy and reducing dependence on finite resources.
- Learn the development of biotechnological tools and techniques for the detection, quantification, and characterization of pollutants.

Course 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 and environmental threats.	K2
CLO2	Predict the scientific, ethical and/or social issues of alleviating the environmental concerns.	K3
CLO3	Outline solutions for waste management and effluent treatment.	K4
CLO4	Distinguish the pollution detection methods.	K5
CLO5	Report about Environmental pollution and its remediation measures.	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

Syllabus

Unit - I Biogeography and Environmental problems

12 hrs

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

Unit - II Biofuels Sources and Production

12 hrs

Biofuels and biological control of air pollution, Plant derived fuels, Biogas, Landfill gas, Biohydrogen. Use of biological techniques in controlling air pollution. Removal of chlorinated hydrocarbons from air, Types of environmental hazards and Disasters. Natural - volcanic eruption, earthquakes, landslides, cyclones, lightning, hailstorms. Hazardous Waste Management and Waste Handling rules.

Unit - III Pollution and Management Systems

11 hrs Sewage

and waste water treatment and solid waste management, Chemical measure of water pollution, Conventional biological treatment, Role of microphyte and macrophytes in water treatment. Recent approaches to biological waste water treatment. Composting process and techniques, Use of composted materials.

Unit - IV Pollution Detection Methods

11 hrs

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

12 hrs

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.

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 Wrubel P , Sheldon Krimsky	Agricultural Biotechnology and the Environment	University of Illinois Press. 1 st Edition	1996
2.	P. Bajpai , R. Kondo	Biotechnology for Environmental Protection in the Pulp and Paper Industry	Springer. 2 nd Edition	2011

Course Designer:

Dr.Archana G

Dr.P.Suganya

MBY2212– ENVIRONMENTAL BIOTECHNOLOGY

Module No.	Topic	No. of periods	Content delivery methods	CLO'S
UNIT I				
1	Biogeochemical cycles in ecological systems – Carbon, Phosphorus and Nitrogen cycles	3	Lecture& PPTs	CLO1, CLO2
2	Limiting factors, Energy transfer. Response of microbes	2	Discussion	CLO2, CLO3
3	plant and animals to environmental stresses. Concept of ecosystems and ecosystem management.	3	Lecture and Quiz (Quizalize)	CLO2, CLO3, CLO4
4	Environmental problems- ozone depletion, green house effect, water, air and soil pollution, and land degradation	2	Discussion	CLO4, CLO5
5	Climate change.	2	https://www.youtube.com/watch?v=G4H1N_yXBIA Video Lecture and Assignment	CLO3, CLO4, CLO5
UNIT II				
9	Biofuels and biological control of air pollution.	3	Group Seminar	CLO1, CLO2.
10	Use of biological techniques in controlling air pollution. Removal of chlorinated hydrocarbons from air, Types of environmental hazards and Disasters	3	Lecture& PPTs	CLO3, CLO4, CLO5
11	Natural - volcanic eruption, earthquakes, landslides, cyclones, lightning, hailstorms.	3	Lecture and Quiz (Quizalize)	CLO2, CLO3. CLO4
12	Hazardous Waste Management and Waste Handling rules	3	Video Lecture and Assignment https://www.youtube.com/watch?v=0tLJFb3YrWA	CLO3, CLO4, CLO5
UNIT III				
9	Sewage and waste water treatment and solid waste management	2	Group Seminar	CLO1, CLO2
10	Chemical measure of water pollution, Conventional biological treatment, Role of microphyte and macrophytes in water treatment	4	Lecture and assessment (Kahoot)	CLO3, CLO4, CLO5
11	Recent approaches to biological waste water treatment	2	Lecture& PPTs	CLO2, CLO3. CLO4
12	Composting process and techniques, Use of composted materials.	3	https://youtu.be/nxTzuasQLFo Video Lecture and Assignment	CLO3, CLO4, CLO5
UNIT IV				
13	Plant test system- algal bioassay. DNA gene probe, PCR based detection system for Shigella, Salmonella in water.	3	Lecture-Videos ,PPT https://youtu.be/Xwx211gkg8I	CLO1, CLO2
14	Techniques in pollution detection - Remote sensing, Bioindicators and Biosensors for detection of pollution.	3	Interaction on topics and Assignment https://youtu.be/4UG-dmrCWhA	CLO3, CLO4, CLO5
15	Types of Biosensors – Enzyme electrode, Optical biosensors	3	Lecture-,PPT	CLO2, CLO3. CLO4,

16	H ₂ O ₂ biosensor, Microbial biosensor	2	Discussion and Seminar	CLO3, CLO4, CLO5
UNIT V				
17	Genetically Engineered Microorganisms (GEMs) in environment, Role of Environmental Biotechnology in management of environmental problems	3	Video Lecture and Discussion https://youtu.be/L5bKhBfdptE https://youtu.be/DMUW6l0lC78	CLO1, CLO2
18	Bioremediation: Advantages and Disadvantages, In situ and ex-situ bioremediation, slurry bioremediation. Bioremediation of contaminated ground water and phytoremediation of soil metals.	4	Seminar and quiz (Kahoot) https://youtu.be/6hrctQfAWyg	CLO3, CLO4, CLO5
19	Microbiology of degradation of xenobiotics.	3	Lecture & PPTs	CLO3, CLO4,
20	Biofertilizers, Biomining and Soil enzymes.	2	Group Seminar	CLO3, CLO4, CLO5

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2213	ELECTIVE II – DRUG DISCOVERY AND DEVELOPMENT	ELECTIVE THEORY	58	2	-	4

Objectives

To facilitate the students

- To know about the process of drug discovery and development
- To provide an overview about identifying drug targets and strategies to develop drugs
- To learn about basic and essential qualities of a candidate drug and testing methods
- To understand the prerequisites of obtaining drug approval and to know about clinical trials, regulatory approval process

Course Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Describe about the various process of drug discovery and development	K2
CLO2	Predict the drug targets and strategies to develop drugs	K3
CLO3	Outline the basic and essential qualities of a candidate drug and testing methods	K4
CLO4	Apply the drug screening process	K5
CLO5	Execute the prerequisites of obtaining drug approval, clinical trials, regulatory approval process	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

Syllabus

Unit - I Introduction to drug discovery and development 12 hrs

General introduction to drug discovery research and development, Different stages of drug discovery and development, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.

Unit - II Target identification and validation 12 hrs

Concept of target, different approaches to identify drug targets, Target validation, Single target versus multi-targets approaches, Off target and adverse effects, Drug repurposing. Concept of target, different approaches to identify drug targets, Target validation, Single target versus multi-targets approaches, Off target and adverse effects, Drug repurposing.

Unit - III In-silico drug designing 11 hrs

Basics of structural bioinformatics, Role of Bioinformatics in drug design, Target understanding at molecular level, lead optimization and in-silico validation, Structure- and ligand-based drug design, Molecular docking and docking algorithms, de-novo ligand design and molecular dynamics simulation.

Unit - IV Drug Screening 11 hrs

Understanding protein-protein, protein-small molecule interaction study, Role of Structural Biology in Drug Discovery, Cell-free and cell-based assays, exploiting cell biology to design assay platforms, High-throughput screening, Introduction to High Content Screening, Designing and development of disease model.

Unit - V Medicinal Chemistry, Pharmacology and Drug Development 12 hrs

Small molecules as drugs, Lipinski rule five, hit identification to lead development process, Chemistry Manufacturing and Control (CMC), Pre-clinical study, Clinical study, Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA.

Reference Books

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Benjamin Blass	Basic Principles of Drug Discovery and Development	Elsevier, 1 st Edition	2015
2.	Claudio N. Cavasotto	In Silico Drug Discovery and Design Theory, Methods, Challenges, and Applications	CRC Press. 1 st Edition	2016

Text Books

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Patwaradhan B	Drug discovery and development.	New India publishing agency, New Delhi	2007
2.	Kristian Stromgaard, Povl Krogsgaard-Larsen, Ulf Madsen	Textbook of Drug Design and Discovery	CRC Press. 5 th Edition	2017
3.	James J. O'Donnell, John Somberg, Vincent Idemyor, James T. O'Donnell	Drug Discovery and Development	CRC Press. 3 rd Edition	2020

Course Designer:

Dr. V. Bhuvaneshwari

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY22S1	SPECIAL COURSE-RESEARCH METHODOLOGY	SPECIAL COURSE THEORY	30	-	-	2

Objectives

To facilitate the students to

- Study the purpose and scope of the research project.
- Gain the skill in selecting appropriate research designs, methods, and techniques that align with the research objectives.
- Focuses on determining the most suitable methods and techniques for data collection.
- Develop skill on analyzing the collected data using appropriate statistical or qualitative analysis techniques.

Course Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Discuss about appropriate graphs for scientific data.	K2
CLO2	Interpret the results of correlation and regression.	K3
CLO3	Analyze tests of significance using sample data sets.	K4
CLO4	Summarize the components of a research review, report and manuscript.	K5
CLO5	Justify the nuances 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

Syllabus

UNIT - I Introduction to research

6 hrs

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 Introduction to Biostatistics

5 hrs

Collection, analysis and tabulation of biological data – Arithmetic Mean, Median, Mode, Standard deviation, Standard error, Coefficient of variation: Applications. Graphical representation of data - bar graph, histogram, box plot, pie diagram and frequency polygon.

UNIT - III Correlation and regression analysis

7 hrs

Correlation, Covariance, Calculation of covariance and correlation, Correlation coefficient from ungrouped data, Spearman's Rank Correlation Coefficient, Scatter and dot diagram. General concepts of regression, Fitting Regression Lines, Regression coefficient, Properties of Regression Coefficients, Standard error of estimate.

UNIT - IV Tests of significance

6 hrs

Small sample tests – Student 't' test, Paired and unpaired t-test. Nonparametric tests -Chi square test & its applications, Analysis of Variance: One way and two way ANOVA, Large sample test – Z test.

UNIT - V Research Ethics and Responsible Conduct in Research

6 hrs

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.	Le, T.C. and Eberly, L.E.	Introductory Biostatistics.	Wiley – Interscience Publishers, USA. 2 nd Edition	2016
2.	Khanum and Khan.	Fundamentals of Biostatistics.	Ukaaz Publications, India	2020
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.	Raymond E. Hampton , John E. Havel	Introductory Biological Statistics	Waveland Press, Inc. 3 rd Edition	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.Archana G

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY22P5	CORE PRACTICAL- V BIOPROCESS TECHNOLOGY & ENVIRONMENTAL BIOTECHNOLOGY	CORE PRACTICALS	-	-	90	4

Objectives

To facilitate the students to

- Acquire knowledge on extraction of enzymes and antibiotics from microbes.
- Expertise in the upstream and downstream process.
- Identify the different parameters to assess water quality
- Access different techniques in removing the chemical pollutants.

Course Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Identify the different parameters to assess water quality	K2
CLO2	Evaluate the conventional and novel methods in industrially important enzymes.	K3
CLO3	Appraise about the selection of a suitable medium for culturing of various microorganisms for environmental application..	K4
CLO4	Compare the different methods in identification of water treatment.	K5
CLO5	Assess the importance of manufacturing systems to generate bioproducts in large volume, at low cost, and with acceptable purity.	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	M	S	M	S
CLO4	S	M	M	S	M
CLO5	S	S	S	S	S

M-Medium S- Strong

LIST OF EXPERIMENTS

BIOPROCESS TECHNOLOGY

Upstream Processing

1. Extraction of extracellular enzymes from bacteria.
2. Optimization of culture condition for growth and enzyme production (Media,pH and Temperature).
3. Production and estimation of organic acid –lactic acid.
4. Wine Production and estimation of alcohol.
5. Production of antibiotics from microbes.

Downstream Processing

6. Protein purification- 1. Ammonium sulfate 2. Dialysis 3. Column chromatography
7. Enzyme entrapment in alginate gel.
8. Production of Mushroom by solid substrate fermentation (Demonstration).
9. Operation of Fermenter (Demonstration).

ENVIRONMENTAL BIOTECHNOLOGY

1. Water quality testing:
 - a) pH , b) Turbidity, c) TDS, d) Residual chlorine e)Hardness
2. Preparation of bio plastics using corn starch.
3. Determination of optimum concentration of coagulant in water using Jar test. .
4. Removal of chemical pollutants from the water through adsorption to biomaterials.
5. Estimation of biological oxygen demand in water/sewage samples
6. Estimation of chemical oxygen demand in water/sewage samples

Reference Books

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Stanbury, P.F, Whitaker, A and Hall, S.J.	Principles of Fermentation Technology.	Butterworth-Heinemann, UK. 3 rd Edition	2018
2.	Ojha, K.S and Tiwari, B.K.	Novel Food Fermentation Technologies.	Springer, USA. 2 nd Edition	2018
3.	Thakur, I.S.	Environmental Biotechnology, Basic Concepts and Applications.	Dreamtech Press, India. 2 nd Edition	2019
4.	Patra, J.K and Das, G <i>et al.</i>	A Practical Guide to Environmental Biotechnology.	Springer, USA. 1 st Edition	2020

Text Books

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	Supriya Dash & Swagat Kumar Das H N Thatoi	Practical Biotechnology: Principles and Protocols	I K International Publishing House. 1 st Edition	2017
2.	Watson	Industrial Biotechnology	CBS publication. 1 st Edition	2015

Course Designer:

Dr.Archana G

Dr. V. Bhuvaneshwari

COURSENO.	COURSE NAME	CATEGORY	L	T	P	CREDI T
MBY22P6	CORE PRACTICAL- VI BIOINFORMATICS & DRUG DISCOVERY AND DEVELOPMENT	CORE PRACTICALS	-	-	90	4

Objectives

To facilitate the students to

- Make the students familiarized with the Bioinformatics databases and their applications.
- Identify genes and proteins, determine their functions, establish evolutionary relationships and predict their conformation.
- Develop technological tools that help analyze biological data using R programming.
- Aids in the enhancement of drug design by optimizing the process and accurately forecasting the behavior of drugs within biological systems.

Course Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Identify different types of biological data, protein structures and alignment	K2
CLO2	Predict and validate macromolecular structure using experimental data	K3
CLO3	Analyze the methods for identifying chemical structure as lead molecules	K4
CLO4	Justify the Application of the principles of bioinformatics in drug discovery and development of a new drug target for a particular disease.	K5
CLO5	Identify basic experimental design principles in solving biological questions using R programming.	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

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

R programming

19. Introduction to R installation, package management and basic operators
20. Bioconductor tools – Introduction & usage
21. Basic plot and customized plot using ggplot2
22. R for large biological datasets
23. Descriptive statistics and One-way ANOVA
24. Image analysis using EB Image

Reference Books

S.No	Authors	Title of the Book	Publishers	Year of Publication
1.	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
2.	Rastogi S.C, Mendiratta, N and Rastogi. P	Bioinformatics: Concepts, Skills & Applications.	CBS Publishers. 2 nd Edition	2019
3.	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
4.	Xiong, J.	Essential Bioinformatics.	Cambridge University Press, UK.	2006
5	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.	Michael Agostino	Practical Bioinformatics	Garland Science. 1 st Edition	2012
2.	Janusz M. Bujnicki	Practical Bioinformatics	Springer. 1 st Edition	2004

Course Designer:

Dr.V.Bhuvaneshwari

Dr. G. Shalini

Mrs R Kiruba



**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 - IV

BATCH 2022-24

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.



DEPARTMENT OF BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM & OUTCOME BASED EDUCATION
MASTER OF SCIENCE BIOTECHNOLOGY-2022-2024 BATCH
SYLLABUS & SCHEME OF EXAMINATION

Applicable to students admitted during the academic year 2022-2023 onwards (IV Sem)

Sem	Subject Code	Title of the Paper	Instruction hours/week	Contact hours	Tutorial	Duration of Examination	Examination Marks			Credits
							CA	ESE	TOTAL	
IV	MBY2214	Paper XIV Bioethics, Biosafety and IPR	4	58	2	3	50	50	100	4
	MBY2215	Supportive Course – Bioentrepreneurship	2	28	2	3	50	50	100	2
	MBY22PROJ	Project (Jan – March)		3 Months		Viva Voce	100	100	200	10
	MBY22AC1 MBY22AC2	Advanced Learners Course* Stem Cell Technology/ Microbial & Clinical Genomics	-	Self- Study	-	3	25	75	100*	5*
							Grand Total	2300	90 +5*	

*Extra credit course

QUESTION PAPER PATTERN

CIA Test	:	10 Conducted for 60 marks, 3 units after 50 days
Model Exam	:	20 Conducted for 100 marks after 85 days (Q.P. Pattern (2,6,12) Each Unit 20 Marks)
Seminar/Assignment/Quiz	:	10
Class Participation	:	7
Attendance	:	3
Total	:	50 + ESE 50 Marks (Conducted for 100 Marks)

CA Question Paper (First 3 Units)

Question from each unit comprising of

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

One question with a weightage of 6 Marks (Internal Choice at the same CLO level) : $6 \times 3 = 18$

One question with a weightage of 12 Marks (Internal Choice at the same CLO level): $12 \times 3 = 36$

Total : 60 Marks

Model/ESE Question Paper Pattern: 5 x 20 = 100 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 6 Marks (Internal Choice at the same CLO level) : $6 \times 5 = 30$

One question with a weightage of 12 Marks (Internal Choice at the same CLO level): $12 \times 5 = 60$

Total : 100 Marks

Internal component for ALC-25 marks

CIA	-10 marks
Model exam	-15 marks
Total	-25 marks

Model/End Semester for PG - Advance Learner Courses

Section A : 5 questions out of 8 - open choice 5x5 : 25 marks

Section B : 5 questions out of 8-open choice 5x10 : 50 marks

Total : 75 marks

Project: 100 / 100 = 200 Marks

Internal component for Project : 100 marks

Review I : 20 marks

Review II : 40 marks

Review III : 40 marks

Total Internal : 100 Marks

ESE Project Pattern : 100 Marks

ESE : Evaluation of Project : 60 marks

Viva – voce examination : 40 marks

Total ESE for project : 100 Marks

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2214	PAPER XIV BIOETHICS, BIOSAFETY AND IPR	CORE THEORY	58	2	-	4

Learning 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 recommend the basics of Intellectual property.
- To report about the process of filing a patent application.

Course Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Explain about the concepts in Bioethics.	K2
CLO2	Examine the biosafety and risk assessment of products derived from recombinant DNA research.	K3
CLO3	Distinguish National and International biosafety regulations.	K4
CLO4	Recommend the basics of Intellectual property.	K5
CLO5	Report about the process of filing a patent application.	K6

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

BIOETHICS, BIOSAFETY AND IPR

SYLLABUS

UNIT-I Bioethics

11h

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-II Biosafety

11h

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-III National & International biosafety regulations

12h

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-IV Introduction to IPR

12h

Introduction to intellectual property; types of IP: patents, trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications, protection of new GMOs, International framework for the protection of IP, IP as a factor in R&D, IPs of relevance to biotechnology and few case studies. Introduction to history of GATT, WTO, WIPO and TRIPS; plant variety protection and farmers rights act; concept of ‘prior art’: invention in context of “prior art”; patent databases - country-wise patent searches (USPTO, EPO, India); analysis and report formation.

UNIT-V Patenting

12h

Basics of patents: types of patents, Indian Patent Act 1970, recent amendments. WIPO Treaties- Budapest Treaty, Patent Cooperation Treaty (PCT) and implications, procedure for filing a PCT application, role of a Country Patent Office; filing of a patent application; precautions before patenting-disclosure/non-disclosure - patent application- forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies, fee structure, time frames. Licensing – outright sale, licensing, royalty, patenting by research students and scientists-university/organizational rules in India and abroad. Indian Patent Agent Examination - options and opportunities.

TEXT BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Goel, D and Parashar, S	IPR, Biosafety and Bioethics.	Pearson Education, India.	2013
2.	Campbell, A.V.	Bioethics -The basics.	Routledge	2018
3.	Sibi, G.	Intellectual property rights, Bioethics, Biosafety and Entrepreneurship in Biotechnology.	Wiley India Pvt Ltd	2021
4.	Uzochukwu, S.	Biosafety and Bioethics in Biotechnology.	Taylor and Francis Ltd, UK	2022

REFERENCE BOOKS

S.No	Authors	Title of the Book/Link	Publishers	Year of Publication
1.	Recombinant DNA safety guidelines and regulation. DBT, Govt of India. 2018			
2.	Verkey, E and Saji, J.	Intellectual Property	Eastern Book Company	2021
3.	http://www.cbd.int/biosafety/background.shtml			

Course Designer:

Dr. D. Subha

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY2215	SUPPORTIVE COURSE - BIOENTREPRENEURSHIP	THEORY	28	2	-	2

Learning Objectives

- To classify the types of Bioindustries and their role.
- To examine the business strategy and marketing methods.
- To analyze the business feasibility and financial management issues.
- To distinguish the local and foreign technology transfer agencies.
- To report about the steps involved in starting a small industry.

Course Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Classify the types of Bioindustries and their role.	K2
CLO2	Examine the business strategy and marketing methods.	K3
CLO3	Analyze the business feasibility and financial management issues.	K4
CLO4	Distinguish the local and foreign technology transfer agencies.	K5
CLO5	Report about the steps involved in starting a small industry.	K6

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

BIOENTREPRENEURSHIP

SYLLABUS

UNIT-I Innovation and entrepreneurship in bio-business

6h

Introduction and scope in Bio-entrepreneurship, Types of bio-industries, Sub-industries of the bio-sector (e.g. pharmaceuticals vs. Industrial biotech), Strategy and operations of bio-sector firms: Factors shaping opportunities for innovation and entrepreneurship in bio-sectors, Business implications of those opportunities, Alternatives faced by emerging bio-firms, relevant tools for strategic decision, Entrepreneurship development programs of public and private agencies (MSME, DBT, BIRAC, Make In India), strategic dimensions of patenting & commercialization strategies.

UNIT-II Bio markets - Business strategy and marketing

6h

Negotiating the road from lab to the market (strategies and processes of negotiation with financiers, government and regulatory authorities), Pricing strategy, Challenges in marketing in bio business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs), Basic contract principles, different types of agreement and contract terms typically found in joint venture and development agreements, Dispute resolution skills.

UNIT-III Finance and Accounting

5h

Business plan preparation including statutory and legal requirements, Business feasibility study, financial management issues of procurement of capital and management of costs, Collaborations & partnership, Information technology.

UNIT-IV Technology management

6h

Technology – assessment, development & upgradation, Managing technology transfer, Quality control & transfer of foreign technologies, Knowledge centers and Technology transfer agencies, Understanding of regulatory compliances and procedures (CDSCO, NBA, GCP, GLA, GMP).

UNIT-V Start-up

5h

Setting of a small industry, location of an enterprise, steps of starting small industry, Incentive & subsidies for industry, Problems of entrepreneurship, The Art of Negotiation, Workable marketing and the strength of distribution.

TEXT BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Shimasaki, C.D.	Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies.	Elsevier, Netherlands.	2014
2.	Jordan, J.F.	Innovation, Commercialization and Start-Ups in Life Sciences.	CRC Press, UK	2014
3.	Adams, D. J. & Sparrow, J. C.	Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences.	Scion Publishing Ltd.	2008
4.	Thiel, P & Masters, B	Zero to One: Notes on Start Ups.	Random House, UK	2014

REFERENCE BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Poornima, M and Charanthmath	Entrepreneurship Development – Small business enterprises.	Pearson Education. India.	2005
2.	Desai, V	Dynamics of Entrepreneurial Development and Management.	Himalaya Publishing House, India.	2009
3.	Pisano, G.P..	Science Business The Promise, the Reality, and the Future of Biotech	Harvard Business School Press, USA	2013

Course Designer:

Dr. G. Anbarasi

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY22PROJ	PROJECT	PRACTICAL	-	-	-	10

Course Objectives

- To make the students understand the importance of experimental analysis, scientific approach in solving problems related to the environment and society and to educate and train the students to write scientific papers.
- To develop critical thinking through the tackling of an independent research project.

Execution procedure for the allotment of students for the project

- Project students are assigned through the system. Staff members are allotted to choose the project students by lot system. Projects were all based on the student's interest.

Execution of research

- The research work can be carried out in the department or any other organization approved by the research project supervisor and the Head of the Department.
- Three review meetings will be conducted in between to monitor the progress of the research.
- Viva voce examination will be conducted by an external examiner and the research project supervisor guiding the project.

Area of work

- Genetic Engineering, Biotechnology, Microbiology, Enzyme technology, Bioremediation, Solid waste management, Genomics, Cloning, Transcriptomics, Synthetic Biology, Molecular Biology, Bioinformatics, Artificial Intelligence and areas relevant to Biotechnology.

Methodology

- Each project should contain the following details
- Brief introduction to the topic
- Review of literature
- Materials and Methods
- Experimental Results and Discussion- evidence in the form of Figures, tables, graphs and photographs can be enclosed.
- Summary and References

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY22AC1	ADVANCED LEARNERS COURSE -STEM CELL TECHNOLOGY	ALC THEORY	Self-study	-	-	5*

Learning Objectives

- To explain basic concepts of cell culture types, aseptic techniques, risk assessment and safety issues, cell culture methods.
- To apply cell line characterization, media preparation, cytotoxicity assays and culture maintenance.
- To evaluate the impact of cell transformation, establishment, cryopreservation of cell line, cell banks, and transportation of cells.
- To summarize recent advances in cell line research, principles of tissue engineering & applications.

Course Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Explain the basic concepts of cell culture types, aseptic techniques, risk assessment and safety issues, cell culture methods.	K2
CLO2	Apply their knowledge on cell line characterization, media preparation, cytotoxicity assays and culture maintenance.	K3
CLO3	Evaluate the impact of cell transformation, establishment, cryopreservation of cell line, cell banks, and transportation of cells.	K4
CLO4	Summarize recent advances in cell line research, principles of tissue engineering & applications.	K5
CLO5	Report about various types of stem cells in the human body and their potential applications in regenerative medicine.	K6

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

STEM CELL TECHNOLOGY

SYLLABUS

UNIT-I Stem cells and Types

Introduction to stem cells: Definition, properties, proliferation, culture of stem cells. Classification, Sources and Properties –Types of stem cells: methods of isolation, study of stem cells and their viability IPSC, embryonic stem cells, cancer stem cells. – Preservations of Stem cell. Embryonic stem cell: Isolation, Culturing, Differentiation, Properties – Adult stem cell: Isolation, Culturing, Differentiation, Trans-differentiation, Plasticity, and Properties.

UNIT-II Preparation and Cell Culture Maintenance

Media: Physicochemical Properties, Balanced Salt Solutions, Complete Media, Serum, Disadvantages of Serum supplemented media, Serum-Free Media, Advantages of Serum-Free media. Types of cell culture: anchorage dependent and suspension cultures; Steps involved in Primary cell culture: Isolation of Tissue, Subculture, Propagation and maintenance. Contamination: Sources, Type of microbial contamination, Monitoring, Eradication of Contamination, Cross-Contamination. Cryopreservation: Need of Cryopreservation, Preservation, Cell banks, Transporting Cells.

UNIT-III Assessment of Cytotoxicity

Cytotoxicity: Aberrant Growth Control, Cell counting, Plating Efficiency, Labeling Index, Generation Time of established cell line. Measurement of Cytotoxicity: Cell viability; Cell Proliferation Assays; Metabolic Cytotoxicity Assays; Microtitration and Clonogenic survival; Drug Interaction; Mutagenesis Assay by Sister Chromatid Exchange; Applications of Cytotoxicity Assays. Apoptosis and its determination; Necrosis; Difference between apoptosis and necrosis.

UNIT-IV Therapeutic applications of various types of stem cells

Different kinds of stem cells – Adult Stem cells, embryonic stem cells, Embryonic Germ cells, Hematopoietic stem cell, neural stem cells, muscle and cardiac stem cells, Umbilical cord blood stem cells, cancer stem cells. Therapeutic applications: stem cells and neurodegenerative disorders, stem cells and diabetes, stem cells and cardiac disorders, regeneration of epidermis, Success stories of stem cell therapy. Stem cellbanking and ethical approaches on stem cells.

UNIT-V Principles and Applications of Tissue Engineering

Principles of Tissue Engineering – History and scope, Basics of Tissue Engineering, Cell-ECM interaction, Wound healing mechanism, Tissue Engineering Bioreactors, Models of Tissue Engineering,

and Biomaterials in Tissue Engineering. Bioartificial organs – source of cells, choosing the right scaffold material, mode of transplantation. Commercial products: Bladder reconstruction, Skin equivalents, Liver reconstruction, Bone regeneration through tissue engineering.

TEXT BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Clarke, M and Frampton J	Stem Cell Biology and Application.	Taylor and Francis, UK	2020 (1 st Edition)
2.	Slack J. M. W	The Science of Stem Cells.	Wiley-Blackwell, USA	2018 (1 st Edition)
3.	Huang, N, L'heureux, N, Li,S	Engineering Stem Cells for Tissue Regeneration.	1. World Scientific Publishing Co Pvt Ltd, Singapore.	2018 (1 st Edition)

REFERENCE BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Lanza, R, Langer. R, Vacanti, J.P and Atala, A	Principles of Tissue Engineering.	Academic Press, USA	2020 (5 th Edition)
2.	Cooper, G, Herrera, J, Kirkbride, J and Iman, Z.	Regenerative Medicine for Spine and Joint Pain.	Springer, USA	2020 (1 st Edition)

Course Designer:

Dr. G. Archana

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MBY22AC2	ADVANCED LEARNERS COURSE- MICROBIAL AND CLINICAL GENOMICS	ALC THEORY	Self- study	-	-	5*

Learning Objectives

- To describe the current developments in the diagnosis of infectious diseases.
- To examine the importance of microbes to produce novel compounds.
- To compare the different chromosomal disorders.
- To distinguish the different genetically inherited diseases.
- To report about uses of biomarkers in cancer research.

Course Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Describe the current developments in the diagnosis of infectious diseases.	K2
CLO2	Examine the importance of microbes to produce novel compounds.	K3
CLO3	Compare the different chromosomal disorders.	K4
CLO4	Distinguish the different genetically inherited diseases.	K5
CLO5	Report about uses of biomarkers in cancer research.	K6

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

MICROBIAL AND CLINICAL GENOMICS

SYLLABUS

UNIT-I Microbial Genomics

Infectious disorders-Identification of human disease genes. Targets for treatment of viral infection. Current development in diagnosis of tuberculosis, malaria and HIV. DNA based approaches to disease diagnosis, Whole genome sequencing, Detecting RNA signatures of disease. Molecular probes in forensic medicine. Biomarkers of pathogens, Use of nucleic acid probes in tissue typing.

UNIT-II Microbial Engineering

Microorganisms as factories for the production of novel compounds. Genetic engineering of microbes to improve production of antibiotics, amino acids, lipids, enzymes, steroids and secondary metabolites. Biopolymers and bioplastics.

UNIT-III Clinical Genomics

Chromosomal disorders - Numerical chromosome abnormalities e.g. Trisomy and Monosomy, Structural chromosomal abnormalities e.g. Deletions, Duplications, Translocations and Inversions. Single gene disorders - Sickle Cell Anemia, Thalassemia and Hemophilia. Polygenic disorders & gene clustering, Alzheimer's disease, Type 1 Diabetes, Mitochondrial disorders: Parkinson's disease.

UNIT-IV Human Genetic disorders

Symptoms and treatment of the Genetically inherited diseases: Phenylketonuria, Alkaptonuria, Galactosemia, G6P Dehydrogenase deficiency, Von Gierke disease, Lesch-Nyhan syndrome, Gout, Lactose intolerance, Therapy of Genetic Disease; Genetic disorders: Prenatal Diagnostic testing and Counseling.

UNIT-V Cancer Genomics

Historical perspective on development of cancer genomics. Cancer characterization using sequencing approaches. Advances in sequencing technologies, Discoveries using second generation sequencing technologies. Cancer transcriptome sequencing and analysis. Cancer

pharmacogenomics & biomarker discovery and development, Uses of biomarkers in cancer research and cancer care. Detection of miRNA signatures of cancers.

TEXT BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Glick, B.R and Patten, C.L	Molecular Biotechnology: Principles and Applications of Recombinant DNA	John Wiley and Sons, USA.	2022 (6 th Edition)
2.	Jorde, L.B, Carey, J.C and Bamshad, M.J.	Medical Genetics	Elsevier, Netherlands.	2019 (6 th Edition)
3.	Harzevili, F.D. and Chen, H.	Microbial Biotechnology: Progress and Trends.	CRC Press, UK	2017 (1 st Edition)
4.	Ramaswamy, G and Siddhartha, D.	Cancer Genomics for the Clinician.	Springer Publishing	2019
5.	Chaitanya, K.V.	Diagnostics and gene therapy for Human genetic disorders.	CRC Press	2022

REFERENCE BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1.	Glick, B.R, Delovitch, T.L and Patten, C.L	Medical Biotechnology	ASM Press, USA.	2014
2.	Dellaire G, Berman J.N and Arceci	Cancer Genomics: from Bench to Personalized Medicine.	Elsevier Science, UK	2014 (1 st Edition)
3.	Palavra, F, Reis, F and Marado, D	Biomarkers of Cardiometabolic Risk, Inflammation and Disease.	Springer, USA.	2015
4.	Uppal, K	Handbook of FAQ's on Basic Genetics and common Genetic disorders for students.	CBS Publishers and Distributors.	2022

Course Designer:

Dr. G. Archana