BHARATHIAR UNIVERSITY:: COIMBATORE 641 046
UD- Department of Biotechnology: M.Sc. Medical Biotechnology Curriculum
(DBT Supported)
(For the students admitted during the academic year 2026-27 onwards)

Scheme of Examination

Subject Code	Course Code	Title of the Course		Credits	Hours		Maximum Marks		
					Theory	Practical	CIA	ESE	Total
FIRST SEMESTER									
13A	**26MB1C01**	Core-1	Biochemistry	4	4	-	25	75	100
13B	**26MB1C02**	Core-2	Cell and Molecular Biology	4	4	-	25	75	100
13C	**26MB1C03**	Core-3	Medical Devices	2	2	-	12	38	50
13D	**26MB1C04**	Core-4	Genetics	4	4	-	25	75	100
13E	**26MB1C05**	Core-5	Biostatistics	4	4	-	25	75	100
13F	**26MB1C06**	Core-6	Biophysical Principles and Analytical Techniques	4	4	-	25	75	100
13P	**26MB1P01**	Practical-1	Cell Biology and Analytical Techniques	4	-	6	25	75	100
1VA*	**26MB1V01**	VAC-1	Soft Skills and Business Communication Skills for Employability Training	2	2	-	50	-	50
			Total	**26**	**22**	**6**	**162**	**488**	**650**
SECOND SEMESTER									
23A	**26MB1C07**	Core-7	Developmental Biology and Physiology	4	4	-	25	75	100
23B	**26MB1C08**	Core-8	Immunology	4	4	-	25	75	100
23C	**26MB1C09**	Core-9	Omics Concepts and Data Integration	4	4	-	25	75	100
23D	**26MB1C10**	Core-10	Bioinformatics	4	4	-	25	75	100
23E	**26MB1C11**	Core-11	Molecular Diagnostics and Clinical Testing	4	4	-	25	75	100
2EA	**26MB1E1A**	E1ective-1	Plant Molecular Pharming	2	2	-	12	38	50
2EB	**26MB1E1B**		Indian Systems of Medicine						
23P	**26MB1P02**	Practical-2	Immunotechnology and Molecular Diagnostics	4	-	6	25	75	100
2JA*	**26MB1J01**	JOCC-1	SAS Programming for Clinical Trials Management	2	2	-	50	-	50
			Total	**26**	**22**	**6**	**162**	**488**	**650**
THIRD SEMESTER									
33A	**26MB1C12**	Core-12	Animal Biotechnology and Stem Cell Biology	4	4	-	25	75	100
33B	**26MB1C13**	Core-13	Clinical Biochemistry and Disease Metabolism	4	4	-	25	75	100
33C	**26MB1C14**	Core-14	Medical Microbiology and Infection Biology	4	4	-	25	75	100
33D	**26MB1C15**	Core-15	Genetic Engineering and Genome Editing Technologies	4	4	-	25	75	100
33E	**26MB1PR1**	Project-1	Research Project Proposal Preparation and Defense	2	-	2	25	25	50

3EA	**26MB1E2A**	E1ective-2	Nanobiotechnology	4	4	-	25	75	100
3EB	**26MB1E2B**		Pharmaceutical Biotechnology						
33P	**26MB1P03**	Practical-3	Clinical Biochemistry and Microbiology	4	-	6	25	75	100
37V*	**26MB1S01**	Internship	One Month Summer Internship in Hospital/ Biomedical Industries/Research Institute	2	-	-	50	-	50
3JA*	**26MB1J02**	JOCC-2	Assisted Reproductive Techniques	2	2	-	50	-	50
			Total	**26**	**20**	**8**	**175**	**475**	**650**
FOURTH SEMESTER									
43A	**26MB1C16**	Core-16	Bioethics, Biosafety, IPR and Entrepreneurship	4	4	-	25	75	100
47V	**26MB1PR2**	Project-II	Research project with a mandatory Co-guide from other Department(s) / Industries	8	-	-	50	150	200
4NS*	**26MB1NS**	Swayam	MOOC/Swayam - Online Learning Course	2	2	-	-	-	-
4VA*	**26MB1V02**	VAC -2	Advanced Instrumentation Training	2	2	-	50	-	50
4SP*	**26MBDM01**	SP1	Disaster Management	2	2	-	50	-	50
			Total	**12**	**-**	**-**	**75**	**225**	**300**
			Grand Total	**90**	**-**	**-**	**-**	**-**	**2250**

**Co-Scholastic Courses*

The final grading and ranking will only be based on scholastic courses. However, the award of the degree requires the mandatory completion of Co-Scholastic courses.

No.	Course Type	No. of Courses	Credits / Course	Total Credits
Co-Scholastic Courses				
1	Online SWAYAM Course	1	2	2
2	Value Added Courses	2	2	4
3	Job Oriented Certificate Courses	2	2	4
4	Summer Internship	1	2	2
5	Special Programme	1	2	2
	Total	**7**	**10**	**14**

SEMESTER ONE

Biochemistry

Credits 4

Marks: 100

Course Code	26MB1C01	Course Type	Core 1	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	A Basic Knowledge on Biomolecules and Metabolic Pathways								

Course Objectives:

1. To gain a fundamental understanding of biomolecules and their roles in biological functions.
2. To provide an overview of energy metabolism and its regulation in living systems.
3. To develop knowledge of the central dogma of molecular biology and the role of genetic material in human disorders.
4. To build competence in enzymology, biochemical pathways, and their clinical relevance.
5. To familiarize students with modern biochemical techniques and their applications in research and diagnostics.

Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Familiarize the structural properties of proteins that are building blocks of life. Clear understanding about factors that determine the structure and functions of a protein by equipping them to apply the knowledge in biopharmaceutical industry.	**K1, K2 and K4**
CO2	Obtain a comprehensive knowledge about enzymes as modulators of biochemical reactions. Enable students to apply their critical thinking to evaluate applications of enzymes in therapeutics and commercial applications.	**K1, K2, and K3**
CO3	Understand the biochemical events that lead to production of energy and the functional importance of energy reserves of the body. Improve their ability to understand the direct relationship between physiology and metabolism.	**K1, K2, K3, K4 and K5**

CO4	Understand the central dogma of molecular biology. Develop insights into the structural importance of DNA in health and disease. Strong basics will be very useful for developing clinical tests involving biomolecules.	**K1, K2, K3, K4 and K5**
CO5	Acquire strong theoretical knowledge about bioenergetics and pathways that tightly regulate energy metabolism. Detailed understanding of various signaling pathways involved, will be helpful in understanding the pathological importance of these pathways in disease biology.	**K1, K2, K3, K4 and K5**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate		

Unit I

Protein Structure

10 Lectures

Chemical basis of life: Miller-Urey experiment, abiotic formation of amino acid oligomers, composition of living matter; Water – properties of water, essential role of water for life on earth, pH, buffer, maintenance of blood pH and pH of gastric juice, pH optima of different enzymes (pepsin, trypsin and alkaline phosphatase), ionization and hydrophobicity, emergent properties of biomolecules in water, biomolecular hierarchy, macromolecules, molecular assemblies; Structure-function relationships: amino acids – structure and functional group properties, peptides and covalent structure of proteins, elucidation of primary and higher order structures, Ramachandran plot, evolution of protein structure, protein degradation and introduction to molecular pathways controlling protein degradation, basic principles of protein purification; tools to characterize expressed proteins; Protein folding: Anfinsen's Dogma, Levinthal paradox, cooperativity in protein folding, free energy landscape of protein folding and pathways of protein folding, molten globule state, chaperons, diseases associated with protein folding, introduction to molecular dynamic simulation.

	Self-learning: structure-function relationships in model proteins like ribonuclease A, myoglobin, haemoglobin, chymotrypsin, etc.
Unit II **Enzyme Kinetics** **8 Lectures**	Enzyme catalysis – general principles of catalysis; quantitation of enzyme activity and efficiency; relevance of enzymes in metabolic regulation, activation, inhibition and covalent modification; single substrate enzymes; concept of catalytic antibodies; catalytic strategies with specific examples of proteases, carbonic anhydrases, restriction enzymes and nucleoside monophosphate kinase; isozymes; role of covalent modification in enzymatic activity; zymogens. *Self-learning*: Enzyme characterization and Michaelis-Menten kinetics
Unit III **Glycobiology** **6 Lectures**	Sugars-mono, di, polysaccharides and complex carbohydrates with specific reference to glycogen, amylose and cellulose, glycosylation of other biomolecules-glycoproteins and glycolipids; lipids-structure and properties of important members of storage and membrane lipids; lipoproteins.
Unit IV **Structure and functions of DNA & RNA** **8 Lectures**	Nucleosides, nucleotides, nucleic acids - structure, a historical perspective leading up to the proposition of DNA double helical structure; difference in RNA and DNA structure, importance of DNA as the genetic material in evolution of disease diagnosis
Unit V **Bio-energetics** **10 Lectures**	Bioenergetics-basic principles; equilibria and concept of free energy; coupled interconnecting reactions in metabolism; oxidation of carbon fuels; Introduction to GPCR, *myo*-Inositolcontaining phospholipids/DAG//PKC and Ca++ signaling pathways; reciprocal regulations and non-carbohydrate sources of glucose; citric acid cycle as

	a source of biosynthetic precursors; Oxidative phosphorylation; importance of electron transfer in oxidative phosphorylation; F_1-F_0 ATP Synthase; shuttles across mitochondria; regulation of oxidative phosphorylation; *Self-learning:* Glycolysis, Gluconeogenesis, Citric acid cycle, entry to citric acid cycle, Photosynthesis – chloroplasts and two photosystems; proton gradient across thylakoid membrane.
Unit V **Role of Vitamins & Cofactors in Metabolism** **10 Lectures**	Roles of epinephrine and glucagon and insulin in glycogen metabolism; protein turnover and amino acid catabolism; nucleotide biosynthesis; biosynthesis of membrane lipids and sterols with specific emphasis on cholesterol metabolism and mevalonate pathway; elucidation of metabolic pathways; logic and integration of central metabolism; entry/ exit of various biomolecules from central pathways; principles of metabolic regulation; steps for regulation; TOR (target of rapamycin) & autophagy regulation in relation to C & N metabolism *Self-learning:* Calvin cycle and pentose phosphate pathway; glycogen metabolism, reciprocal control of glycogen synthesis and breakdown, Fatty acid metabolism, starvation responses and insulin signaling.
Unit VI **Contemporary issues**	Guest lectures by academic/industry experts, online seminars - webinars
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	L	L
CO2	S	S	M	L	L
CO3	S	M	L	L	L

CO4	S	M	M	M	M
CO5	S	S	S	L	L
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Laurence AM, Robert AH, Gray S and Marc P (2022). Principles of Biochemistry, Pearson Education, 14th edition.
2. Berg JM, Tymoczko JL and Stryer L (2019). Biochemistry, WH Freeman and Company, 9th edition.
3. Ritu S, Rajeev G and Denice RF (2024). Lippincott's Illustrated Reviews – Biochemistry, Wolters Kluwer India, 2nd South Asian edition.
4. Lehninger WH, David LN and Michael C (2017). Principles of Biochemistry, Freeman and Company 7th edition.
5. Peter JK, Kathleen MB, Owen MG and Victor WR (2022). Harper's illustrated Biochemistry. McGraw-Hill Professional, 32nd edition.

Related Online Contents:

1. https://onlinecourses.swayam2.ac.in/cec20_bt12/preview
2. https://nptel.ac.in/courses/104/105/104105076/

Course adapted from DBT curriculum and handled by Dept. of Biotechnology	**Dr. S. Velayuthaprabhu** **Assistant Professor**

SEMESTER ONE

Cell and Molecular Biology

Credits 4

Marks: 100

Course Code	26MB1C02	Course Type	Core 2	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	A Basic Knowledge in Cell Biology								

Course Objectives:

1. To familiarize the student in various aspects of cell and molecular biology streams including cellular organization and their interactions in DNA replication, and protein biosynthesis and translational regulation
2. To develop comprehensive understanding on the complete cellular and molecular function of cell organelles in terms of cell-to-cell interaction, gene regulation, cellular signalling
3. To impart the molecular biology knowledge in applications of various human health care industry for developing drugs.

Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Understand and apply the principles and techniques of molecular biology which prepares students for further education and/or employment in teaching, basic research, or the health professions.	**K1, K2 and K3**
CO2	Exhibit a knowledge base in cell and molecular biology in biomedical sciences	**K2 and K3**
CO3	Cell and molecular biology will render them choose their techniques in molecular biology research and further will help them to get job opportunities in health care industry	**K3 and K4**
CO4	This paper will help the students to conduct independent work pertaining to molecular biology research.	**K3 and K4**
CO5	The theoretical knowledge gained from this paper will help the student to apply these concepts in their future research and innovation.	**K3, K5 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I **Structure and Function of Biological Membranes** **10 Lectures**	Structure and function of biological membranes: Structural models; Composition and dynamics; Glyco conjugates and proteins in membrane systems. Transport of ions and macromolecules; Pumps, carriers and channels; Active and passive transport, Channels and Sodium- Potassium pumps, Calcium pump, Proton pump. Endo and Exocytosis; Cellular junctions and adhesions. Cellular junctions and adhesion.; Selectins, Integrins, Cadherins molecules-based cell adhesions. Extra cellular matrix.
Unit II **Molecular Structure and Functions of Organelle; Cytoskeleton and Cellular Motility** **10 Lectures**	Mitochondria: structure, origin and evolution, organization of respiratory chain complexes, Mitochondrial Genome. Structure-functional relationship; Structure and function of peroxisome; Structure and function of microbodies, Golgi apparatus, lysosomes and Endoplasmic reticulum; Overview of cellular cytoskeleton: Organization and role of microtubules and microfilaments; Intermediate filaments; Cellular motility; Molecular motors. Nucleus: structure and function of nuclear envelope, lamina and nucleolus; Chromatin organization and packaging;
Unit III **Organization and Functions of DNA Cell cycle Regulation and Cell Signalling** **10 Lectures**	Central dogma, DNA as genetic material; Organization of bacterial genome; Structure of eukaryotic chromosomes: DNA compaction, nucleosome, 10nm "beads-on-a-string" fibre, 30nm chromatin fibre and metaphase chromosome; Nuclear matrix in chromosome organization and function; Heterochromatin and Euchromatin; DNA melting and buoyant density; Tm; DNA reassociation kinetics (Cot curve analysis); Genetic code in mitochondria; Degeneracy of codons; Termination codons; Wobble hypothesis. DNA Replication: initiation, elongation and termination in prokaryotes and eukaryotes; Enzymes and accessory proteins and mechanisms; Fidelity;

	Replication of single stranded circular DNA. Cell cycle and Cell cycle control mechanisms. Cell signalling – types of cell signalling - G protein mediated, Tyrosine kinase mediated signalling. MAP Kinases mediated cell signalling.
Unit IV **Transcription, RNA Processing and Regulation in Prokaryote** **10 Lectures**	Structure and function of prokaryotic mRNA, tRNA (including initiator tRNA) and rRNA (and ribosomes); Prokaryotic Transcription -RNA polymerase and sigma factors, Transcription unit, Promoters, Promoter recognition, Initiation, Elongation and Termination (intrinsic, Rho and Mfd dependent); Processing of mRNA, rRNA and tRNA transcripts; Translation in prokaryotes. Gene regulation: Repressors, activators, positive and negative regulation, Constitutive and Inducible, small molecule regulators, operon concept: *lac*, *trp*, *his* operons .
Unit V **Transcription, RNA Processing and Regulation in Eukaryotes** **12 Lectures**	Structure and function of eukaryotic mRNA, tRNA (including initiator tRNA) and rRNA (and ribosomes). Eukaryotic transcription - RNA polymerase I, II and III mediated transcription: RNA polymerase enzymes, eukaryotic promoters and enhancers, General Transcription factors; TATA binding proteins (TBP) and TBP associated factors (TAFs); assembly of pre-initiation complex for nuclear enzymes, interaction of transcription factors with the basal transcription machinery and with other regulatory proteins, mediator; Processing of hnRNA, tRNA, rRNA; 5'-Cap formation; 3'-end processing of RNAs and polyadenylation, Splicing of tRNA and hnRNA; snRNPs and snoRNPs in RNA processing; Regulation of RNA processing: capping, splicing, polyadenylation; RNA editing, mRNA stability and degradation: degradation and surveillance pathways. Families of DNA-binding transcription factors: Helix-

	turn-helix, helix-loop-helix, homeodomain; 2C 2H zinc finger, multi cysteine zinc finger, basic DNA binding domains: Leucine zipper. Translational machinery; Mechanism of Translation: Protein synthesis in eukaryotes; Co- and Post-translational modifications of proteins.
Self study:	Types of Cancer: Benign Tumors Vs. Malignant Tumors. Hall marks of cancers. Common Symptoms, tumor suppressor. and oncogenes. Cancer markers. Causes of Cancer: Chemical Carcinogenesis; Irradiation Carcinogenesis. Aging and Cancer.
Unit VI	
Contemporary issues	Expert lectures, online seminars - webinars
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	M	S	S	S	S
CO3	S	S	S	S	S
CO4	M	S	S	S	S
CO5	S	S	S	S	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Darnell J (1990). Molecular Cell Biology. Scientific American Books Inc, 2nd edition.
2. Lodish H et al. (2021). Molecular Cell Biology. Macmillan Publishers, 9th edition.
3. Karp G, Iwasa J and Marshall W (2021). Karp's Cell and Molecular Biology. Wiley, 9th edition.
4. Sadava DE (2009). Cell Biology: Organelle Structure and Function. CBS

Publishers & Distributors.
5. Wolfe, S. L. (1993). Molecular and cellular biology. Wadsworth Publishing Company.
6. Beck G and Wolfe SL (1995). Molecular and Cellular Biology. The Quarterly Review of Biology.
7. Brown TA (1991). Molecular Biology Labfax. Oxford, UK: BIOS Scientific Publishers.

Related Online Contents:

1. Swayam- Molecular biology course by Dr. Nayan K. Jain
2. Swayam- Cell Biology by Dr. K. Sanatombi
3. NPTEL - Molecular Cell Biology by Prof.D. Karunagaran – IIT Madras

Course adapted from DBT curriculum and handled by Dept. of Biotechnology	**Dr. S. Girija** **Associate Professor**

SEMESTER ONE

Medical Devices

Credits 2

Marks 50

Course Code	26MB1C03	Course Type	Core 3	L	T	P	C	Syllabus version	2026-2027
				2	✓	-	2		
Pre-requisite	Basic Knowledge in Health Sciences								

Course objectives:

1. The course aim is to familiarize students with emerging trends in medical devices for early detection and selection of appropriate treatment.
2. The course will also give an insight about monitoring treatment effectiveness and disease surveillance.

Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Know about the detailed insights on sensors, transducers, and optical sensors	**KI and K4**
CO2	Understand the concepts related to bio-recognition systems, electrodes and immobilization	**K2 and K5**
CO3	Obtain a comprehensive knowledge about fundamentals and applications of microfluidics	**K1 and K3**
CO4	Extend principles of engineering to the development of medical devices and design of sensors	**K6**
CO5	Appreciate basic configuration and distinction among biosensor systems	**K5**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I

Sensors

4 Lectures

Rationale of electronic biosensors; Essence of three types of electronic biosensors (*i.e.*, potentiometric, amperometric, and cantilever-based sensors); Three essential metrics that define modern electronic sensors; detection time, sensitivity, and selectivity; Physics of detection time that allows one to organize every available sensor in a systematic way; Fundamental limits of detection of various classes of sensors;

	Opportunities and challenges of integrating sensors in a system platform.
Unit II **Transducers** **4 Lectures**	Principles and applications of Calorimetric, Piezoelectric, semiconductor, impedimetric, based transducers; Biochemical Transducers: Electrode theory: electrode-tissue interface, metal-electrolyte interface, electrode-skin interface, electrode impedance, electrical conductivity of electrode jellies and creams.
Unit III **Optical sensors** **4 Lectures**	Photo detectors, optical fiber sensors, indicator mediated transducers; General principles of optical sensing, optical fiber temperature sensors; Pulse sensor: photoelectric pulse transducer, strain gauge pulse transducer.
Unit IV **Bio recognition systems** **3 Lectures**	Enzymes; Oligonucleotides Nucleic Acids; Lipids (Langmuir-Blodgett bilayers, Phospholipids, Liposomes); Membrane receptors and transporters; Immunoreceptors; Chemoreceptors.
Unit V **Electrodes and immobilization** **4 Lectures**	Microelectrodes, body surface electrodes, needle electrodes, pH electrode, specific ion electrodes/ Ion exchange membrane electrodes, enzyme electrodes; Reference electrodes: hydrogen electrodes, silver-silver chloride electrodes, Calomel electrodes; Enzyme immobilization; Peptide immobilization; Antibody immobilization; Oligonucleotides and Nucleic Acid immobilization; Cell immobilization; Mono-enzyme electrodes; Bi-enzyme electrodes: enzyme sequence electrodes and enzyme competition electrodes.
Unit VI **Fundamentals and Applications of Microfluidics** **3 Lectures**	Capillary flow and electro kinetics; Micro pump, Micro mixers, Micro reactors, Micro droplets, Micro particle separators; Micro fabrication techniques (different types of lithography methods); Application of micro-fluidics (*eg*. Lab-in –Chip).

Unit VII **Applications** **4 Lectures**	Biomarkers: Disease and pathogen specific information, availability by sample type (blood, serum, urine, sputum, saliva, stool, mucus); Specificity, sensitivity, shelf life, portability; Clinical chemistry; Test-strips for glucose monitoring; Urea determination; Implantable Sensors for long-term monitoring; Drug development and detection; Environmental monitoring; Examples of various diseases (Cancer, HIV/AIDS, Tuberculosis, Malaria, Lymphatic Filariasis, Schistosomiasis, Dengue, Chikungunya).
Unit VIII **Contemporary Issues**	Guest lectures by academic/industry experts, online seminars - webinars

Total Lectures – 26

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	L	L	L
CO2	S	S	M	L	L
CO3	S	S	M	L	L
CO4	M	S	S	L	M
CO5	M	M	L	S	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Cunningham A (1998). Introduction to bioanalytical sensors. John Wiley & Sons.
2. Janata J (2009). Principles of chemical sensors, Plenum Press, 2nd edition.
3. Scheller F, Schubert F and Fedrowitz J (1997). Frontiers in biosensors. Birkhäuser.
4. Eggins B (2002). Chemical sensors and biosensors. John Wiley & Sons.
5. Ramsay G (1998). Commercial biosensors. John Wiley & Sons.

6. Spichiger-Keller U (1998). Chemical sensors and biosensors for medical and biological applications, Wiley-VCH.
7. Berthier J and Silberzan P (2010). Microfluidics for biotechnology (2nd ed.). Artech House.
8. Gomez FA (2008). Biological applications of microfluidics, Wiley.
9. Webster JG (1998). Encyclopedia of medical devices and instrumentation (Vols. I–IV), Wiley-Blackwell.

Related online contents:

1. Ligler F, RoweTaitt C (2002). Optical Biosensors. Present &Future, Elsevier.
2. Jenkins G, Mansfield CD (2013), Microfluidic Diagnostics: Methods and Protocols, Springer.

Course adapted from DBT curriculum and handled by Dept. of Nanoscience and Technology	**Dr. N. Ponpandian, Professor**

SEMESTER ONE

Genetics

Credits 4

Marks 100

Course Code	26MB1C04	Course Type	Core 4	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	A Basic Knowledge in Genetics								

Course objectives:

1. To provide basic knowledge of genetics encompassing prokaryotic/phage genetics, and higher eukaryotic and over all concepts of Mendelian genetics.
2. To enable students to develop an understanding of the relationship between genotype and phenotype in human genetic traits.
3. To impart knowledge of basics of human genetics and disease gene mapping.
4. To provide students with foundational knowledge of various techniques in cytogenetics and epigenetics.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Explain the principles of prokaryotic and phage genetics and apply this knowledge to analyze genetic mechanisms in microorganisms.	**K1 and K2**
CO2	Describe the genetic principles of Drosophila, analyze inheritance patterns using experimental data, and apply these concepts to understand broader genetic mechanisms.	**K1 and K2**
CO3	Interpret the principles of human gene inheritance and evaluate how genetic variations contribute to the development of human diseases.	**K2, K3 and K5**
CO4	Demonstrate proficiency in cytogenetic, molecular, and immunogenetic techniques and apply these methods effectively for the diagnosis of genetic and immunological diseases.	**K2 and K3**
CO5	Articulate the concept of genetic variation, examine the mechanisms of epigenetics, and evaluate the role of transgenerational epigenetics in heredity and disease.	**K4 and K5**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate

Unit I **Genetics of bacteria and bacteriophage** **10 Lectures**	Concept of a gene in pre-DNA era ; mapping of genes in bacterial and phage chromosomes by classical genetic crosses; fine structure analysis of a gene; genetic complementation and other genetic crosses using phenotypic markers; phenotype to genotype connectivity prior to DNA-based understanding of a gene; Restriction modification systems – history, types of systems and their characteristics, applications of RM systems, methylation-dependent restriction enzymes, transposable elements – types, properties and applications.
Unit II **Principles of Mendelian & Non-Mendelian genetics** **12 Lectures**	Principles of Mendelian inheritance; Mendel's experiments-monohybrid, dihybrid, trihybrid and multihybrid crosses. Interaction of genes: incomplete dominance, codominance, epistasis, complementary genes, duplicate genes, polymeric genes, modifying genes; lethal genes. Environment and gene expression: penetrance and expressivity; temperature, light, phenocopies. Approaches to analysis of complex traits-'Nature nurture' concept, role of Family and shared environment, monozygotic and dizygotic twins and adoption studies, Multiple alleles; Sex determination; Polygenic inheritance. Extra nuclear inheritance; Linkage and crossing over. Chromosomal anomalies: variation in chromosome number: Euploidy & aneuploidy. Variation in chromosome structure: deletion, duplication, translocation, inversion and B-chromosome.
Unit III **Human Genetics** **10 Lectures**	History of human genetics, Monogenic traits, Autosomal inheritance-dominant, recessive Sex-linked inheritance, Sex-limited and sex-influenced traits, Mitochondrial inheritance, OMIM number, Complications to the basic pedigree patterns- non-penetrance, variable,

	expressivity, pleiotropy, late onset, dominance problems, anticipation, genetic heterogeneity, genomic imprinting and uniparental disomy, spontaneous mutations, mosaicism and chimerism, male lethality, X-inactivation; Genetic susceptibility in multifactorial disorders (alcoholism, diabetes mellitus, obesity), Estimation of genetic components of multifactorial traits: empiric risk, heritability, coefficient of relationship.
Unit IV **Cytogenetics, Developmental Genetics and Immunogenetics** **10 Lectures**	Pedigree analysis: pedigree symbols, construction of pedigrees, Cytogenetics: Techniques in human chromosome analysis, Human karyotype: banding, nomenclature of banding, Pathology of human chromosomes, Nomenclature of aberrant karyotypes, Common syndromes due to numerical chromosome changes, Common syndromes due to structural alterations (translocations, duplications, deletions, microdeletion, fragile sites) Common chromosome abnormalities in cancer, Genetics of fetal wastage Disorders of sex chromosomes and autosomes; Molecular cytogenetics– Fluorescence In situ Hybridization (FISH); Comparative Genomic Hybridization (CGH).
Unit V **Mutagenesis and Epigenetics** **10 Lectures**	Mutations; kinds of mutation; agents of mutation; genetic polymorphism; uses of polymorphism; The epigenome, epigenetic modifications: DNA methylation, histone modification, chromatin remodeling and non-coding RNAs; cellular maintenance of the epigenome; epigenetic control of gene expression, and epigenetics and development. Transgenerational epigenetic inheritance.
Unit VI **Contemporary issues**	Guest lectures by academic/industry experts, online seminars - webinars
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	L	M	M
CO2	S	S	L	M	M
CO3	S	S	M	S	S
CO4	S	S	M	S	S
CO5	S	S	M	S	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Pierce BA (2012). Genetics: a conceptual approach. Macmillan, 5th Edition.
2. Hartwell L, Goldberg ML, Fischer JA, Hood LE and Aquadro CF (2018). Genetics: from genes to genomes (p. 960). New York, NY, USA: McGraw-Hill Education, 6th edition.
3. Klug WS, Cummings MR., Spencer CA and Palladino MA (2015). Essentials of Genetics. Pearson, 12th edition.
4. Snustad DP and Simmons MJ (2015). Principles of Genetics. John Wiley & Sons, 7th edition.
5. Hartl DL, and Jones EW (2009). Genetics: analysis of genes and genomes. Jones & Bartlett Learning, 4th edition.

Related online contents:

1. https://www.classcentral.com/course/swayam-genetics-and-genomics-17623
2. https://nptel.ac.in/courses/102/104/102104052/
3. https://www.coursera.org/learn/genetics-evolution

Course adapted from DBT curriculum and handled by Dept. of Biotechnology	**Dr. V. Thirunavukkarasu** **Associate Professor**

SEMESTER ONE

Biostatistics

Credits 4

Marks 100

Course Code	26MB1C05	Course Type	Core 5	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	Basic Understanding on the Objectives of Statistics and Computations								

Course objectives:

1. Introduce the basics of biostatistics
2. Instil knowledge to compute statistical measures for analysing data
3. Instruct the applications of statistical methods for biological problems

Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Understand and apply statistical methods to analyze and interpret data in practical contexts	**K1-K6**
CO2	Compute statistical measures for decision making	**K2-K3**
CO3	Formulate hypotheses and perform statistical analysis for biological problems	**K1-K6**
CO4	Perform analysis of variance for experimental designs	**K1-K6**
CO5	Make interpretations of results from the derived results	**K1-K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I

Descriptive Statistics

10 Lectures

Nature of Biological, Clinical and Experimental Data – Graphical and Diagrammatic Representation of Data – Line Diagram - Box Plots – Histogram - Grouped Data – Frequency Distribution - Frequency Curve. Measures of Location: Mean, Median and Mode. Measures of Spread: Range, Standard Deviation, Quartile Deviation - Coefficient of Variation – Measures of Skewness and Kurtosis.

Unit II **Probability and Probability Distributions** **10 Lectures**	Definition of Probability – Addition and Multiplication Laws of Probability – Conditional Probability – Bayes' Rule and Applications - Random Variables: Discrete and Continuous Random Variables – Probability Function: Mass and density Functions – Permutations and Combinations – Bernoulli, Binomial, Poisson and Normal Probability Distributions – Properties and Problems. Basics of Exact Distributions.
Unit III **Hypothesis Testing: One-sample, Two-sample Multi-sample Inference** **10 Lectures**	Fundamental notions of estimation and hypothesis testing of population parameters - Null and alternative hypothesis, simple and composite hypothesis, critical region, type I and type II errors, level of significance, power function – Confidence interval for population parameters, mean and variance = Parametric Tests: One Sample Tests for the Mean and Variance of a Normal Distribution Based on normal, t and chi-square tests - One Sample Inference for the Binomial and Poisson Distributions. Two-sample t – Tests for Independent Samples – Paired t- Tests - Tests for the Equality of Two Variances – Analysis of Variance for One-Way and Two-Way Classified Data – Kruscal – Wallis Test. Nonparametric Tests – Sign, Wilcoxon Signed Rank, Wilcoxon Rank-Sum and Friedman Tests.
Unit IV **Regression and Correlation Methods** **10 Lectures**	General Concepts – Fitting Regression Lines: Method of Least Squares – Goodness of Fit - Inferences about Parameters from Regression Lines – Interval Estimation for Linear Regression. Fitting Quadratic and Exponential Functions - Correlation Coefficient – Simple, Partial and Multiple Correlation – Inference for Correlation Coefficients – Rank Correlation.

Unit V **Statistical Computation using R Programming** **10 Lectures**	Computation Of Probability – Permutations – Combinations – Data Visualization – Line Plot, Bar Plot, Pie Chart, Box Plot, Histogram, Scatter Plot – Descriptive Statistics – Sum, Mean, Median, Mode, Range, Standard Deviation, Variation, Coefficient Of Variation – Inferential Statistics Based On Z-Test, T-Test, F-Test, Chi-Square Test, ANOVA, Sign Test, Wilcoxon Signed Rank Test, Wilcoxon Rank Sum Test, Kruskal-Wallis Test and Friedman Test - Fitting of Linear Regression, Quadratic and Exponential Functions – Computation of Simple, Partial And Multiple Correlation and Regression Coefficients.
Unit VI (Co-scholastic Component) **Basic Notions of R Programming** **2 Lectures**	Introduction to R Programming – Features of R – Data Types: Vectors, List, Matrix, Array, Data Frame and Factors – Conditional Structures – Functions: Built-In and User Defined Functions – Data Management – R Packages.
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	L	L
CO2	S	S	M	L	L
CO3	S	S	M	L	M
CO4	S	S	M	L	L
CO5	S	S	S	M	M
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Rosner B (2016). Fundamentals of biostatistics, Cengage Learning, 8th edition.
2. Daniel WW and Cross CL (2013). Biostatistics: A foundation for analysis in the health sciences, John Wiley & Sons, 10th edition.

3. Zar JH (2010). Biostatistical analysis, Pearson, 5th edition.
4. Campbell RC (1967). Statistics for biologists, Cambridge University Press.
5. Lewis AE (1984). Biostatistics, Van Nostrand Reinhold.
6. Pagano M and Gauvreau K (2018). Principles of biostatistics, Chapman & Hall/CRC Press, 2nd edition.
7. Crawley MJ (2013). The R book, John Wiley & Sons, 2nd edition.

Related online contents:

1. https://nptel.ac.in/courses/102/106/102106051/
2. https://nptel.ac.in/courses/102/101/102101056/
3. https://cran.r-project.org
4. https://cran.r-project.org/doc/contrib/Seefeld_StatsRBio.pdf

Remarks:

1. The contents in Unit 6 shall be considered as Co-scholastic and there shall be no examination.

Course adapted from DBT curriculum and handled by Dept. of Statistics	**Dr. R. Muthukrishnan, Professor**

SEMESTER ONE

Biophysical Principles and Analytical Techniques

Credits 4

Marks 100

Course Code	26MB1C06	Course Type	Core 6	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	Basic principles of analytical techniques and instrumentation								

Course objectives:

1. Develop a strong foundation in the physical and chemical principles underlying biochemical processes.
2. Acquire knowledge of electromagnetic radiation and spectroscopic techniques for biomolecular analysis.
3. Gain expertise in hydrodynamic methods, radioisotopic techniques, and their applications in biochemical research.
4. Understand and apply advanced separation, identification, and molecular biology techniques.
5. Operate and evaluate modern microscopic, spectroscopic, and analytical instruments for biotechnology research.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Integrate principles of physical chemistry and biochemistry to understand biochemical processes at the molecular level-biochemical processes.	**K1, K2, K3 and K4**
CO2	Analyze electromagnetic radiation and apply spectroscopic techniques (UV-Vis, IR, NMR, ESR, fluorescence) to study biomolecules.	**K2, K4 and K6**
CO3	Demonstrate proficiency in hydrodynamic methods (centrifugation, sedimentation) and radioisotopic techniques for biochemical fractionation and reaction studies.	**K2, K4 and K6**
CO4	Apply and evaluate separation and identification techniques (electrophoresis, chromatography, crystallography, PCR, blotting, biosensors) in molecular biology and chemical biology.	**K2, K3, K4, K5 and K6**

CO5	Operate advanced microscopic and spectroscopic devices (optical tweezers, confocal microscopy, mass spectrometry) and design innovative instruments for biotechnology research.	**K4, K5 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I **Fundamentals of Solution Chemistry** **10 Lectures**	Units of measurement of solutes in solution: normality, molality, molarity, percentage solutions and parts-per units; water - structure and properties; complications of pH measurement - dependence of pH on ionic strength, relationship between pH and pOH, Henderson–Hasselbalch equation; buffer preparation; types of pH electrodes; principles of glass and reference electrodes; basic thermodynamics; theories of chemical reactions.
Unit II **Principles of Electromagnetic Radiation and Related Spectroscopic Techniques** **12 Lectures**	**Electromagnetic Radiation:** Energy, wavelength, wave number and frequency; Absorption and emission spectra, Beer-Lambert's law, light absorption and its transmittance; UV and visible spectrophotometry-principles, instrumentation and applications on enzyme assay and kinetic assays. **Spectrophotometry**: Protein structural studies, nucleic acid structural studies; Basic principles, instrumentation and applications of UV-visible, IR, fluorimetry; Basic principles, instrumentation and applications of ESR, NMR; Biochemical applications of fluorescence, emission, Fluorescence life-times, Anisotropy, time-resolved fluorescence methods and their applications, IR-Raman Spectroscopic applications in biology.
Unit III **Hydrodynamic Methods, Radioactivity and Radioisotopic Techniques** **10 Lectures**	**Hydrodynamic Methods:** Basic principles and types of centrifugation-rotors, boundary, differential, density gradient, zonal isopycnic centrifugation, equilibrium; Sedimentation - sedimentation velocity, preparative and analytical ultracentrifugation techniques: principles & applications in biochemical fractionation methods. **Radioisotopic Techniques:** Radioactivity, stable and radioactive isotopes, concepts of half-life and decay, principles of scintillation counting, GM counters, applications of isotopes, Application of radioactive isotopes in biochemical reaction mechanisms.

Unit IV **Electrophoresis, Chromatography, X-Ray Crystallography, Molecular and Chemical Biology** **10 Lectures**	**Electrophoresis:** Principles of electrophoretic separation, zonal and continuous electrophoresis, paper, cellulose acetate/nitrate, gel and capillary electrophoresis, use of native and denaturating gels, Protein subunit molecular weight determination using SDS-PAGE, Anomalous protein migration of some proteins in SDS-PAGE, Acid-urea PAGE and their physical basis, Isoelectric focusing and two dimensional gel electrophoresis, electroporation, pulse field gel electrophoresis, gradient gels. **Chromatography**: principles of adsorption, partition and ion-exchange chromatography, gel permeation chromatography, GC, GC-MS and HPLC; X-ray Crystallography-protein crystals, Bragg's law, Principles & applications; Basic protein structure prediction methods. **Polymerase Chain Reaction**; PCR types; Gel electrophoresis; DNA sequencing. **Molecular hybridization:** Southern blot; Northern blot. Protein analyses: Western blot & Immunoprecipitation; **Cytophotometry**: Flow Cytometry, FACS, MACS and Microarray; Circular dichroism and optical rotatory dispersion. **Rewriting DNA**: mutations; random mutagenesis; point mutation; Site-specific mutations. **Click-chemistry**: Principles & applications; Biosensors. Chemical sensors for in-cell biochemistry**.**
Unit V **Optical Tweezers, Optical Microscopy Methods, and Mass Spectroscopy** **10 Lectures**	**Single-molecule measurements:** Atomic Force microscopy, surface-enhanced Raman scattering, Near-field Microscopy- Principles & applications. Force measurements at single molecule to cell level using optical tweezers- Principles & applications. **Light Microscopy**: lenses and microscopes, resolution: Rayleigh's Approach, Darkfield; Phase Contrast; Differential Interference Contrast; fluorescence and fluorescence microscopy; Confocal microscope: confocal principle, resolution and point spread function; nonlinear microscopy: multiphoton microscopy; principles of two-photon fluorescence, advantages of two-photon excitation, tandem scanning (spinning disk) microscopes, deconvolving confocal

	images; image processing, three dimensional reconstruction; Total Internal reflection microscopy, STED microscopy. **Ionization techniques**: mass analyzers/overview MS; FT-ICR and Orbitrap, fragmentation of peptides; proteomics, nano LC-MS; Phospho proteomics; interaction proteomics, mass spectroscopy in structural biology; imaging mass spectrometry.
Unit VI **Contemporary issues**	Guest lectures by academic/industry experts, online seminars - webinars
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	L	L	M
CO2	S	S	S	L	M
CO3	S	S	M	M	M
CO4	S	S	S	L	M
CO5	S	S	M	L	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Skoog DA, Holler FJ and Crouch SR (2017). Principles of instrumental analysis, Cengage Learning, 7th edition.
2. Wilson K and Walker J (2018). Principles and techniques of biochemistry and molecular biology, Cambridge University Press, 7th edition.
3. Skoog DA, West DM, Holler FJ and Crouch SR (2014). Fundamentals of analytical chemistry, Cengage Learning, 10th edition.
4. Campbell I (2012). Biophysical techniques. Oxford University Press.
5. Lakowicz JR (2006). Principles of fluorescence spectroscopy, Springer, 3rd edition.
6. Green MR and Sambrook J (2012). Molecular cloning: A laboratory manual, Cold Spring Harbor Laboratory Press, 4th edition.

Related online contents:

1. https://onlinecourses.swayam2.ac.in/ugc19_bt16/preview

Course adapted from DBT curriculum and handled by Dept. of Biotechnology	**Dr. M. A. Shibu,** **Assistant Professor (DBT-RRF)**

SEMESTER ONE

Laboratory I:

Credits 4

Cell Biology and Analytical Techniques

Marks 100

Course Code	26MB1P01	Course Type	Practical-1	L	T	P	C	Syllabus version	2026-2027
				6	-	✓	4		
Pre-requisite	Basic Knowledge in Microscopy and Biochemistry								

Course objectives:

1. To obtain practical understanding of cell biology and its importance in human disease.
2. To provide an overview about morphological features of cells in context to healthy and diseased conditions.
3. To learn advanced microscopic technique, which includes live cell imaging, correlative light and electron microscopy, confocal microscopy and its underlying biophysical principles. To gain operational skills.
4. To understand biochemical principles by performing experiments.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Develop application knowledge to employ appropriate microscopes for studying complexities of disease biology.	**K2 and K4**
CO2	Demonstrate particle gun–mediated gene delivery, agroinfiltration for transient GFP expression, and RNA isolation from plant samples, and evaluate the quality of experimental results using appropriate analytical methods.	**K1 and K5**
CO3	Cultivate and identify microorganisms from skin samples, perform Gram staining and biochemical assays, and isolate anaerobic bacteria, thereby applying these techniques to microbial analysis and disease-related investigations.	**K5 and K6**
CO4	Quantify flavonoid content in fruits, determine free radical scavenging activity using the DPPH assay, and calculate stomatal index through microscopic analysis, thereby applying	**K2 and K6**

	these methods to evaluate plant physiology and biochemical traits.	
CO5	Demonstrate the ability to determine cellular osmosis in blood, culture mammalian cells to assess phagocytosis, and detect apoptosis using fluorescent staining methods, thereby applying these techniques to evaluate cell function and viability.	**K5 and K6**
CO6	Evaluate cellular morphology by enumerating nuclei using fluorescent staining, localize specific proteins through immunohistochemistry, and separate amino acids by thin layer chromatography, thereby applying these methods to study cellular structure and biochemical properties.	**K1 and K3**
CO7	Demonstrate the ability to prepare and validate buffer systems, assess catalase enzyme activity, and estimate antioxidant potential using the ABTS assay, thereby applying these methods to study biochemical properties and reactions.	**K1 and K2**
CO8	Perform and interpret laboratory techniques such as cell isolation and culture, chromosome visualization, and protease activity detection, applying these methods to genetic and disease-related investigations.	**K2, K3, K4 and K5**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Molecular Toxicology (Dr. P. Ekambaram)

1. Measurement of cell size by oculometer and stage micrometer.
2. Identification of Barr bodies from buccal smear.
3. Visualization of F-actin by Phalloidin staining.

Plant Genetic Engineering (Dr. R. Sathishkumar)

1. Particle gene gun mediated gene delivery of GFP in tobacco.
2. Transient expression of Green Fluorescence Protein (GFP) in tobacco by agroinfiltration and visualization using fluorescent microscope.
3. Isolation of total RNA from plant sample and checking its quality and quantity.

Molecular Microbiology (Dr. S. R. Prabagaran)

1. Cultivation of Bacteria, Actinomycetes, and Fungi from skin.
2. Bacterial staining (Gram Staining) and biochemical characterization (Citrate utilization).
3. Isolation of anaerobic bacteria from biological samples.

Plant Biotechnology (Dr. S. Girija)

1. Quantification of flavonoid content in the fruit sample.
2. Determination of free radical scavenging activity by DPPH assay.
3. Calculate the stomatal index using the bright field microscope.

Translational Genomics and Proteomics (Dr. V. Thirunavukkarasu)

1. Determination of cellular osmosis in animal blood.
2. Culture of HeLa/ J774 cells and determination of the extent of phagocytosis.
3. Detection of the extent of apoptosis in cultured cells using dual Acridine Orange/ Ethidium Bromide (AO/EB) fluorescent staining.

Reproductive Immunology and Molecular Pathology (Dr. S. Velayuthaprabhu)

1. Enumeration of number and morphology of nucleus in tissue using DAPI/PI staining.
2. Localization of specific protein in the tissue sample by Immunohistochemistry (IHC).
3. Titration of amino acids and separation of aliphatic, aromatic and polar amino acids by thin layer chromatography.

Plant Molecular Biology (Dr. M. Arun)

1. Preparation of Acetic-Na Acetate Buffer and validation of the Henderson-Hasselbach equation.
2. Assessment of catalase enzyme activity.
3. Estimation of antioxidant potential using ABTS assay.

Regenerative Engineering and Molecular Medicine (Dr. M.A. Shibu)

1. Isolation of peripheral blood mononuclear cells and lymphocyte culture.
2. Giemsa Staining Technique for Visualization of Metaphase Chromosomes.
3. Detection of Protease Activity by Gelatin Zymography.

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	M	L	M
CO2	S	S	M	M	M
CO3	S	S	M	S	M
CO4	S	S	M	L	M
CO5	S	S	S	M	M
CO6	S	S	S	M	M
CO7	S	S	M	M	M
CO8	S	S	S	M	M
***S-Strong; M-Medium; L-Low**					

Course adapted from DBT curriculum and handled by all faculty from Dept. of Biotechnology

SEMESTER ONE

Soft Skills and Business Communication Skills for Employability Training

Credits 2

Marks 50

Course Code	26MB1V01	Course Type	Value Added Course 1	L	T	P	C	Syllabus version	2026-2027
				2	✓	✓	2		
Pre-requisite	Basic Interest to Showcase their Biotechnology Knowledge in Interviews, Discussions and in Entrepreneurships								

Name of the Department	**Department of Biotechnology**
Name and Address of the Faculty Member	Dr. S. Girija Associate Professor Department of Biotechnology Bharathiar University
Inter / Intra Department Course	Intra Department
Duration of the Course	26 Hours
Eligibility	PG students of Biotechnology
Number of Candidates to be Admitted	35 (maximum number)
Mode of the Course	In person
Collaboration if any with Companies (if Yes, Full Address of the Company Address , Name of the Contact Person, Phone, e-mail etc.)	**Er. C. K. Arivazhagan** C. K. Eduventures Pvt Limited Kalverampalayam Coimbatore - 641046 Ph: 9842685547 arivazhagank1@yahoo.co.in
Job Opportunities: Research Laboratories, Pharmaceutical Companies, Knowledge Process Outsourcing Companies, Analytical Lab Equipment Service Companies	

Course objective

1. Develop interpersonal, communication, and professional skills required for enhanced employability.

2. Strengthen leadership, teamwork, decision-making, and business etiquette through experiential and activity-based learning

3. Build self-confidence, presentation, interview, and time management skills for successful professional and career development.

Expected Course outcome

On the successful completion of the course, students will be able to:		
CO1	Demonstrate soft skills and professional behaviour for personal and career development.	**K4**
CO2	Show ability to work effectively in teams and apply leadership, decision-making, business etiquette, and effective communication skills in academic and professional environments.	**K5**
CO3	Demonstrate confidence, public speaking, group discussion, and interpersonal communication skills for effective professional interaction.	**K6**
CO4	Understand and develop strategies to manage glossophobia.	**K6**
CO5	Prepare and deliver structured presentations tailored for job interviews	**K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Course content		
Unit 1	**Self-Analysis and Attitude-** Exploring the importance of Self and Hidden qualities, Effects of attitude in work environment**. Team Work and Conflict** Management. Qualities of a Team player, handling workplace conflicts**.**	**5 -- hours**
Unit 2	**Leadership and Decision Making and Business Etiquettes:** Qualities of a Leaders and the need for Leadership i**n** Organisations. Decision making to enhance professional excellence. Business etiquettes mentors participants on Workplace Behaviour and Healthy relations for Professional success.	**5 -- hours**
Unit 3	**Self Confidence and Self Esteem, Effective Business Communication:** Importance of Self Love and respecting self-leading to increased Self-confidence and making one a better communicator. Business Communication takes the participants through the need for	**6-- hours**

	Reading and Writing Skills to excel in Business and achieve organisational goals**.**	
Unit 4	**Public Speaking Skills, Group Discussion and Criteria to Stand out in GD's:** Overcoming fear of Public Speaking to become a good communicator/presenter. Group Discussions and their importance in Job selections.	**5 -- hours**
Unit 5	**Interview Skills and Time Management, Mock Interviews and Practice:** Getting ready for facing Interviews to Qualify for Job prospects. Importance of Time Management in Interviews.	**5 -- hours**
	Total	**26 Hours**
Book(s) for Study		
1	Student Work Book shall be provided	
Book(s) for reference		
1	Carnegie D (1936). How to Win Friends and Influence People, Simon and Schuster.	
Related Online Contents		
1	ALISON Courses	
2	Supportive topic-based videos shall be screened during the Training Session	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	L	S	M	M
CO2	M	S	S	M	M
CO3	L	M	S	M	S
CO4	M	S	S	M	M
CO5	M	S	S	M	S
***S-Strong; M-Medium; L-Low**					

Course adapted from DBT curriculum and handled by Dept. of Biotechnology	**Dr. S. Girija** **Associate Professor**

SEMESTER TWO

Developmental Biology and Physiology

Credits 4

Marks 100

Course Code	26MB1C07	Course Type	Core 7	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	Basic Understanding in Cell Development and Differentiation								

Course objectives:

1. To learn the basic overview of developmental biology and its key concepts.
2. To enable the students to learn the actual pathway of physiological metabolism of major invertebrates and vertebrates including humans.
3. To understand the mechanism behind functioning and maintenance of various living system

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Articulate the importance and key concepts of developmental biology.	**K1 and K2**
CO2	Analyze and explain the processes and mechanisms of early embryonic development—including fertilization, cleavage, blastula, gastrula, and neurula stages—in vertebrates (frog, chicken, mouse) and invertebrates (Drosophila melanogaster, sea urchin), applying this knowledge to comparative developmental biology.	**K2, K3 and K4**
CO3	Identify the molecular pathways controlling axis formation (anterior-posterior, dorsal-ventral and left-right axes) in amphibians (frog), mammals (mouse, humans) and fly (Drosophila) including the signalling molecules and key gene regulators.	**K3 and K4**
CO4	Understand how individual cellular and tissue components interest to maintain the body's internal balance (homeostasis) during stressors like environmental changes or disease and apply physiological principles to understand the pathogenesis of diseases.	**K1, K2, K3 and K4**

CO5	Comprehend the mechanical, physical and biochemical functions of major organ systems, including the cardiovascular, respiratory, nervous, endocrine, renal and reproductive systems.	**K2, K3 and K4**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze		

Unit I **Introduction to Developmental Biology** **10 Lectures**	Defining developmental biology. Structure and function of reproductive system: Male reproductive system, Female reproductive system. Production of gametes: Spermatogenesis, Oogenesis. Cell surface molecules in sperm - egg recognition in animals; zygote formation, cleavage, blastula formation, gastrulation and formation of germ layers in animals. Early developmental events in vertebrates.
Unit II **Basic Concepts of Development** **10 Lectures**	Overview of homeotic genes, axis formation in sea urchin, *C.elegans*, *D.melanogaster*, amphibians and mammals; formation of vulva in *C. elegans*; Embryonic fields, potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; genomic equivalence and the cytoplasmic determinants; imprinting. Role of epigenetics in development. Postembryonic development: metamorphosis, regeneration and aging; Developmental constraints on evolution. Developmental defects and disorders. Introduction to AI/ML in developmental biology.
Unit III **System Physiology: Digestion and Haematology** **10 Lectures**	Homeostasis, nutrition, structure and functions of digestive system. Physiology of digestion. Blood corpuscles, haemopoiesis, plasma function, blood volume, hemostasis. Comparative anatomy of heart structure, myogenic heart, ECG- its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.
Unit IV	Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Respiration and Excretion **10 Lectures**	Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, electrolyte balance and acid-base balance.
Unit V **Nervous System** **10 Lectures**	Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system. Types, structure and functions of muscles, Physiology of muscle contraction. Sense organs: vision, hearing and tactile response. Endocrine glands, basic mechanism of hormone action, hormone and diseases; Thermoregulation. Role of AI in physiology.
Unit VI **Contemporary issues** **2 Lectures**	Guest lectures by academic/industry experts, online seminars - webinars
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	L	S
CO2	S	S	S	L	S
CO3	S	M	S	L	S
CO4	S	M	S	L	S
CO5	S	M	S	L	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Barresi MJF and Gilbert SF (2023). Developmental Biology, Oxford University Press, 13th edition.

2. Hall JE and Hall ME (2025). Guyton and Hall Text book of Medical Physiology, Elsevier, 15th edition.
3. Carlson BM (2023). Human Embryology and Developmental Biology, Elsevier, 7th edition.
4. Tickle C, Arias AM, Placzek M and Wolpert L (2025). Wolpert's Principles of Development, Oxford University Press. 7th edition.
5. Rastogi SC (2019). Essentials of Animal Physiology, New Age International Publications, 4th edition.
6. Barrett KE, Barman SM, Brooks HL, Yuan J and Boitano S (2025). Ganong's Review of Medical Physiology, McGraw Hill Professional, 27th edition.

Related online contents:

1. https://nptel.ac.in/courses/102/106/102106084/
2. https://nptel.ac.in/courses/102/104/102104058/
3. https://onlinecourses.nptel.ac.in/noc20_bt35/preview
4. https://onlinecourses.swayam2.ac.in/cec20_bt19/preview
5. Luo M, Yang W, Bai L, et al. (2024). Artificial intelligence for life sciences: A comprehensive guide and future trends. The Innovation Life 2(4): 100105.
6. Villoutreix P (2021). What machine learning can do for developmental biology. Development, 48(1). https://doi.org/10.1242/dev.188474.
7. Chou YS and Cheng TL (2026). Artificial Intelligence in Physiology and Pathophysiology: A Tool for Mechanistic Insights and Translational Opportunities. Journal of Physiological Investigation, 69(2), 83–87. https://doi.org/10.4103/ejpi.EJPI-D-25-00057
8. Jacob, Ninan, Kumar BAA and Padodara R (2022). A Glimpse into Artificial Intelligence in Animal Physiology and Allied Sciences. Animal Reproduction Update. 2. 72-81.10.48165/aru.2022.2104.
9. Geaney A, O'Reilly P, Maxwell P et al. (2023). Translation of tissue-based artificial intelligence into clinical practice: from discovery to adoption. Oncogene 42, 3545–3555. https://doi.org/10.1038/s41388-023-02857-6

Course adapted from DBT curriculum and handled by Dept. of Biotechnology	**Dr. P. Ekambaram** **Professor**

SEMESTER TWO

Immunology

Credits 4

Marks 100

Course Code	26MB1C08	Course Type	Core 8	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	Basic Concepts in Immune System								

Course objectives:

1. Learn about structural features of components of immune system as well as their function.
2. Emphasis on development of immune system and mechanisms by which our body elicit the immune response.
3. Understand the imperative to think like an immunologist and predict about nature of immune response that develops against bacterial, viral or parasitic infection, and prove it by designing new experiments.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Evaluate the usefulness of immunology in different pharmaceutical companies.	**K1 and K2**
CO2	Acquire knowledge on antibodies and their commercial importance in diagnosis and treatment of human diseases.	**K1 and K2**
CO3	Apply their knowledge and design immunological experiments to demonstrate innate, humoral or cytotoxic T lymphocyte responses and figure out the kind of immune responses in the setting of infection (viral or bacterial) by looking at cytokine profile.	**K1 and K2**
CO4	Understand the importance of vaccine development and identify the proper research lab working in the area of vaccine production.	**K1 and K4**
CO5	Distinguish and characterize the CD4+ and other T helper cell lineages in the regulatory T cell.	**K1 and K2**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze		

Unit I **Immunology: Fundamental Concepts and Anatomy of the Immune System** **12 Lectures**	Components of innate and acquired immunity; Cells involved in the Immune response: Macrophages, B and T lymphocytes, Dendritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells. The lymphoid organs: Bone marrow, Spleen, lymph nodes, MALT. Haemopoiesis and differentiation, lymphocyte trafficking. Complement.
Unit II **Immune Responses Generated by B and T Cells** **14 Lectures**	Lymphocyte development and activation: The maturation of B and T lymphocytes. Differentiation of B and T cells into functionally and phenotypically distinct subpopulations. B cells development and maturation; Structure of TCR and its interaction with MHC-I and MHC-II peptide Complex - T cell selection. Organization of TCR gene segments and their rearrangement. B cell activation: T cell independent and T cell dependant mechanisms. Class switching. T cell development and maturation; Humoral immune responses. Major Histocompatibility Complex: MHC molecules and organization of their genes; Structure and function of MHC gene products. Antigen Presentation: Antigen processing; Role of MHC and non-MHC molecules in antigen presentation. T cell activation; Regulation of TH1 and TH2 subset differentiation. Activation T_H and T_C cells; Generation of T memory cells. Cell-mediated immune responses, ADCC; cytokines-properties, receptors and therapeutic uses
Unit III **Antigen-Antibody Interactions**	Antigens - immunogens, haptens; characteristics of antigen, adjuvants. Superantigens. The epitopes seen by B Cells and T Cells. Immunoglobulins-basic structure, classes &

14 Lectures	subclasses of immunoglobulins; multigene organization of immunoglobulin genes; Function of various classes of Immunoglobulins; Antibody-Antigen interactions; Immunization protocol; The various immunotechniques for detection and quantification of antigens/antibodies: Precipitation, agglutination and complement mediated immune reactions; advanced immunological techniques - RID, ODD, immunoelectrophoresis, rocket immunoelectrophoresis, RIA, ELISA, western blot, ELISPOT assay, flowcytometry, immunofluorescence and confocal microscopy. CMI techniques- lymphoproliferation assay, mixed lymphocyte reaction, HLA typing. Generation of antibody diversity. Antibody engineering: Hybridoma technique and monoclonal antibodies- Applications of monoclonal antibodies
Unit IV **Clinical Immunology** **14 Lectures**	Immunity to infection: bacteria, viral, fungal and parasitic infections (Tuberculosis, HIV/ AIDS, Schistosomiasis, Kala Azar, Chikungunya, Dengue); hypersensitivity reactions – Type I-IV; autoimmunity; types of autoimmune diseases; mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; transplantation – immunological basis of graft rejection; clinical transplantation and immunosuppressive therapy; tumor immunology – tumor antigens; immune response to tumors and tumor evasion of the immune system, cancer immunotherapy; immunodeficiency-primary immune deficiencies, acquired or secondary immune deficiencies, anaphylactic shock

Unit V **Vaccinology** **13 Lectures**	Active and passive immunization; live, killed, attenuated, subunit vaccines; vaccine technology- role and properties of adjuvants, recombinant DNA and protein based vaccines, reverse vaccinology; peptide vaccines, conjugate vaccines; antibody genes and antibody engineering- chimeric, hybrid monoclonal antibodies; catalytic antibodies and 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 and therapeutic vaccine; Success stories in vaccinology *e.g.* Hepatitis, Polio, Small pox, DPT.
Unit VI **Contemporary issues**	Guest lectures by academic/industry experts, online seminars - webinars
Total Lectures – 65	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	L	L	L
CO2	S	S	M	L	L
CO3	S	S	M	L	L
CO4	L	S	S	M	M
CO5	M	M	L	L	M
*S-Strong; M-Medium; L-Low					

Recommended Textbooks and References:

1. Parham P (2014). The Immune System. W. W. Norton & Company, 4th edition.
2. Aravind K (2013). Textbook of Immunology. The Energy and Resources Institute, TERI.
3. Abul KA, Andrew HL and Shiv P (2024). Basic Immunology Functions and Disorders of The Immune System. Elsevier, 7th Edition.
4. Jenni P, Sharon S, Patricia J and Judith AO (2018). Kuby Immunology. WH Freeman, 8th Edition.
5. Doan T (2024). Lippincott Illustrated Reviews Immunology. Lippincott Williams & Wilkins, 3rd Edition.
6. Peter JD, Seamus JM, Dennis RB and Ivan MR (2026). Roitt's Essential Immunology, Wiley Blackwell Science, 13th Edition.

Related online contents:

1. https://nptel.ac.in/courses/102/105/102105083/

2.https://www.coursera.org/specializations/immunology

Course adapted from DBT curriculum and handled by Dept. of Biotechnology	**Dr. S. Velayuthaprabhu** **Assistant Professor**

SEMESTER TWO

OMICS CONCEPTS AND DATA INTEGRATION

Credits 4

Marks 100

Course Code	26MB1C09	Course Type	Core 9	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	Basic Exposure in Bioinformatics, Molecular biology and Recombinant DNA technology								

Course objectives:

1. To learn the omics concepts and emerging technologies.
2. To learn how to, integrate large data sets, its challenges and its applications.
3. To impart working knowledge and to appreciate the global understanding of biological systems and its implications on human health and disease.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Apply high-throughput technologies and Systems Biology modelling strategies to investigate complex biological pathways.	**K1, K2 and K3**
CO2	Analyze genomic variations, non-coding sequences, and transcriptomic networks to decipher gene regulatory mechanisms.	**K2, K3 and K4**
CO3	Analyze proteomic and metabolomic expression profiles to map and interpret interconnected biochemical networks.	**K2, K3 and K4**
CO4	Evaluate emerging omics datasets using artificial intelligence methodologies for computer-aided drug discovery workflows.	**K3, K4 and K5**
CO5	Design integrated multi-omics pipelines and biological network models to discover clinical disease biomarkers.	**K5 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I **Introduction to Systems Biology** **10 Lectures**	Background, Overview of Systems Biology, Model Organisms, High throughput Technologies
Unit II **Genomics and Transcriptomics** **10 Lectures**	Interpreting expression data using Gene Ontology; Evolution of modularity and transcriptional networks, Riboswitches, metabolite sensing, and translational control; Microarrays-types, Data analysis and applications, Importance of non-coding sequence.
Unit III **Proteomics and Metabolomics** **10 Lectures**	Protein-carbohydrate metabolism; Biochemical cycles; Interconnection of pathways-metabolic regulation; Translating biochemical networks into linear algebra; KEGG: theory and practice.
Unit IV **Emerging OMICS** **10 Lectures**	Genomics, Proteomics, Metabolomics, Transcriptomics, Interactomics, Phenomics, Localizomics; Gene networks - Integration of Networks. Combination of omics approaches: data integration, modelling; Synthetic biology, Artificial Intelligence (AI): Methodology, tools, and its application in agriculture, drug discovery.
Unit V **Introduction to Multi-Omics Data Integration** **10 Lectures**	Concepts to Applications: Introduction to Multi-Omics, Importance of Integrating Multi-Omics Data in Biological Research, Challenges and Opportunities in Multi-Omics Data Integration, Types of Multi-Omics Data and Their Characteristics, Strategies for Data Normalization and Pre-processing in Multi-Omics Data Analysis, Tools and Software for Multi-Omics Data Integration, Introduction to Popular Tools for Multi-Omics Data Integration, Network Analysis in Multi-Omics Data: Introduction to Biological Networks (e.g., Gene Regulatory Networks, Protein-Protein Interaction Networks), Case Studies: Network Analysis in

	Disease Biomarker Discovery, Applications, Practical Challenges and Considerations.
Unit VI	
Contemporary issues **2 Lectures**	Guest lectures by academic/industry experts, online seminars – webinars
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	-	L
CO2	S	S	M	-	L
CO3	S	S	M	-	L
CO4	S	S	S	L	M
CO5	S	S	S	M	M
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Arivaradarajan P and Misra G (2018). Omics approaches, technologies and applications: Integrative approaches for understanding omics data, Springer.
2. Lesk AM (2017). Introduction to genomics, Oxford University Press.
3. Brown TA (2018). Genomes 4, Garland Science.
4. Campbell AM and Heyer LJ (2007). Discovering genomics, proteomics, and bioinformatics, Benjamin Cummings, 2nd edition.
5. Twyman RM (2013). Principles of proteomics, Garland Science/Taylor & Francis Group, 2nd edition.
6. Griffiths WJ (2008). Metabolomics, metabonomics and metabolite profiling, The Royal Society of Chemistry.
7. Fan TWM, Lane AM and Higashi RM (2012). The handbook of metabolomics, Springer.
8. Liebler DC (2002). Introduction to proteomics: Tools for the new biology, Humana Press.

9. Mount DW (2004). Bioinformatics: Sequence and genome analysis, Cold Spring Harbor Laboratory Press, 2nd edition.
10. Pandey A and Mann M (2000). Proteomics to study genes and genomes, Nature, 405(6788), 837–846.
11. Stoughton RB (2005). Applications of DNA microarrays in biology, Annual Review of Biochemistry, 74, 53–82.
12. Monti M, Orru S, Pagnozzi D and Pucci P (2005). Functional proteomics, Clinica Chimica Acta, 357(2), 140–150.
13. Han X, Aslanian A and Yates JR (2008). Mass spectrometry for proteomics, Current Opinion in Chemical Biology, 12(5), 483–490, 3rd edition.
14. Furey TS (2012). ChIP–seq and beyond: New and improved methodologies to detect and characterize protein–DNA interactions, Nature Reviews Genetics, 13(12), 840–852.
15. Metzker ML (2010). Sequencing technologies—the next generation, Nature Reviews Genetics, 11(1), 31–46.
16. Hendry JI, Dinh HV, Foster C, Gopalakrishnan S, Wang L and Maranas CD (2020). Metabolic flux analysis reaching genome-wide coverage: Lessons learned and future perspectives, Current Opinion in Chemical Engineering, 30, 17–25.
17. Pinu FR, Beale DJ, Paten AM, Kouremenos K, Swarup S, Schirra HJ and Wishart D (2019). Systems biology and multi-omics integration: Viewpoints from the metabolomics research community, Metabolites, 9(4), 76.
18. Kitano H (2001). Foundations of systems biology, MIT Press.

Related online contents:

1. https://omicstutorials.com/introduction-to-multi-omics-data-integration-from-concepts-to-applications/#google_vignette
2. NPTEL - Computational Systems Biology - Prof. Karthik Raman – IIT Madras - https://nptel.ac.in/courses/102/106/102106068/
3. NPTEL - Introduction to Proteogenomics - Prof. Sanjeeva Srivastava – IIT Bombay - https://nptel.ac.in/courses/102/101/102101076/
4. NPTEL - Applications of interactomics using Genomics and proteomics technologies - Prof. Sanjeeva Srivastava – IIT Bombay - https://nptel.ac.in/courses/102/101/102101072/

Course adapted from DBT curriculum and handled by Dept. of Biotechnology	**Dr. R. Sathishkumar** **Professor**

SEMESTER TWO

Bioinformatics

Credits 4

Marks 100

Course Code	26MB1C10	Course Type	Core 10	L	T	P	C	Syllabus version	2026-2027
				4	✓	✓	4		
Pre-requisite	Basic Knowledge in Biology								

Course objectives:

1. Make the students understand the both theory and practical aspects of Bioinformatics.
2. Know the computational methods for Sequence Alignment, Multiple Sequence alignment and Evolutionary analysis.
3. Understand the steps in Protein modelling and structure prediction
4. Genome sequencing technologies and analysis methods

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Gain working knowledge of these computational tools and methods	**K1**
CO2	Develop an understanding of the basic theory of these computational tools	**K2**
CO3	Interpret the algorithms, scoring functions involved in the sequence alignment.	**K3**
CO4	Evaluate the phylogenetic relationship of an organism from sequences using bioinformatics tools.	**K4**
CO5	Model 2D and 3D structure of a target from the sequence.	**K5**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate		

Unit I **Bioinformatics Basics** **12 Lectures**	Bioinformatics basics: Computers in biology and medicine; Importance of Unix and Linux systems and its basic commands; Database concepts; Protein and nucleic acid databases; Structural databases; databases and search tools: biological background for sequence analysis; Identification of protein sequence from DNA sequence; searching of databases for similar sequences; NCBI; publicly available tools; resources at EBI; resources on the web; database mining tools.
Unit II **DNA Sequence Analysis** **12 Lectures**	DNA sequence analysis: gene bank sequence database; submitting DNA sequences to databases and database searching; sequence alignment; pairwise alignment techniques; motif discovery and gene prediction; local structural variants of DNA, their relevance in molecular level processes, and their identification; assembly of data from genome sequencing - Multiple sequence alignment; similarity searching with the FASTA3 programme package; use of CLUSTAL W and CLUSTAL X for multiple sequence alignment; methods of phylogenetic analysis
Unit III **Protein Modelling** **13 Lectures**	Protein modelling: introduction; force field methods; energy, buried and exposed residues; side chains and neighbours; fixed regions; hydrogen bonds; mapping properties onto surfaces; fitting monomers; RMS fit of conformers; assigning secondary structures; sequence alignment- methods, evaluation, scoring; protein completion: backbone construction and side chain addition; small peptide methodology; software accessibility; building peptides; protein displays; substructure manipulations, annealing
Unit IV	Protein structure prediction: protein folding and model generation; secondary structure prediction; Chou-Fasman, GOR method, Neural Network; analyzing

Protein Structure Prediction and Docking **14 Lectures**	secondary structures; homology modelling: potential applications, description, methodology, homologous sequence identification; align structures, align model sequence; Threading and Fold recognition; RAPTOR; Validation of the Model; Ramachandran Plot; PROCHECK; Elements of *in-silico* drug design; Virtual library; AutoDock; Drug-receptor interaction. Pymol, Rasmol viewer
Unit V **Genome Analysis** **14 Lectures**	Genome Projects; Genome sequencing technologies and analysis methods; Microarrays; Next Generation Sequencing; Next Generation Sequencing technologies; Analysis of gene expression data; Function, gene set enrichment and pathway analysis; BiNGO and DAVID tools.
Unit VI **Contemporary issues**	Guest lectures by academic/industry experts , online seminars - webinars
Total Lectures – 65	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	L	M
CO2	S	M	L	L	M
CO3	S	S	M	L	M
CO4	S	S	M	M	M
CO5	S	S	M	M	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Lesk AM (2002). Introduction to bioinformatics, Oxford University Press.
2. Mount DW (2001). Bioinformatics: Sequence and genome analysis, Cold Spring Harbor Laboratory Press.
3. Bourne PE and Gu J (2009). Structural bioinformatics, Wiley-Liss.

4. Leach AR (2001). Molecular modeling: Principles and applications, Pearson Education.
5. Lesk AM (2004). Introduction to protein science: Architecture, function, and genomics, Oxford University Press.
6. Brown TA (2001). Genomes, Taylor & Francis Group.
7. Zvelebil MJ and Baum JO (2007). Understanding bioinformatics, Garland Science.
8. Baxevanis AD and Ouellette BFF (1998). Bioinformatics: A practical guide to the analysis of genes and proteins, Wiley.
9. Strømgaard K, Krogsgaard-Larsen P and Madsen U (2009). Textbook of drug design and discovery, CRC Press.
10. Gibbons A (1998). Comparative genomics, Science, 281(5382), 1437–1438.

Related online contents:

1. SWAYAM - Bio-Informatics: Algorithms and Applications- Prof. M. Michael Gromiha – IIT Madras.
2. https://nptel.ac.in/courses/102/103/102103044/

Course adapted from DBT curriculum and handled by Dept. of Bioinformatics	**Dr. N. Jeyakumar** **Professor**

SEMESTER TWO

Molecular Diagnostics and Clinical Testing

Credits 4

Marks 100

Course Code	26MB1C11	Course Type	Core 11	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	Basic Knowledge in Diagnostics								

Course objectives:

1. Understand the vantages of molecular diagnostics in precision diagnosis and learn about state-of-the-art techniques that are used in clinical diagnosis of diseases.
2. Develop skills by understanding technical details of the assays to be applied for developing novel tests for improved diagnosis.
3. Learn about existing examples which promotes critical thinking that can help in developing tests. Comprehensive knowledge about ethical and regulatory aspects of handling and conducting tests in clinical samples.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Understand disease types and their diagnosis. Obtain knowledge about ethical and regulatory aspects of conducting diagnostic tests.	**K3**
CO2	Apply technical knowledge of various diagnostic methods to design and develop new clinical tests, thereby bridging theoretical concepts with practical applications in medical diagnostics.	**K4**
CO3	Show comprehensive knowledge about various biotechnological investigations used to monitor molecular-level changes, and will understand the uniqueness and limitations of biological assays, analyzing and applying them to the development of clinical tests.	**K5**
CO4	Develop skills to interpret the results of molecular techniques when performing them practically.	**K6**

CO5	Know about how important diseases are diagnosed using molecular diagnostic methods. Learn practical applications of precision diagnostics in disease management.	**K4**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I **Introduction to Molecular Diagnostics** **10 Lectures**	Definition - History – Diseases- infectious, physiological and metabolic errors, and inherited diseases. Biomarkers- types, potential uses and limitations. Diagnostics – types and importance in clinical decision making. Benefits of molecular diagnostics over conventional diagnostics. Ethical issues related to molecular diagnostics. Clinical specimens: National and International guidelines for Sample collection- method of collection, transport and processing of samples, Personal safety and laboratory safety. GLP for handling highly infectious disease samples and documentation.
Unit II **DNA Based Molecular Techniques for Diagnosis** **10 Lectures**	PCR based assays: Real-time PCR, ARMS, allele specific, multiplex, methylation analysis, MLPA, single-stranded conformational polymorphism analysis, heteroduplex analysis, competitive oligonucleotide priming, DHPLC, DGGE, CSCE. Mutation screening panels (xTAG, Luminex) Micro arrays: SNP chromosomal microarrays, EST, SAGE, Nanostring gene expression analysis.
Unit III **Proteomic and Metabolomics Assays for Diagnostics** **10 Lectures**	Diagnostic proteomics: SELDI-TOF MS; LC-MS, MALDI-TOF, Isotope coated affinity tag (ICAT), SILAC, i-TRAQ, Protein microarray, Lateral flow devices. Metabolite profile for biomarker detection in the body fluids/tissues under various metabolic disorders by making use of LCMS & NMR technological platforms.
Unit IV	Major Histocompatibility Complex (MHC), HLA typing- RFLP, PCR based methods: SSO, SSP and SBT

Applications of Molecular Diagnostics **10 Lectures**	methods. Role of Molecular diagnostics in bone marrow transplantation and organ transplantation. Bone marrow transplant engraftment analysis. Diagnosis of inherited diseases- Thalassemia, Cystic Fibrosis. Neonatal and Prenatal disease diagnostics- Prenatal and pre-implantation diagnosis. Non-invasive: Triple test, Ultrasonography (USG), Invasive: Amniocentesis (AC), chorionic villi sampling. Molecular diagnosis for early detection of cerebral palsy, Down syndrome. Fragile X syndrome.
Unit V **Applications In Molecular Oncology and Microbial Diseases** **8 Lectures**	Molecular oncology testing in malignant disease- Acute and Chronic leukemias, Melanoma, colon, lung and breast cancers. Circulating tumour cell testing (CTC). Molecular diagnosis of various viral diseases: Dengue, Chikungunya and SARS. Direct detection & 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- 16s rRNA typing.
Unit VI **Molecular Therapeutics** **4 Lectures**	Gene therapy; Intracellular barriers to gene delivery; Overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome and nanoparticles mediated gene delivery; Clinical applications of recombinant technology; Erythropoietin; Insulin analogs and its role in diabetes; Recombinant human growth hormone; Streptokinase and urokinase in thrombosis; Recombinant coagulation factors; Immunotherapy; Monoclonal antibodies and their role in cancer; Role of recombinant interferons; Immunostimulants; Immunosupressors in organ transplants; Role of cytokine therapy in cancers; Types of recombinant vaccines and clinical applications; Gene silencing technology; Antisense therapy; siRNA.

Total Lectures – 52

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	L	S	S
CO2	S	S	L	M	M
CO3	M	S	M	M	M
CO4	M	S	M	S	S
CO5	S	S	S	S	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Burtis C, Ashwood E and Bruns D (2012). Tietz textbook of clinical chemistry and molecular diagnostics, Elsevier, 5th edition.
2. Wilson, K and Walker J (2010). Principles and techniques of biochemistry and molecular biology, Cambridge University Press.
3. Buckingham L and Flaws ML (2011). Molecular diagnostics: Fundamentals, methods and clinical applications, F. A. Davis Company.
4. Harmening DM (2018). Modern blood banking & transfusion practices. F. A. Davis Company.
5. Bruns DE, Ashwood ER and Burtis CA (2007). Fundamentals of molecular diagnostics, Elsevier.

Related online contents:

1. Biomolecules: Structure, function in Health and Disease-CEC
2. Fabrication Techniques for MEMs-based sensors : clinical perspective- NPTEL
3. Economics of Health and Healthcare- NPTEL

Course adapted from DBT and handled by Dept. of Biotechnology	**Dr. V. Thirunavukkarasu** **Associate Professor**

SEMESTER TWO

Plant Molecular Pharming

Credits 2

Marks 50

Course Code	26MB1E1A	Course Type	Elective 1	L	T	P	C	Syllabus version	2026-2027
				2	✓	-	2		
Pre-requisite	Basic Understanding of Plant Systems								

Course objectives:

1. To impart fundamental knowledge of plant molecular pharming and its applications.
2. To enable students to understand the techniques involved in the production of plant-derived recombinant proteins.
3. To familiarize students with the advantages and limitations of plant-based recombinant protein production systems.
4. To provide knowledge of biosafety, regulatory aspects, ethical issues, and public acceptance related to plant molecular pharming.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Understand the principles of plant tissue culture, plant transformation, and gene delivery methods employed in plant molecular pharming.	**K2 and K3**
CO2	Explain the host systems, production strategies, and downstream processing techniques involved in the production of plant-derived recombinant therapeutic proteins.	**K1, K2 and K3**
CO3	Analyze different plant-based expression technologies and their applications in the production of pharmaceutical proteins.	**K2, K4 and K6**
CO4	Evaluate the production and applications of plant-expressed biopharmaceuticals, edible vaccines, and other plant-derived biologics.	**K2, K4 and K5**

CO5	Analyze the biosafety, ethical, regulatory, and public acceptance aspects associated with plant molecular pharming.	**K2, K4 and K5**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I

Plant Tissue Culture and Methods of Gene Delivery into Plant Cells

10 Lectures

Totipotency. Plant tissue culture media and hormones. Regeneration system – Direct organogenesis, Indirect organogenesis and somatic embryogenesis. Plant Transformation: Stable and transient expression system. Indirect DNA delivery method - *Agrobacterium* mediated transformation. Direct DNA delivery method - particle bombardment. Agroinfiltration technique and its advantages.

Unit II

Host Plants and Downstream Processing

10 Lectures

Host plants – Tobacco, Cereals and legumes, Fruit and vegetables. Strategies for improving expression technology. Downstream processing of plant-derived recombinant therapeutic proteins. Novel downstream strategies – Rhizosecretion, Guttation, Oleosin fusion technology.

Unit III

Production Technologies

10 Lectures

Production of pharmaceutical proteins in plants, suspension and root cultures. Chloroplast expression system. Monocot expression systems for molecular farming. Efficient and reliable production of pharmaceuticals in alfalfa. Novel sprouting technology for recombinant protein production.

Unit IV

Pharmaceuticals

10 Lectures

Plant expressed biopharmaceuticals and edible vaccines. Production of secretory IgA in transgenic plants. Production of active human glucocerebrosidase in carrot cells. Plant biologics and case studies.

Unit V **Biosafety Aspects, Regulations and Public Acceptance** **10 Lectures**	Biosafety aspects of molecular farming in plants - Ethical issues and regulations. Public acceptance towards molecular pharming. Advantages and limitations of using plant systems for recombinant protein production.
Unit VI **Contemporary issues** **2 Lectures**	Guest lectures by academic/industry experts. Online seminars – webinars.
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	L	L	M
CO2	S	S	M	L	M
CO3	S	S	M	M	M
CO4	M	S	M	S	M
CO5	M	M	M	S	S
*S-Strong; M-Medium; L-Low					

Recommended Textbooks and References:

1. Kimmo K (2004). Novel Sprouting Technology for Recombinant Protein Production, Wiley, ISBN: 9783527307869.
2. Abrahamian P, Hammond RW and Hammond J (2020). Plant virus–derived vectors: Applications in agricultural and medical biotechnology, Annu Rev Virol, 2020;7:1-25.
3. Reng Q, Gang T and Qike L (2009) Transient gene expression mediated by agroinfiltration and its application, Mol Plant Breed.
4. Fischer R, Vaquero-Martin C, Sack M, Drossard J, Emans N and Commandeur U (1999). Towards molecular farming in the future: transient protein expression in plants. Biotechnol Appl Biochem, 30(2):113-116.
5. Schiermeyer A, Dorfmuller S and Schinkel H (2004) Production of

pharmaceutical proteins in plants and plant cell suspension cultures. In: Molecular Farming, Wiley, ISBN: 9783527307869.

6. Yagi Y and Shiina T (2014). Recent advances in the study of chloroplast gene expression and its evolution. Front Plant Sci, 5:61.
7. Chargelegue D, Drake PM, Obregon P and Ma JKC (2004). Production of secretory IgA in transgenic plants. In: Molecular Farming: Plant-Made Pharmaceuticals and Technical Proteins, Wiley, 159-169. ISBN: 9783527307869.
8. Twyman RM (2004). Host plants, systems, and expression strategies for molecular farming, In: Molecular Farming, Wiley,191-216. ISBN: 9783527307869.
9. Ahmad K (2014). Molecular farming: strategies, expression systems, and bio-safety considerations, Czech J Genet Plant Breed, 50(1):1-10.
10. Sharma R and Sathishkumar R (2017). Rapid production of therapeutic proteins using plant systems, Defence Life Sci J., 2(2):95-102.
11. Drossard J (2004). Downstream processing of plant-derived recombinant therapeutic proteins. In: Molecular Farming, Wiley, 217-231. ISBN: 9783527307869.

Related online contents:

1. NPTEL - Downstream Processing - Prof. Mukesh Doble – IIT Madras
2. NPTEL - Plant Biotechnology - Dr. Rakhi Chaturvedi – IIT Guwahati
3. NPTEL - Organic Farming for Sustainable Agricultural Production - Prof. Dilip Kumar Swain – IIT Kharagpur

Course adapted from DBT and handled by Dept. of Biotechnology	**Dr. M. Arun** **Assistant Professor**

SEMESTER TWO

Indian Systems of Medicine

Credits 2

Marks 50

Course Code	26MB1E1B	Course Type	Elective1B	L	T	P	C	Syllabus version	2026-2027
				2	✓	-	2		
Pre-requisite	Basic Knowledge on Traditional Medicines								

Course objectives:

1. To introduce students to the fundamental principles and practices of various Indian Systems of Medicine (ISM).
2. To provide knowledge of pharmacognosy, phytochemistry, and pharmacological mechanisms underlying ISM formulations and their therapeutic roles.
3. To familiarize students with Good Manufacturing Practices (GMP), documentation standards, and industrial requirements for ISM drug development.
4. To develop understanding of quality control, quality assurance, and regulatory frameworks governing ISM products in India and globally.
5. To cultivate skills in scientific validation of ISM practices through experimental, clinical, and evidence-based approaches.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Demonstrate understanding of fundamental concepts, dosage forms, and formulation guidelines across major Indian Systems of Medicine.	**K1 and K2**
CO2	Analyze the pharmacological actions, molecular targets, and active phytochemicals present in ISM products, and apply the knowledge of pharmacognosy for therapeutic applications.	**K2 and K3**
CO3	Apply knowledge of GMP, GLP, and documentation processes in the preparation and evaluation of ISM formulations for industrial and regulatory compliance.	**K2, K3 and K4**
CO4	Evaluate ISM formulations using quality assurance techniques, regulatory standards, and stability studies to ensure safety and efficacy	**K2, K3, K4 and K5**

CO5	Critically assess traditional claims of ISM through scientific validation, case studies, and evidence-based medicine approaches.	**K4, K5 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I

Introduction to Various Indian Systems of Medicine

10 Lectures

Fundamental concepts of Ayurveda, Siddha, Unani, Homoeopathy, Naturopathy, Yoga, Sowa-Rigpa, and Tribal Medicine. Different dosage forms, their merits and demerits. General guidelines for ISM drug development. Important class of formulations as per Ayurveda, Siddha, Homeopathy, and Unani Pharmacopoeia. Standardization and problems in standardization of ISM.

Unit II

Pharmacognosy and Phytochemistry of ISM products

10 Lectures

Pharmacological action and mechanism: Anti-inflammatory, antioxidant, immunomodulatory mechanisms, Role in Metabolic disorders. Molecular targets (cytokines, GPCRs, PRRs, transcription factors) and active principles (Cardiac glycosides, phytoestrogens, antioxidants, Anticancer phytochemicals, Adaptogens, phytoalexins, laxatives) of ISM products. Analysis of formulations and bio-crude drugs with references to Identity, purity, and quality. Shelf life and Stability studies of ISM formulations. Pharmacokinetics in traditional formulations.

Unit III

Good Manufacturing Practice, Industrial requirements &Drug documentation

10 Lectures

Components of GMP (schedule T), GAP, GLP, and its objectives. Infrastructural Requirements: working space, storage area, machinery and equipment, standard operating procedures, health and hygiene, documentation, and records. Preparation of documents for new drug application and export registration.

Unit IV **Quality Control, Quality Assurance, and Regulatory Aspects** **10 Lectures**	Quality assurance and control in ISM formulation industry. Regulatory aspects: Drugs and Cosmetics Act, State Licensing Authorities, Central Drugs Standards Control organization (CDSCO), National/Regional Pharmacopoeias, Role of Ministry of AYUSH in regulation and Research. quality. Shelf life and Stability studies of ISM formulations.
Unit V **Scientific validations of ISM** **10 Lectures**	Evidence based Medicine vs traditional claims: Scientific evidence validating different products and practices of the Indian system of medicine. Experimental Validation: in vitro, in vivo, clinical trials. Safety pharmacology and toxicity studies. Case-studies with suitable examples (*Withania somnifera*, *Curcuma longa*, *Azadirachta indica*).
Unit VI **Contemporary issues** **2 Lectures**	Guest lectures by academic/industry experts, online seminars – webinars
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	L	L	M
CO2	S	S	M	L	L
CO3	M	S	S	M	L
CO4	M	M	S	S	L
CO5	S	M	S	M	S
*S-Strong; M-Medium; L-Low					

Recommended Textbooks and References:

1. Government of India. (n.d.). Ayurvedic pharmacopoeia. The Controller of Publications.
2. Panda H (2005). Handbook on Ayurvedic medicines, National Institute of Industrial Research.
3. Mukherjee PK (2003). GMP for botanicals: Regulatory and quality issues on phytomedicine, Business Horizons.
4. Indian Medicines and Cosmetics Public Sector. (n.d.). Homeopathic pharmacopoeia: Formulary of homeopathic medicines. IMCOPS
5. Odoh UE, Shailendra Sg and Michael OC (2025). Pharmacognosy and phytochemistry: Principles, techniques, and clinical applications, John Wiley & Sons.

.

Related online contents:

1. https://www.ayush.gov.in/docs/guideline-drug-development.pdf

Course adapted from DBT and handled by Dept. of Biotechnology	**Dr. M. A. Shibu** **Assistant Professor (DBT-RRF)**

SEMESTER TWO

Laboratory II:
Immunotechnology and Molecular Diagnostics

Credits 4

Marks 100

Course Code	26MB1P02	Course Type	Practical 2	L	T	P	C	Syllabus version	2026-2027
				6	-	✓	4		
Pre-requisite	Basic Knowledge in Immunology, Microbiology and Molecular Biology								

Course objectives:

1. Develop an understanding the practical aspects of components of immune system as well as their function.
2. Familiarize the students with basic as well as advanced methods to detect different antigen and antibody interactions. Provide hands-on for isolation of different lymphocyte cells etc. and analysis.
3. Provide the students with practical skills on basic microbiological and genetic engineering techniques

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Demonstrate the ability to isolate and quantify DNA from animal tissue, perform haematological investigations including RBC/WBC counts and differential leucocyte analysis, and handle small laboratory animals (mice and rats) responsibly, thereby applying core techniques in molecular biology, physiology, and animal experimentation	**K2, K3, K4, K5 and K6**
CO2	Acquire knowledge of gateway cloning technology, apply affinity chromatography and SDS-PAGE for recombinant protein purification and analysis, and validate protein identity through immunoblotting with chromogenic substrates.	**K2, K3, K4, K5 and K6**
CO3	Perform genomic DNA using the CTAB method, perform antibiotic sensitivity testing through the Kirby–Bauer technique, and evaluate bacterial diversity using ARDRA,	**K2, K3, K4, K5 and K6**

	thereby applying molecular and microbiological approaches to study genetic material and microbial populations	
CO4	Carry out *Agrobacterium tumefaciens*-mediated transformation, screening secondary metabolites from medicinal plants, and assessing antimicrobial activity of plant extracts.	**K2, K3, K4, K5 and K6**
CO5	Apply advanced molecular and cellular biology techniques by isolating and quantifying total RNA for cDNA preparation and SNP detection using allelic PCR, identify genetic aberrations in cancer patient samples through next-generation sequencing and detect specific cellular proteins via Western blotting.	**K2, K3, K4, K5 and K6**
CO6	Gain hands-on expertise in isolating and quantifying plasmid DNA, performing restriction digestion of plasmid vectors, and optimizing DNA ligation, thereby applying core molecular cloning techniques for genetic engineering applications	**K2, K3, K4, K5 and K6**
CO7	Apply biochemical and immunological techniques for clinical diagnostics by performing biomarker detection in body fluids, estimate blood bilirubin through biochemical colorimetric assays, and purifying IgG antibodies from serum.	**K2, K3, K4, K5 and K6**
CO8	Apply immunological and molecular techniques in determining antigen concentration through rocket immunoelectrophoresis, isolating mitochondrial DNA from mammalian cells, and designing primers for gene expression analysis using RT-PCR	**K2, K3, K4, K5 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Molecular Toxicology (Dr. P. Ekambaram)

1. Determination of Acetylcholinesterase (AChE) activity in Zebrafish.
2. Haematology: RBC and WBC total counts, and leucocyte differential count.
3. Handling of small animals – Mice and Rat.

Plant Genetic Engineering (Dr. R. Sathishkumar)

1. Demonstration of gateway cloning technology.
2. Purification of a recombinant protein using Affinity Chromatography and analysis by SDS-PAGE.
3. Confirmation of recombinant protein by immunoblotting technique using chromogenic substrate (Demo).

Molecular Microbiology Laboratory (Dr. S. R. Prabagaran)

1. Isolation of genomic DNA by CTAB method.
2. Antibiotic sensitivity test by Kirby-Bauer method.
3. Bacterial diversity analysis through ARDRA.

Plant Biotechnology (Dr. S. Girija)

1. Expression of the gene of interest using *Agrobacterium tumefaciens-mediated* Transformation.
2. Screening of secondary metabolites from medicinal plants.
3. Analysis of antimicrobial activity of medicinal plant extract using the Kirby-Bauer disk diffusion method.

Translational Genomics and Proteomics (Dr. V. Thirunavukkarasu)

1. Isolation and quantification of total RNA using Spectrophotometer for cDNA preparation and Single Nucleotide Polymorphism (SNP) detection using allelic PCR.
2. Determination of recognized genetic aberrations in cancer patient samples using next-generation sequencing (NGS) and detail a test-case using web-tutorials and online content- Lecture Demonstration.
3. Detection of a specific cellular protein using Immunoblotting (Western Blotting) - Enhanced chemiluminescence (ECL) method.

Reproductive Immunology and Molecular Pathology (Dr. S. Velayuthaprabhu)

1. Biomarker detection in Body fluids: Detection of C reactive protein (CRP) using agglutination methods.
2. Biomarker detection in Body fluids: Estimation of Blood Bilirubin by biochemical colorimetric method.
3. Isolation and purification of IgG antibody from serum using Protein G column.

Plant Molecular Biology (Dr. M. Arun)

1. Isolation of plasmid DNA and quantification using UV-Visible spectrophotometer and nano-drop.
2. Restriction digestion of plasmid vectors.
3. Optimization of DNA ligation.

Regenerative Engineering and Molecular Medicine (Dr. M.A. Shibu)

1. Determination of antigen concentration by Rocket immunoelectrophoresis.
2. Mitochondrial DNA Isolation from mammalian cells.
3. Primer designing and gene expression analysis by RT-PCR.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	M
CO2	S	S	M	M	M
CO3	S	S	M	M	M
CO4	S	S	M	M	M
CO5	S	S	M	M	M
CO6	S	S	M	M	M
CO7	S	S	M	S	M
CO8	S	S	M	M	M
***S-Strong; M-Medium; L-Low**					

Course adapted from DBT curriculum and handled by all faculty from Dept. of Biotechnology

SEMESTER TWO

SAS Programming for Clinical Trials Management

Credits 4

Marks 100

Course Code	26MB1J01	Course Type	Job Oriented Certificate Course 1	L	T	P	C	Syllabus version	2026-27
				2	✓	-	2		

Name of the Department	**Biotechnology**
Name and Address of the Faculty Member	**Dr. V. Thirunavukkarasu** Associate Professor Dept. of Biotechnology Bharathiar University
Eligibility	PG students of Medical Biotechnology
Mode of the Course	Hybrid
Collaboration if any with Companies (if Yes, Full Address of the Company Address , Name of the Contact Person)	**Mr. Nishanth Nalan** Practice Head, Life Sciences (India) ACL Digital, ESPEE IT Park, 1st & 2nd Floor, No. 5, Jawaharlal Nehru Road, Ekkatuthangal, Chennai, Tamil Nadu 600032 Office: +91 44 4595 9208 I Mobile: +91 8402 53443 I E: nishanth.n@acldigital.com Website: https://www.acldigital.com/industries/life-sciences LinkedIn: https://www.linkedin.com/in/nishanthnalan
Registration Procedure	Through department office (offline/online)

Job Opportunities: Contract Research Organisations and Research and Development of Pharmaceutical Industries

Course objectives:

1. To gain basic knowledge about drug discovery
2. Understand the workflow of clinical trials and importance of management of clinical data and interpretation.
3. Gain basic knowledge of SAS programming
4. Acquire knowledge about applying SAS programming for CT management
5. Understand CDISC SDTM and ADaM rules for data standardization

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Demonstrate in-depth learning about work flow of new drug discovery	**K1 and K2**
CO2	Recognise the importance of clinical research in drug discovery	**K2 and K4**
CO3	Apply SAS programming for clinical trial data management	**K2 and K4**
CO4	Apply SAS to model clinical data and interpret datasets for clinical research and drug development applications	**K3 and K4,**
CO5	Perform data standardization and evaluate its application in clinical trials	**K2 and K5**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Course Content	Lecture / Practical / Internship
Module 1 **3 hours**	Drug development process. History of Drug Development. Types of drugs. Target identification. Drug Discovery – New entities (Chemical, Biological). In Vitro and In vivo studies. Nonclinical studies and IND. Basics of pharmacokinetics and pharmacodynamics
Module 2 **2 hours**	Clinical trials – Terminology, 4 phases and Documentation (SOPs, Protocols and SAPs. CRFs and Annotated CRFs. NDA, BLA). Cross functional teams and roles in clinical trials.
Module 3 **3 hours**	Introduction to SAS. Libraries and Datasets, Variables and Observations. Types of data - raw vs. sas data; numeric vs. character. sas files -. sas, .sas7bdat, .log, .lst. SAS program structure - Data and Proc steps, Keywords, Statements, Global

	statements. Syntax rules - dataset and variable names and their attributes, semicolon and comments. SAS dates and Global Options
Module 4 **3 hours**	Data step iterative processing. Compilation and execution. Informats and formats. Dataset combining - set and merge. Read and write data. Conditional execution of statements - If-Then-Else. Do loop processing Array processing. SAS functions - character, numeric and date. Assignment, Retain, Sum, Output and Global statements. Automatic variables.
Module 5 **3 hours**	Basic SAS procedures. General - Contents, Sort, Print, Format, Transpose, Import, Export, Compare. Statistical - Freq, Means. Reporting - Report. Graph - Gplot, Gchart. Where, Var, Id and Class Statements. Output Delivery System - Trace, Output, RTF, EXCEL. Debugging SAS programs. Compilation and Execution errors. Data, Syntax and Logic errors.
Module 6 **2 hours**	Macro programming. Advantages of Macro programming. Macro variables - Global and local. Macro routines and macro code. Keyword and positional parameters. Macro debugging. Writing macros with conditional logic. Methods of creating macro variables.
Module 7 **2 hours**	Proc SQL. Creating and modifying datasets. labels and formats. Combining data using union and join statements. Case expression. Sorting - Order by clause. Except and Intersect statements. Separated by and having clauses.
Module 8 **3 hours**	CDISC Standards. Purpose of SDTM and ADaM datasets. SDTM – Introduction, Fundamentals, submitting standard data, Assumptions for domain models, Special purpose domains, General observation classes, Trial design datasets, Representing relationships.
Module 9 **2 hours**	ADaM – Introduction, Fundamentals, Standard ADaM variables – Conventions, Analysis Dataset – Subject Level (ADSL), Basic data structure (BDS) datasets; Occurrence data structures. Common implementation issues and solutions

Module 10 **3 hours**	SAS in the Pharmaceutical Industry. Role of a SAS programmer. Attributes of a good programmer. SOPs, Protocols and SAPs. CRFs and Annotated CRFs. Importing raw clinical data. Edit checks and cleaning clinical data. Transforming data and creating analysis datasets. Continuous vs. categorical data. LOCF, windowing, Transposing data. Dataset specifications and Mock tables. Creating Tables, listing and Graphs.
Total – 26 hours	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	L
CO2	S	S	S	M	M
CO3	S	S	S	M	M
CO4	S	S	M	S	M
CO5	S	S	S	M	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Shreve NJ and Holland DD. SAS® Certification Prep Guide: Statistical Business Analysis Using SAS®9, Publisher: SAS Institute.
2. SAS® Certification Prep Guide: Advanced Programming for SAS®9, Publisher: SAS Institute, 2nd edition.
3. Shostak J. SAS® Programming in the Pharmaceutical Industry, Publisher: SAS Institute, 2nd edition.
4. Blass EB (2021). Basic Principles of Drug Discovery and Development, Elsevier Science.
5. CDISC Implementation Guides and Model documents – SDTM and ADaM; CDISC.

Dept. of Biotechnology with Relevant Industry Partner	**Dr. V. Thirunavukkarasu** **Associate Professor with Industry partner**

SEMESTER THREE

Animal Biotechnology and Stem Cell Biology

Credits 4

Marks 100

Course Code	26MB1C12	Course Type	Core 12	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	Basic Knowledge in Animal sciences								

Course objectives:

1. To provide students with knowledge of wide-ranging topics related to stem cells, regenerative medicine and tissue engineering.
2. To offer the student state of the art education of stem cells and how the pluripotent and multipotent cells can be used to treat the neurodegenerative disorders, cardiovascular disorders and diabetes.
3. To review the current scenario of tissue engineering applications in bioartificial organs constructing and transplantation.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Apply fundamental knowledge in stem cell biology and tissue engineering.	**K1 and K2**
CO2	Describe sources, selection, potential manipulations and challenges of using stem cells for Regenerative medicine.	**K2 and K3**
CO3	Explain significance, current status and future potential of Stemcells and tissue engineering.	**K3 and K4**
CO4	Identify key challenges in tissue engineering of different human tissues.	**K3, K4 and K5**
CO5	Describe design, fabrication and biomaterials selection criteria for tissue engineering scaffolds	**K5 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I **Introduction to Stem cells and Basics of Stem cell culture** **10 Lectures**	Introduction to Stem Cells – Definition, Classification, characteristics; Stem cell Vs Somatic cells; Differentiation, dedifferentiation and transdifferentiation. Cellular signaling and maintenance of stem cells. Mechanism of pluripotency in stem cells. Instrumentations in stem cell culture/research; Basics of animal cells/stem cells culture; Isolation, expansion, genetic manipulation, genetic reprogramming, and cloning of Stem cells. Stem cell markers, role of feeder layer in stem cell culture. Stem Cells cryopreservation.
Unit II **Types of Stem Cells** **10 Lectures**	Different kinds of stem cells – Embryonic stem cells, Embryonic Germ cells; Stem cell Niche. Adult Stem Cells: heamtopoietic stem cells, neural stem cells, muscle and cardiac stem cells, umbilical cord blood stem cells, cancer stem cells, mesenchymal stem cells, induced pluripotent Stem cells.
Unit III **Stem Cell Therapy** **10 Lectures**	Therapeutic applications: stem cells and neurodegenerative disorders, stem cells and diabetes, stem cells and cardiac disorders, Stem cell therapy for kidney failure, liver failure, infertility and cancer. Stem cell banking. Success stories of stem cell therapy. Current status of Stem cell research. National and International Guidelines/Regulations for stem cell research. Ethical considerations in stem cells research.
Unit IV **Introduction to Tissue Engineering, Biomaterials and Scaffolds** **10 Lectures**	Principles of Tissue Engineering – History, importance and scope, Basics/fundamentals of Tissue Engineering, Tissue dynamics/homeostasis. Tissue Engineering triangle, Role of growth factors, Biomaterials and Scaffolds in Tissue Engineering. Requirement of biomaterials as tissue engineering scaffold. properties and types of scaffolds, tissue specific scaffolds; Methods of scaffold design/preparation. Cell-ECM/Scaffold

	interactions, Animal cell culture on scaffolds. Tissue Engineering Bioreactors.
Unit V **Tissue Engineering Applications** **10 Lectures**	Tissue and organ transplantation. Bio-artificial organs: Skin Tissue engineering, Liver tissue engineering, Bladder reconstruction, Kidney tissue engineering, Muscle tissue engineering, Neural tissue engineering, Bone and cartilage tissue engineering, Cardiovascular tissue engineering. Commercial products from tissue engineering. Ethical issues in tissue engineering. AI in tissue engineering and limitations.
Unit VI **Contemporary issues** **2 Lectures**	Guest lectures by academic/industry experts, online seminars - webinars
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	M
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	M	S	S
CO5	S	S	S	S	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Lanza R, Langer R, Vacanti JP, Atala A (2020). Principles of Tissue Engineering, Academic Press,5th Edition.
2. Lanza R and Atala A (2026). Essentials of Stem Cell Biology, Academic Press, 4th Edition.

3. Blitterswijk CV, Boer JD (2022). Tissue Engineering, Academic Press, 3rd Edition.
4. Pallua N and Suschek CV (2011). Tissue Engineering: from Lab to Clinic, Springer.
5. Barnes SJ and Harris LP (2008). Tissue Engineering: Roles, Materials and Applications, Nova Science Publishers Inc, 1st Edition.
6. Minuth WW, Strehl R and Schumacher K (2017). Tissue Engineering: from Cell Biology to Artificial Organs, Wiley VCH.
7. Zhao RC (2015). Stem Cells: Basics and Clinical Translation (Translational Medicine Research), Springer.
8. Knoepfler P (2013). Stem Cells: An Insider's Guide, World Scientific Publishing Company.
9. Harris J, Quigley M and Chan S (2012). Stem Cells: New Frontiers in Science & Ethics, World Scientific Publishing Co Pte Ltd.
10. Atala A and Lana R (2002). Methods of Tissue Engineering, Academic Press.
11. Sharma CP, Chandy T and Thomas V (2023). Artificial intelligence in tissue and organ regeneration. Elsevier.
12. Plugmann P and Portius D (2025). Innovations in healthcare and outcome measurement. https://doi.org/10.1007/978-3-031-77302-0

Related online contents

1. https://nptel.ac.in/courses/102/106/102106036/
2. https://www.classcentral.com/course/stem-cells-10745
3. https://research.pasteur.fr/en/course/mooc-advances-in-stem-cell-biology/

Course adapted from DBT and handled by Dept. of Biotechnology	**Dr. P. Ekambaram** **Professor**

SEMESTER THREE

Clinical Biochemistry and Disease Metabolism

Credits 4

Marks 100

Course Code	26MB1C13	Course Type	Core 13	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	Basic Biochemistry Knowledge								

Course objectives:

1. To build upon previous knowledge of biochemical pathways and immunology to develop an appreciation of applications of this knowledge in clinical diagnostics and treatment.
2. To make students aware about various disease diagnostic techniques
3. To understand disease pathologies and clinical case studies within the context of each topic
4. To get the knowledge on the biochemical parameters on disease biology
5. To know the organ functions and dysfunctions with respect to biochemical changes

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Apply the acquired knowledge in clinical diagnostics	**K1 and K2**
CO2	Identify the molecular basis of various pathological conditions from the perspective of biochemical reactions.	**K2 and K3**
CO3	Demonstrate the knowledge on marker enzymes in diagnosis and treatment of human diseases.	**K2 and K3**
CO4	Illustrate the importance of metabolism in various disease pathophysiology	**K3 and K4,**
CO5	Evaluate the usefulness of cellular mechanism for the diagnosis of diseases	**K5 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I **Introduction to Clinical Biochemistry** **10 Lectures**	Clinical specimen Considerations - Types of Samples, Sample Processing, Sample Variables, Chain of Custody; Infection control, the vascular system, composition and types of blood specimens, venepuncture, paediatric and geriatric venepuncture, capillary specimen collection, capillary puncture procedures. Place and time of sample collection, preservation, influence of nutrition, drugs, posture, etc. Choice and correct use of anticoagulants; Care of the specimens, identification, transport, storage, influence of temperature, freezing/thawing; Laboratory safety and regulations – Safety awareness, safety equipment, biological, chemical, fire and radiation safety; Method evaluation and quality management, Basic concepts, Reference interval study, Diagnostic efficiency, Method evaluation, Quality Control and quality management.
Unit II **Amino acids and Protein Biochemistry** **10 Lectures**	Amino acids - Basic Structure, Metabolism, Essential Amino Acids, Non-essential Amino Acids, Body amino acid pool, Aminoacidopathies, Amino Acid Analysis, glutathione hyperglycinemias, formation of taurine, homocystinuria, cystinuria and cystinosis, phenyl ketonuria and alkaptonuria, albinism, tyrosinemia; Proteins – Importance, Molecular Size, Catabolism and Nitrogen Balance, Structure, Classification, Dynamic state of body proteins; Plasma proteins - Prealbumin (Transthyretin), Albumin, Globulins; Total Protein abnormalities – Hypoproteinemia, Hyperproteinemia; Methods of analysis – Total nitrogen, Total proteins, Fractionation, Identification and Quantification of specific proteins, Serum protein electrophoresis, High-resolution protein electrophoresis, Immunochemical methods; Proteins in other body fluids – Urinary proteins and Cerebrospinal fluid proteins; Non-protein nitrogen compounds (Physiology, clinical application, methods and pathophysiology) – Urea, Uric acid,

	Creatine, Creatinine, Ammonia, Synthesis of thyroid hormones, Synthesis and catabolism of catecholamines.
Unit III **Clinically Important Enzymes and Related Pathophysiology** **10 Lectures**	Enzymes of clinical significance - Creatine Kinase, Lactate Dehydrogenase, Aspartate Aminotransferase, Alanine Aminotransferase, Alkaline Phosphatase, Acid Phosphatase, Glutamyl transferase, Amylase, Lipase, Glucose-6-Phosphate Dehydrogenase, Drug-Metabolizing Enzymes, Tumour markers, Bone markers, Cardiac markers, liver markers, Inborn errors associated with carbohydrate metabolism; Inborn errors of metabolism- Glycogen storage diseases, Fructosuria, Fructose intolerance, Pentosuria, Galactosuria, Urine screening.
Unit IV **Diagnosis and Treatment of Carbohydrate Disorders** **8 Lectures**	Blood glucose regulation (fasting/pp/random) – hormones influencing carbohydrate utilization, Insulin, glucagon, glucocorticoids, epinephrine, growth hormone. Hyperglycemia, Diabetes Mellitus - Aetiology and pathophysiology of Diabetes Mellitus, Symptoms and complications, Criteria for Testing for Prediabetes diabetes, Criteria for the Diagnosis of Diabetes Mellitus, Criteria for the Testing and Diagnosis of Gestational Diabetes Mellitus, Hypoglycemia - Genetic Defects in Carbohydrate Metabolism.
Unit V **Transport Mechanism and Associated Disorders** **6 Lectures**	Transport of plasma lipids, lipoprotein metabolism, lipid profile and diet, PUFA and dietary fiber, Serum triglycerides; Diagnosis and treatment of lipid disorders –Arteriosclerosis, Hyperlipoproteinemia, Hypercholesterolemia, Hypertriglyceridemia, Combined Hyperlipoproteinemia, Lipoprotein(a) Elevation, Hypolipoproteinemia, Hypoalphalipoproteinemia; Lipid and lipoprotein analyses - Lipid Measurement, Cholesterol Measurement, Triglyceride Measurement, Lipoprotein Methods, High- Density Lipoprotein Methods, Low-Density Lipoprotein Methods, Compact Analyzers, Apolipoprotein Methods, Phospholipid Measurement, Fatty Acid Measurement.
Unit VI	Pituitary function - Introduction to Hormones and Pituitary Function - hypophysiotropic or hypothalamic

Assessment of Organ System Function

8 Lectures

hormones; Anterior pituitary hormones; Pituitary tumors; Growth hormone; Actions of growth hormone; Testing; Acromegaly; Growth hormone deficiency; Prolactin; Prolactinoma; Other causes of hyperprolactinemia; Clinical evaluation of hyperprolactinemia; Management of prolactinoma; Idiopathic galactorrhea; Hypopituitarism - Etiology of hypopituitarism; Treatment of panhypopituitarism; Posterior pituitary hormones – Oxytocin and Vasopressin.

Liver Function - Anatomy - Gross Anatomy, Microscopic Anatomy, Biochemical functions - Excretory and Secretory, Synthetic, Detoxification and Drug Metabolism, Liver function alterations during disease – Jaundice, Cirrhosis, Tumors, Reye Syndrome, Drug- and Alcohol-Related Disorders Assessment of liver function/liver - Function tests: Bilirubin, Urobilinogen in Urine and Faeces, Serum Bile Acids, Enzymes, Tests Measuring Hepatic Synthetic Ability, Tests Measuring Nitrogen Metabolism, Hepatitis. Cardiac Function - Anatomy and function of the heart - Anatomy Function, Pathologic conditions of the heart, Cardiovascular Disease, Congenital Cardiovascular Defects, Heart Failure, Acute Coronary Syndromes, Hypertensive Heart Disease, Infective Heart Disease, Diagnosis of heart disease - Laboratory Diagnosis of Myocardial Infarction, Markers of Inflammation and Coagulation Disorders, Markers of Congestive Heart Failure, Patient-Focused Cardiac Tests, Disease.

Renal Function - Renal anatomy, Renal physiology - Glomerular Filtration, Tubular Function, Elimination of Nonprotein Nitrogen Compounds, Water, Electrolyte, and Acid-Base Homeostasis, Endocrine Function, 1,25-Dihydroxy Vitamin D3, Analytic procedures, Clearance Measurements, Urine Electrophoresis, 2-Microglobulin,

Myoglobin, Microalbumin, Urinalysis, Pathophysiology – Glomerular Diseases, Tubular Diseases, Urinary Tract Infection/Obstruction, Renal Calculi, Renal Failure.

Pancreatic Function and Gastrointestinal Function - Physiology of pancreatic function, Diseases of the pancreas, Tests of pancreatic function - Secretin/Cholecystokinin Test, Fecal Fat Analysis, Sweat Electrolyte Determinations, Serum Enzymes, Physiology and biochemistry of gastric secretion, Clinical aspects of gastric analysis, tests of gastric function - Measuring Gastric Acid in Basal and Maximal Secretory Tests, Measuring Gastric Acid, Plasma Gastrin, Intestinal physiology, Clinicopathologic aspects of intestinal function, Tests of intestinal function - Lactose Tolerance Test, D-Xylose Absorption Test, Serum Carotenoids, Other Tests of Intestinal Malabsorption.

Total Lectures – 52

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	L	L	L
CO2	S	S	M	L	L
CO3	S	S	M	L	L
CO4	L	S	S	M	M
CO5	M	M	L	L	M
*S-Strong; M-Medium; L-Low					

Recommended Textbooks and References:

1. Burtis C, Ashwood E and Bruns LE (2013). Basic principles and practice of clinical chemistry, Lippincott Williams & Wilkins, 7th edition.
2. Marshall WJ, Lapsley M, Day AP and Ayling RM (2014). Clinical biochemistry: Metabolic and clinical aspects, Churchill Livingstone,

3rd edition.

3. Murphy MJ, Srivastava R and Deans K (2023). Clinical biochemistry, Elsevier, 7th edition.
4. Vasudevan DM, Sreekumari S and Kannan V (2023). Textbook of biochemistry for medical students, Jaypee Brothers Medical Publishers, 10th edition.

Related online contents:

1. https://onlinecourses.swayam2.ac.in/cec20_ag01/preview

Course adapted from DBT and handled by Dept. of Biotechnology	**Dr. S. Velayuthaprabhu** **Assistant Professor**

SEMESTER THREE

Medical Microbiology and Infection Biology

Credits 4

Marks 100

Course Code	26MB1C14	Course Type	Core 14	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	A Basic Knowledge in Microbiology and Infectious Diseases								

Course objectives:

1. To impart knowledge on Medical Microbiology with special reference to Bacteria, viruses, fungi, protozoan and sexually transmitted diseases.
2. To understand, epidemiology, pathogenesis, prevention and treatment of various diseases.
3. To enlighten on sexually transmitted diseases and congenital diseases.
4. To obtain overall holistic knowledge on host-parasite relationship.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Demonstrate understanding of microbial virulence factors (toxins, enzymes, adherence, invasion, antigenic variation, iron acquisition) and their role in disease pathogenesis.	**K1 and K2**
CO2	Analyze bacterial, viral, fungal, protozoan, and helminthic infections, identifying causative organisms and evaluating their clinical impact.	**K2, K3 and K4**
CO3	Apply knowledge of antimicrobial chemotherapy by explaining mechanisms of drug action, resistance development, and strategies to combat multidrug resistance.	**K2, K3 and K4**
CO4	Evaluate host–pathogen interactions, including immune evasion, persistence, and inflammatory responses, using examples such as Mycobacterium tuberculosis, HIV, and Plasmodium.	**K4 and K5**

CO5	Demonstrate comprehension of the human microbiome and prebiotics, assessing their beneficial roles in health, immunity, and disease prevention.	**K2, K3 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I **Bacterial Diseases** **10 Lectures**	Pathogenesis and virulence factors - Koch's postulates, Adherence and invasion, Toxins, Enzymes, Antiphagocytic factors, Antigenic heterogeneity, Iron acquisition; *Bacillus anthracis, Clostridium* spp., *Corynebacterium diptheriae; E. coli, Vibrio cholerae, Helicobacter pylori, Salmonella typhi and paratyphi, Shigella dysenteriae; Listeria monocytogenes, Mycobacterium* spp., Rickettsial diseases; *Haemophilus influenzae, Bordetella pertussis*, Brucellosis, Streptococcal and Staphylococcal infections; Chlamydial infections (*Chlamydia trachomatis*); Antibacterial chemotherapy (with examples of antibiotics) - Inhibition of cell wall synthesis, inhibition of cell membrane function, inhibition of protein and nucleic acid synthesis, antimetabolites
Unit II **Viral and sexually transmitted diseases** **10 Lectures**	Viral Pathogenesis - Routes of entry, Viral spread (local and systemic infection), Viral persistence (chronic and latent infection); Polio, Chicken pox, Mumps, Measles, Rubella; Viral hemorrhagic fever, viral encephalitis, Dengue and Yellow fever; Influenza virus infection(emphasis on Avian and swine flu), Rabies and Prion diseases; Hepatitis and Human Cancer viruses; Emerging viral diseases – Ebola, Marburg, SARS, Hanta, Chikungunya, Zika, Chandipura; Antiviral chemotherapy and Viral vaccines; Nucleotide and nucleoside analogs, Reverse transcriptase inhibitor, protease inhibitor, fusion inhibitor, etc., Interferons, Killed and attenuated vaccines. Sexually transmitted diseases and congenital infections: Syphilis and Gonorrhoeal infections; AIDS and Lentiviral infection;

	Herpes infections; Congenital viral infections – Cytomegalovirus, Varicella zoster, HBV, Enterovirus, Parvovirus B19, etc.
Unit III **Fungal and Protozoan Diseases** **10 Lectures**	Types of Mycoses (with specific example of causative fungi) – Superficial, Cutaneous, Sub-cutaneous; Types of Mycoses (with specific example of causative fungi) - Endemic and Opportunistic; Mycotoxins and Antifungal chemotherapy – Mycetismus, Aflatoxins, classes of currently available drugs and new inhibitors in the pipeline; Protozoan diseases - Giardiasis, Amoebiasis; Leishmaniasis, African sleeping sickness; Malaria, Cryptosporidiosis; Infection by Helminths – Nematodes, Trematodes, Cestodes. Mycoplasma and Ureaplasma infection; Toxoplasmosis.
Unit IV **Host-pathogen interaction** **10 Lectures**	Intracellular and extracellular pathogens, Principles of microbial pathogenesis, host damage, inflammatory responses, adaptation strategies of pathogen- impact of host and pathogen metabolism on immunity and pathogen survival; Chronic pathogens and mechanisms of persistence; Evasion mechanisms of pathogens; Bacterial – host interaction- *Mycobacterium tuberculosis, Borrelia burgdorferi*; Viruses – host interaction: HIV, Influenza; Protozoan – hos tinteraction: *Plasmodium* sp., *Leishmania major.* Drug resistance - origin (genetic and non-genetic), mechanisms, antimicrobial activity *in vitro* and *in vivo*, multi-drug resistance and its mechanisms *e.g.* MDR-TB; Nosocomial infection
Unit V **Human Microbiome** **10 Lectures**	Normal microflora (microbiome) of human body and its role – Skin, mouth and respiratory tract, intestinal tract, urogenital tract; Beneficial organisms of human microbiome mechanism of action, role in health, Human microbiome project. Prebiotics-Concept, definition,

	criteria, types and sources of prebiotics, prebiotic and gut microflora, health benefits
Unit VI **Contemporary issues** **2 Lectures**	Guest lectures by academic/industry experts, online seminars - webinars
Total Lectures – 52	
Self-study **AI in Medical Microbiology**	• Applications of Artificial Intelligence in Clinical Microbiology Diagnostic Testing https://www.sciencedirect.com/science/article/abs/pii/S0196439920300258 • Artificial intelligence: Applications for the clinical microbiology lab today https://asm.org/Webinars/AI-Webinar • Artificial intelligence in Microbiology for faster actionable results https://www.mlo-online.com/information-technology/artificial-intelligence/article/13009222/artificial-intelligence-in-microbiology-for-faster-actionable-results • Image analysis and artificial intelligence in infectious disease diagnosis,https://www.clinicalmicrobiologyandinfection.com/article/S1198-743X(20)30155-5/abstract • Application of Artificial Intelligence to Predictive Microbiology https://www.researchgate.net/publication/290131735_Application_of_Artificial_Intelligence_to_Predictive_Microbiology

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	S	S	M	M	M
CO3	S	S	M	S	M
CO4	S	S	M	S	M
CO5	S	M	M	M	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Carroll KC, Morse SA, Mietzner T and Miller S (2016). Jawetz, Melnick & Adelberg's medical microbiology, McGraw Hill, 27th edition.
2. Kudva IT, Cornick NA, Plummer PJ, Zhang Q, Nicholson TL, Bannantine JP and Bellaire BH (2016). Virulence mechanisms of bacterial pathogens, ASM Press, 5th edition.
3. Kumar V, Abbas AK and Aster JC (2015). Robbins & Cotran pathologic basis of disease, Elsevier, 9th edition.
4. Abbas AK (2015). Cellular and molecular immunology, Elsevier, 8th edition.
5. Ananthanarayan R and Paniker CKJ (2013). Textbook of microbiology, Universities Press, 8th edition.
6. Baveja CP (2001). Textbook of microbiology. McGraw Hill Education, 5th edition.
7. Owen J, Punt J and Stranford S (2012). Kuby immunology, W. H. Freeman, 7th edition.
8. Murphy K and Weaver C (2016). Janeway's immunobiology, Garland Science, 9th edition.

Related online contents:

1. https://www.news-medical.net/life-sciences/Human-Microbiome-Project-(HMP).aspx
2. https://www.news-medical.net/life-sciences/Microbiome-and-Disease.aspx

3. https://bio.libretexts.org/Bookshelves/Human_Biology/Book%3A_Human_Biology_(Wakim_and_Grewal)/20%3A_Immune_System/20.7%3A_Human_Microbiome
4. https://kids.frontiersin.org/article/10.3389/frym.2017.00035
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6463098
6. https://www.coursera.org/learn/bacterial-infections
7. https://www.coursera.org/learn/parasitology
8. https://www.udemy.com/course/medvirone/
9. https://www.classcentral.com/course/canvas-network-intro-to-medical-microbiology-1-bacteriology-12514

Course adapted from DBT and handled by Dept. of Microbial Biotechnology	**Dr. J. Angayarkanni** **Professor** **Dr. Brindha Priyadarshini** **Associate Professor**

SEMESTER THREE

Genetic Engineering and Genome Editing Technologies

Credits 4

Marks 100

Course Code	26MB1C15	Course Type	Core 15	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	A Basic Knowledge in Molecular Biology								

Course Objectives:

1. To impart comprehensive theoretical knowledge of the tools and techniques used in genetic engineering.
2. To familiarize students with various genetic engineering approaches and their applications in biotechnology research and industry.
3. To enable students to understand the principles, variations, and applications of PCR techniques in modern molecular biology.
4. To provide knowledge of gene cloning, gene expression profiling, foreign DNA transfer methods, and sequencing technologies.
5. To enrich students' understanding of recent advances in gene silencing and genome editing technologies and their biotechnological applications.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Apply the principles and tools of genetic engineering to perform gene cloning, recombinant DNA construction, and vector selection for biological research and biotechnological applications.	**K1, K3 and K4**
CO2	Understand and apply various cloning strategies, vector systems, and gene library construction techniques used in molecular biology research.	**K2, K3 and K4**
CO3	Explain, perform, and evaluate different PCR techniques and their applications in molecular diagnostics, mutation detection, and biotechnology research.	**K2, K3 and K5**

CO4	Analyze methods for foreign DNA introduction, genomic and cDNA library construction, hybridization techniques, and DNA sequencing technologies.	**K2, K4 and K5**
CO5	Evaluate genome sequencing, gene silencing, and genome editing technologies, including CRISPR-Cas systems, and their applications in medicine, agriculture, and biotechnology.	**K2, K4, K5 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I

Tools for Genetic Engineering

10 Lectures

Impact of genetic engineering in modern society. 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, homopolymer tailing. Labelling of DNA - nick translation, random priming, radioactive and non-radioactive probes. Hybridization techniques - northern, southern, south-western, far-western, colony hybridization, and fluorescence in situ hybridization.

Unit II

Vectors and Gene Cloning

10 Lectures

Plasmids, Bacteriophages, M13mp vectors, pUC19 and pBluescript vectors, phagemids, Lambda vectors, Insertion and Replacement vectors, Cosmids, Artificial chromosome vectors (YACs and BACs). pMal, GST, pET-based vectors. Intein-based vectors. Mammalian expression and replicating vectors, Baculovirus and *pichia* vectors system, plant-based vectors, Ti and Ri as vectors, yeast vectors, shuttle vectors. Principles for maximizing gene expression in vectors. Cloning methods: Restriction enzyme cloning, recombination cloning (Gateway), TA/TOPO cloning, Gibson assembly, Golden gate, Ligation independent cloning, Infusion cloning. Heterologous Protein purification - His-tag, GST-tag, MBP-tag *etc.* Inclusion bodies, methodologies to reduce formation of inclusion bodies.

Unit III

Introduction of foreign DNA into host cells - transformation, electroporation, transfection. PCR: Principles

Introduction of Foreign DNA Into Host Cells and PCR Techniques **10 Lectures**	of PCR, primer design, fidelity of thermostable enzymes, DNA polymerases, Proof reading enzymes. Types of PCR - multiplex, nested, real time PCR, touchdown PCR, hot start PCR, colony PCR. Cloning of PCR products, T – vectors. PCR based site specific mutagenesis. PCR in molecular diagnostics, viral and bacterial detection. Mutation detection - SSCP, DGGE, RFLP. Chemical synthesis of oligonucleotides.
Unit IV **cDNA Analysis and Sequencing methods** **10 Lectures**	Construction of genomic and cDNA libraries, mRNA enrichment, Reverse transcription, Strategies for library screening, Yeast two and three hybrid systems, phage display. Sequencing methods - enzymatic DNA sequencing, chemical sequencing of DNA, automated DNA sequencing, RNA sequencing, methylation sequencing, Human genome project.
Unit V **Gene Silencing and Genome Editing Technologies** **10 Lectures**	Principle of gene silencing. RNAi - siRNA, miRNA, and antisense RNA technology. Gene silencing by homologous recombination. Epigenetic gene silencing. Applications of gene silencing. Introduction to genome editing: TALEN and Zinc-Finger-Nucleases, Genome editing by CRISPR-CAS - Cloning genomic targets into CRISPR/ Cas9 plasmids, *in vitro* synthesis of single guide RNA (sgRNA), purification of DNA from Cas9 treated cells and evaluation of Cas9 gene editing, Applications of CRISPR/cas9 technology. Methods and strategies for genetic manipulations, Transgenics, Applications of genetic manipulation in microbes, plants, humans and animals.
Unit VI **Contemporary issues** **2 Lectures**	Guest lectures by academic/industry experts, online seminars - webinars
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	L	M
CO2	S	S	M	L	M
CO3	S	S	M	L	M
CO4	S	M	S	L	M
CO5	S	S	M	M	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Old RW, Primrose SB and Twyman RM (2001). Principles of Gene Manipulation and Genomics, Blackwell Scientific Publications, 7th edition.
2. Green MR and Sambrook J (2012). Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press.
3. George M and Church G (2018). Genome Editing and Engineering, Cambridge University Press.
4. Morgan D and Mikhails J (2008). An Introduction to Genetic Engineering, University of Paisley, 3rd edition.
5. Huang PC, Kuo TT and Wu R (2012). Genetic Engineering Techniques: Recent Developments. Academic Publishers, ISBN: 9781299554245.
6. Brown TA (2012). Genomes, Garland Science, 3rd edition.
7. Nicholl DST (2019). An Introduction to Genetic Engineering, Cambridge University Press, ISBN: 9780521615211, 3rd edition.
8. Bhattacharya A, Parkhi V and Char B (2020). CRISPR/Cas Genome Editing: Strategies and Potential for Crop Improvement, Springer, ISBN: 9783030420222, 1st edition.

Related Online Contents:

1. Doudna JA and Charpentier E (2014). *The New Frontier of Genome Engineering with CRISPR-Cas9*. Science, 346(6213), 1258096-1258096. doi:10.1126/ science.1258096.
2. Hala TE, Bassyouni L and Mohammed MA (2018).Genome editing: A Review of literature.Lap Lambert Academic Publishing. ISBN: 9786138387534
3. Maeder ML and Gersbach CA (2016). Genome-editing Technologies for Gene and

Cell Therapy. Molecular Therapy, 24(3), 430-446. doi:10.1038/mt.2016.10
4. Genome Editing Resource Library (Thermo Fisher) https://www.thermofisher.com/in/en/home/life-science/genome-editing/genome-editing-learning-center/genome-editing-resource-library.html
5. Cox DB, Platt RJ and Zhang F (2015). Therapeutic Genome Editing: Prospects and Challenges. Nature Medicine, 21(2), 121-131. doi:10.1038/nm.3793
6. Sander JD and Joung JK (2014) CRISPR-Cas Systems for Editing, Regulating and Targeting Genomes. Nature Biotechnology 32, 347–355 doi:10.1038/nbt.2842
7. Joshi M and Deshpande (2010). Polymerase chain reaction: Methods, principles and application. International Journal of Biomedical Research.5:81-97
8. https://www.wcrj.net/wp-content/uploads/sites/5/2020/03/e1510-A-review-on-genome-editing-by-crispr-cas9-technique-for-cancer-treatment
9. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4343198/
10. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5733845/

Course adapted from DBT curriculum and handled by Dept. of Biotechnology	**Dr. M. Arun, Assistant Professor**

SEMESTER THREE

Nanobiotechnology

Credits 4

Marks: 100

Course Code	26MB1E2A	Course Type	Elective 3	L	T	P	C	Syllabus version	2026-2027
				2	✓	-	2		
Pre-requisite	Basic Knowledge in Biological and Chemical Structures								

Course objectives:

1. Provide fundamental knowledge of nanobiotechnology, nanomaterials, and their synthesis, characterization, and functional properties.
2. Develop an understanding of nanotechnology-based approaches in drug delivery, diagnostics, biosensing, catalysis, and other biomedical and industrial applications.
3. Equip students with knowledge of nanomaterial safety, nanotoxicity, environmental impacts, and emerging applications of nanobiotechnology in healthcare, agriculture, food, and environmental sciences.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Explain the principles, classification, synthesis, characterization, and physicochemical properties of nanomaterials used in nanobiotechnology.	**K2, K3 and K4**
CO2	Apply nanotechnology principles to the design and evaluation of nanoparticles for drug delivery, diagnostics, imaging, biosensing, and therapeutic applications.	**K1, K3, K4 and K5**
CO3	Analyze the preparation, functionalization, and biomedical applications of nanomaterials, including nanovesicles, nanocapsules, quantum dots, carbon nanotubes, and related nanostructures.	**K2, K3 and K4**
CO4	Evaluate the applications of nanomaterials in catalysis, agriculture, food, cosmetics, environmental biotechnology, and other industrial sectors.	**K3, K4 and K5**

CO5	Assess the safety, nanotoxicity, environmental fate, and regulatory considerations associated with nanomaterials for their responsible and sustainable applications.	**K3, K4, K5 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I **Introduction to Nanobiotechnology** **10 Lectures**	Introduction to Nanobiotechnology; Concepts, historical perspective; Different formats of nanomaterials and applications with example for specific cases; Cellular Nanostructures; Nanopores; Biomolecular motors; Bio-inspired Nanostructures, Types of nanomaterials and their classifications (1D, 2D and 3D). Nanocrystal, Nanoparticle, Quantum dot, Polymer, Carbon, Inorganic, Organic and Biomaterials.
Unit II **Synthesis** **10 Lectures**	Synthesis and characterization of different nanomaterials. Synthesis and characterization of metal, polymeric nanoparticles. Physical and chemical methods. And Biological synthesis. Colloidal nanostructures; Quantum dots, Carbon nanotubes. Self-Assembly, Nanovesicles; Nanospheres; Nano-capsules
Unit III **Nano-particles in drug delivery** **8 Lectures**	Nanoparticles for drug delivery, concepts, optimization of nanoparticle properties for suitability of administration through various routes of delivery, advantages, strategies for cellular internalization and long circulation, strategies for enhanced permeation through various anatomical barriers. Methods of drug loading in nano materials. Methods used to study cellular internalization of nanomaterials.
Unit IV **Nanoparticles in disease diagnosis.** **10 Lectures**	Nanoparticles for diagnostics and imaging (theranostics); concepts of smart stimuli responsive nanoparticles, implications in cancer therapy, nanodevices for biosensor development. Nanosensors for neuronal disorders.

Unit V **Nano-material applications** **8 Lectures**	Nanomaterials for catalysis, development and characterization of nanobiocatalysts, application of nanoscaffolds in synthesis, applications of nanobiocatalysis in the production of drugs and drug intermediates. Nanoparticles applications in Agriculture, Food, Environment and cosmetic Industry.
Unit VI **Nano-toxicity** **4 Lectures**	Introduction to Safety of nanomaterials, Basics of nanotoxicity, Models and assays for nanotoxicity assessment; Fate of nanomaterials in different state of environment; Eco- toxicity models and assays; Life cycle assessment, containment.
Unit VII **Contemporary Issues** **2 Lectures**	Guest lectures by academic/industry experts, online seminars - webinars
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	L	L	M
CO2	S	S	M	L	M
CO3	S	S	M	L	M
CO4	S	S	M	M	S
CO5	S	S	M	S	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Decher G and Schlenoff JB (2003). Multilayer Thin Films: Sequential Assembly of Nanocomposite Materials, Wiley-VCH Verlag GmbH & Co. KGaA.
2. Goodsell DS (2004). Bionanotechnology: Lessons from Nature, Wiley-Liss.
3. Malsch NH. Biomedical Nanotechnology, CRC Press.
4. Hermanson GT (2013). Bioconjugate Techniques, Elsevier, 3rd edition.

5. Singh R and Gupta SM (2016). Introduction to Nanotechnology, PP:604. ISBN:9780199456789, 1st edition.
6. Pool PC (2020). Introduction to Nanoscience and Nanotechnology. Wiley publisher. PP.508.
7. Kumar N and Kumbhat S (2016). Essentials in Nanoscience and Nanotechnology. Wiley publisher. PP.465. ISBN: 978-1-119-09611-5.
8. Hamdy AS, Barhoum MA (2018). Fundamentals of Nanoparticles.1st Edition. Elsevier. PP.666. Paperback ISBN: 978032351255.
9. Kane DM and Roger AMP (2016). Nanomaterials Science and Applications.1st Edition Jenny Stanford Publishing, PP.418. ISBN 9789814669726.
10. Kumar V, Guleria P, Shivendu R, Dasgupta N and Lichtfouse E (2021). Nanotoxicology and Nanoecotoxicology. Springer International publisher. Vol. 1. pp:318. ISBN 978 3030632410.
11. Nouailhat A (2006). An Introduction to Nanoscience and Nanotechnology. France by Hermes Science/Lavoisier. DOI: https://web.pdx.edu/~pmoeck/phy381/intro-nanotech.pdf
12. Ranzoni A and Cooper MA (2017). Chapter One – The Growing Influence of Nanotechnology in Our Lives. Micro and Nanotechnology in Vaccine Development.PP:1-20.
13. Aliof khazraei and Mahmood (2015). Handbook of Nanoparticles. Springer publisher. ISBN: 978 3319153391.
14. Khan I , Saeed K , Khan I (2019). Nanoparticles: Properties, applications and toxicities. The Arabian journal of chemistry.12(7). PP:908-931.
15. Rajendran S, Mukherjee A, Nguyen T, Godugu C and Shukla R (2020). Nanotoxicity. 1st Edition. Elsevier.pp;504. ISBN: 9780128199442.

Related online contents:

1. https://www.slideshare.net/kirtisingh2011/nanotechnology-ppt
2. http://home.iitk.ac.in/~anandh/MSE694/Introduction_to_Nanomaterials-3.pdf
3. https://travelmantratechnologies.blogspot.com/2021/03/nanofilms-ppt-ppt-nanofilm-technology.html
4. https://application.wiley-vch.de/books/sample/3527331972_c01.pdf
5. https://www.slideshare.net/ganapati123/nanoparticle
6. https://www.slideshare.net/ShrihithRao/application-of-nanotechnolog71235555
7. https://www.eolss.net/Sample-Chapters/C05/E6-152-35-00.pdf

8. https://nptel.ac.in/courses/118/102/118102003/
9. https://ndl.iitkgp.ac.in/homestudy/science

Course adapted from DBT curriculum and handled by Dept. of Nanoscience and Technology	**Dr. N. Ponpandian, Professor**

SEMESTER THREE

Pharmaceutical Biotechnology

Credits 4

Marks 100

Course Code	26MB1E2B	Course Type	Elective 2B	L	T	P	C	Syllabus version	2026-2027
				2	✓	-	2		
Pre-requisite	Basic Understanding in Pharmaceuticals								

Course objectives:

The main objectives of this course are to:

1. To provide an overview about identifying drug targets and strategies to develop drugs
2. To learn about basic and essential qualities of a candidate drug and testing methods
3. To understand the prerequisites of obtaining drug approval, important aspects of commercialization

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Apply knowledge about natural sources of drugs, interaction of drugs with different types of biological molecules to mediate physiological effects, metabolism and removal of drugs from the system. Learn about intricate aspects of drug development that need to be implied during new drug development	**K2**
CO2	Demostrate insight about how various biological systems can be used for biopharmaceutical production. Learn key aspects and methodologies which can transform into their skills. Understanding the advantages and pitfalls of these systems will support them during analysis and decision making during practical application.	**K5**
CO3	Exhibit comprehensive knowledge about vital facets of clinical testing in obtaining approval for new drugs. Improve their prudent skills to be employed in drug discovery efforts.	**K4**
CO4	Show proficiency in emerging powerful tools employed for efficient and safe delivery of drugs into the host system. Enhance	**K6**

	their decision making capacity to choose right system for drug delivery	
CO5	Understand the roles, responsibilities and organizational structure of regulatory bodies. Show in depth knowledge for practical applications while preparing drug approval applications.	**K5**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I **Introduction To Pharmaceuticals** **10 lectures**	Pharmaceutical Biotechnology: Pharmacology, Clinical pharmacology, Drug Legislation & safety, Drugs, Types of drugs- Pharmaceuticals, Biopharmaceuticals, Drug-Nomenclature, Source of drugs – plant, animals, microbes and minerals. Extraction of phytochemicals and evaluation in plants. Drug metabolism – Pharmacokinetics – Absorption, Distribution, Metabolism and Excretion (ADME), Drug efficacy & toxicity- Therapeutic window, Therapeutic Index. Pharmacodynamics – Mechanism of drug action. Drug doses.
Unit II **Drug Targets and Pharmacogenomics** **10 Lectures**	Impact of genomics and proteomics on drug discovery. Biomarkers in early drug development. Pharmacogenomics; Pharmacogenetics; Benefits; Practical applications of pharmacogenomics; Human genetic variation examples of CYP gene variations leading to variable metabolism of drugs. Personalized medicine, example of TPMT and DPD gene mutation and their impact in treatment strategy.
Unit III **Production of Biopharmaceuticals** **10 Lectures**	Prokaryotic and Eukaryotic Cells in Biotech Production: Use of Bacteria and Actinomycetes in Biotech Production, *Saccharomyces cerevisiae* and Other Fungi in Biotech Production, Plants in Biotech Production, Plants and Plant Cell Culture as Bioreactors for pharmaceuticals. Use of animal cell culture system in biopharmaceutical production. Biopharmaceutical products – Hormones, enzymes, antibiotics, blood

	products, nucleic acids and antibodies of therapeutic interest. Biosimilars.
Unit IV **Drug Manufacturing Principles and Regulatory Aspects** **10 Lectures**	Good Manufacturing Practice (GMP): Chemical reactions that affect pharmaceutical products – Oxidation, reduction, hydrogenation, dehydrogenation. Preservatives and phenolic compounds in drug formulations. Manufacturing principles –. Quality control. Guidelines for packing procedure and use of different techniques. Regulatory authorities –Central drug standards control organisation, food and drug administration, European regulations.
Unit V **Drug Development Process and Delivery Systems** **12 Lectures**	Initial product characterization- Physico – chemical properties of the drugs. Pre-clinical studies. Toxicity studies – reproductive toxicity and teratogenicity, mutagenicity, carcinogenicity and other tests, clinical trials, clinical trial design, trial size design and study population. Delivery of biopharmaceuticals – oral delivery systems, pulmonary delivery, nasal, transmucosal and transdermal delivery system. Targeted approaches: Applications of Nano-biotechnology in drug development and delivery. Polymeric and metallic nanoparticles for drug delivery. Nanotechnology for Cancer Diagnostics and Treatment.
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	L	M	L
CO2	S	S	L	M	L
CO3	S	S	M	S	M
CO4	S	S	M	S	M
CO5	S	S	L	S	M
*S-Strong; M-Medium; L-Low					

Recommended Textbooks and References:

1. Walsh G (2013). Pharmaceutical Biotechnology: Concepts and Applications. Wiley India Pvt Ltd. 1st Edition.
2. Crommelin DJ and Sindelar RD (2008). Pharmaceutical Biotechnology: Fundamentals and Applications. CRC Press. 5th Edition
3. Chavda VP and Chen ZSJ (2026). Advances in Pharmaceutical Biotechnology: Volume 1: Exploring Cutting-Edge Innovations and Applications. CRC Press, 1st Edition.
4. Kayser O and Warzecha H (2012). Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications. John Wiley & Sons. 2nd Edition
5. Sambamurthy K (2006). Pharmaceutical Biotechnology, New Age International. 3rd Edition.

Related online contents:

1. Online Refresher course in Pharmacy for Higher Education- AICTE- Swayam
2. Spectroscopic techniques for pharmaceutical and Biopharmaceutical industries- NPTEL
3. Computer aided drug design- NPTEL
4. Drug Delivery: Principles and Engineering-NPTEL

Course adapted from DBT and handled by Department of Biotechnology	**Dr. V. Thirunavukkarasu, Associate Professor**

SEMESTER THREE

Laboratory III:

Clinical Biochemistry and Microbiology

Credits 4

Marks 100

Course Code	26MB1P03	Course Type	Practical 3	L	T	P	C	Syllabus version	2026-2027
				6	-	✓	4		
Pre-requisite	Basic Knowledge in Microbiology, Molecular Biology, Biochemistry and Cell Culture								

Course objectives:

1. To build upon existing knowledge of biochemical and immunological principles for its application in clinical diagnostics and treatment.
2. The course shall equip students with basic skills in clinical biochemistry.
3. Providing hands-on experience in handling animal cell cultures.
4. To impart important microbiology and advanced molecular biology practical knowledge and related instrumentation.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Apply fundamental laboratory techniques in cell biology, biochemistry, and immunohistochemistry, demonstrating proficiency in preparing and analyzing biological samples, performing quantitative assays, and interpreting experimental results for biomedical applications.	**K2, K3, K4, K5 and K6**
CO2	Apply advanced biotechnological techniques—including photobioreactor operation for plant cell culture and metabolite synthesis, DNA barcoding for herbal product authentication, and PCR for GMO detection	**K2, K3, K4, K5 and K6**
CO3	Demonstrate practical skills in advanced microbiological and molecular biology techniques—including 16S rRNA gene library analysis, mutagenesis and screening of antibiotic-resistant mutants, and phylogenetic tree	**K2, K3, K4, K5 and K6**

	construction—to investigate bacterial diversity, genetic variation, and evolutionary relationships	
CO4	Analyse plant physiology, evaluate metabolite production, and interpret biochemical assays for oxidative stress markers, chromatographic quantification of secondary metabolites, and culture-based estimation of phenolic compounds	**K2, K3, K4, K5 and K6**
CO5	Apply core biochemical and cell culture techniques—including protein extraction and quantification, enzymatic marker analysis, and contamination detection.	**K2, K3, K4, K5 and K6**
CO6	Utilize clinical biochemistry techniques—including enzymatic assays for blood glucose estimation, liver function analysis through SGOT/SGPT measurement, and case-based diagnostic testing for nephrotic syndrome.	**K2, K3, K4, K5 and K6**
CO7	Employ molecular biology techniques—including bacterial transformation by electroporation, colony PCR screening, and CRISPR-based genome editing construct design	**K2, K3, K4, K5 and K6**
CO8	demonstrate competence in evaluating drug effects utilizing advanced cell and molecular biology techniques—including cytotoxicity assays, mitochondrial membrane potential staining, and quantitative ROS analysis	**K2, K3, K4, K5 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Molecular Toxicology (Dr. P. Ekambaram)

1. Preparation of primary cells from animal tissue, cell counting and viability.
2. Total Lipid profile: Cholesterol by CHOD-POD Method.
3. Whole mount immunohistochemistry in Zebrafish embryos/larvae.

Plant Genetic Engineering (Dr. R. Sathishkumar)

1. Demonstration of a photobioreactor for plant cell culture and secondary metabolite synthesis.
2. Detection of adulteration in herbal products by DNA barcoding technology.
3. Detection of Genetically Modified Organism (plant) by PCR.

Molecular Microbiology (Dr. S. R. Prabagaran)

1. Bacterial diversity through 16S rRNA gene library analysis
2. Mutagenesis of bacteria by UV rays and screening of antibiotic-resistant mutants
3. 16S rRNA gene sequencing and phylogenetic tree construction

Plant Biotechnology (Dr. S. Girija)

1. Determination of Malondialdehyde (MDA) content in plant tissue
2. Quantification of plant secondary metabolites using HPLC
3. Estimation of phenolic compounds using hairy root cultures.

Translational Genomics and Proteomics (Dr. V. Thirunavukkarasu)

1. Extraction and estimation of total protein content from chicken liver sample using Lowry's method.
2. Assessing the extent of differentiation in mammalian cells by estimating the marker Alkaline Phosphatase (ALP).
3. Lecture demonstration on detection of mycoplasma contamination in animal cell culture.

Reproductive Immunology and Molecular Pathology (Dr. S. Velayuthaprabhu)

1. Estimation of Blood glucose by GOD-POD method.
2. Liver function test: Estimation of SGOT and SGPT in serum.
3. Case study: Nephrotic Syndrome: A five-year old child was brought in paediatric OPD with complaints of weakness and polyuria. On physical examination it was observed that he was having periorbital oedema and swelling over legs. Perform suitable tests in blood/urine sample provided and interpret your findings.

Plant Molecular Biology (Dr. M. Arun)

1. Bacterial transformation by electroporation.
2. Screening of transformed colonies using colony PCR.
3. Designing guide RNA and developing knock-down construct for CRISPR based genome editing.

Regenerative Engineering and Molecular Medicine (Dr. M.A. Shibu)

1. Cytotoxicity screening of chemotherapy drugs in cultured cells using LDH assay.
2. Mitochondrial staining to study their membrane potential with TMRM staining.
3. Quantitative analysis of reactive oxygen species in human RBCs at different concentration of drug treatment by DCFDA assay.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	S	M	M	S
CO3	S	S	M	M	S
CO4	S	S	M	L	S
CO5	S	S	M	M	S

CO6	S	S	M	S	S
CO7	S	S	M	M	S
CO8	S	S	M	S	S
***S-Strong; M-Medium; L-Low**					

Course adopted from DBT curriculum and handled by all the faculty, Dept. of Biotechnology

Course code	26MB1S01	One Month Summer Internship in Hospital/ Biomedical Industries/Research Institute	L	T	P	C
Marks: 50		Internship	2	-	-	2
Course profile		Short Term Internship Course for A Minimum Period of 30 Days	Syllabus Version		2026-27	

Course Objectives:

The main objectives of this course are to:

1. Provide students with practical exposure to professional, industrial, clinical, or research environments relevant to biotechnology.
2. Develop technical, analytical, communication, and professional skills by engaging in real-world biotechnology projects and workplace practices.
3. Enable students to apply biotechnology knowledge, demonstrate ethical and professional responsibility, and evaluate career opportunities through experiential learning.

Expected Course Outcomes:

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

CO1	Apply theoretical knowledge and laboratory skills acquired during the M.Sc. Biotechnology programme to perform assigned tasks in professional, industrial, clinical, or research environments.
CO2	Analyze workplace practices, organizational structure, project objectives, and professional responsibilities in biotechnology-related organizations.
CO3	Demonstrate professional competence, effective communication, teamwork, and ethical conduct while performing internship assignments.
CO4	Evaluate the scientific, technological, and societal significance of the internship project and interpret the outcomes in a professional context.
CO5	Prepare a comprehensive internship report, reflect on learning experiences, and propose future professional or research directions for continuous career development.

Programme Highlights:

- Internship shall be undertaken in a recognized biotechnology industry, research laboratory, academic institution, hospital, government organization, or other related organization.
- The internship organization shall be approved by the Course Coordinator/Mentor prior to commencement of the training.
- Students shall actively participate in research, industrial, technical, analytical, or professional activities relevant to the host organization.
- Students shall maintain an Internship Logbook/Work Diary documenting the activities carried out during the training period.
- At the completion of the internship, students shall submit a comprehensive Internship Report in the prescribed format.
- Students shall deliver a seminar/viva-voce presentation on the internship work before the departmental evaluation committee.
- The internship shall be evaluated based on the performance certificate from the host organization, internship report, seminar presentation, viva-voce, and overall professional conduct.

SEMESTER THREE

Assisted Reproductive Techniques

2

Marks 50

Course Code	26MB1J02	**Course Type**	Job Oriented Certificate Course 2	**L**	**T**	**P**	**C**	**Syllabus version**	2026-2027
				2	✓	✓	2		
Name and Address of the Faculty Member				**Dr. S. Velayuthaprabhu,** Assistant Professor, Department of Biotechnology, Bharathiar University.					
Mode of the Course				Hybrid					
Collaboration if any with Companies (if Yes, Full Address of the Company Address, Name of the Contact Person)				**Chennai Fertility Centre and Research Institute,** Department of clinical embryology and preimplantation genetics, Chennai - 600030					
Job Opportunities: Successful candidate will get job in clinical laboratories and fertility centre.									

Course objectives:

1. Provide fundamental knowledge of human reproductive biology, infertility, and the principles of assisted reproductive techniques (ART).
2. Develop an understanding of clinical andrology, embryology, cryopreservation, and in vitro fertilization (IVF) procedures used in fertility management.
3. Familiarize students with laboratory practices, quality assurance, safety, ethical considerations, and current guidelines in ART laboratories.
4. Equip students with the knowledge and practical skills required for employment in fertility centres, IVF laboratories, and assisted reproduction clinics.

Expected Course Outcomes:

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

CO1	Explain the principles of human reproductive physiology, infertility, clinical andrology, and embryology relevant to assisted reproductive techniques.	**K1, K2 and K3**
CO2	Apply the principles of semen analysis, sperm assessment, embryo evaluation, cryopreservation, and IVF laboratory procedures following established guidelines.	**K2, K3 and K4**
CO3	Analyze ART procedures, including IUI, IVF, ICSI, embryo implantation, and pregnancy assessment, for infertility management.	**K2, K3 and K4**
CO4	Evaluate laboratory safety practices, quality assurance measures, ethical issues, and regulatory guidelines associated with assisted reproductive technologies.	**K3 and K4**
CO5	Demonstrate professional competency in selecting appropriate ART procedures and propose suitable reproductive technologies for infertility management in clinical settings.	**K5 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Course Content	**Lecture / Practical / Internship**
Module 1 **3 hours**	Andrology: Physiology of the Male Reproductive System - Spermatogenesis
Module 2 **3 hours**	Clinical Andrology: Sperm morphology, structure and Function. Semen analysis – sperm motility and count; CASA systems. WHO and ESHRE guidelines.
Module 3 **3 hours**	Embryology: Oogenesis – Regulation, morphology and function
Module 4 **3 hours**	Clinical Embryology: ovarian stimulation. Embryo selection - Embryo hatching - markers of competence.

Module 5 **3 hours**	Cryobiology and Cryopreservation: Principles of cryopreservation. Cryoprotectants and additives. Slow freezing. Cryopreservation of sperm, oocytes and embryos.
Module 6 **3 hours**	IVF Techniques: Oocyte retrieval. Sperm sample preparation - criteria; PESA, TESA, TESE. Fertilization techniques - IUI, IVF and ICSI.
Module 7 **3 hours**	Post Implantation embryology: Gastrulation. Embryo factors vs. uterine factors in implantation/implantation failure.
Module 8 **3 hours**	Pregnancy: Primary infertility and secondary infertility. Extra uterine pregnancies. Spontaneous abortions. Pregnancy test.
Module 9 **1 hours**	Laboratory safety: Minimal safety requirements - Contamination risk - Security. Ethics in IVF.
Module 10 **1 hours**	Applications: Effects of treatment - Advantages and disadvantages of IVF. Social impact.
Total – 26 hours	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	L	M
CO2	S	S	M	M	M
CO3	S	S	S	M	M
CO4	M	M	M	S	S
CO5	S	S	S	S	S
*S-Strong; M-Medium; L-Low					

Recommended Textbooks and References:

Book(s) for Study:

1. Peter RB (2005). A Textbook of In Vitro Fertilization and Assisted Reproduction: The Bourn Hall Guide to Clinical and Laboratory Practice, CRC Press, 3rd edition.
2. David KG, Ariel W, Colin MH and Zeev S (2015). Textbook of Assisted Reproductive Techniques, CRC Press, 4th edition.
3. Kamino AR and Deepika K (2018). Principles and practice of assisted reproductive technology, Yaypee brothers' medical publishers, 2nd edition.
4. Mukargee G (2018). Practical guide in Andrology & Embryology. Yaypee brothers' medical publishers.

Related online contents:

1. https://www.cdc.gov/art/whatis.html
2. https://www.eshre.eu/Guidelines-and-Legal

SEMESTER FOUR

Bioethics, biosafety, IPR and Entrepreneurship

Credits 4

Marks: 100

Course Code	26MB1C16	Course Type	Core 16	L	T	P	C	Syllabus version	2026-2027
				4	✓	-	4		
Pre-requisite	A Basic Knowledge on Intellectual Property								

Course objectives:

1. To become familiar with ethical issues in biological research. This course will focus on consequences of biomedical research technologies such as cloning of whole organisms, genetic modifications, DNA testing.
2. To learn biosafety and risk assessment of products derived from biotechnology and regulation of such products
3. To provide basic knowledge on intellectual property rights and their implications in biological research and product development
4. To become familiar with national and international policies and institutions regulating Bioethics, Biosafety and IPR
5. To introduce the concept of entrepreneurship and to provide conceptual exposure on converting idea to a successful entrepreneurial firm.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Understand ethical considerations in biotechnology and biomedical research.	**K1, K2, K3, K4 and K5**
CO2	Apply biosafety principles and demonstrate risk assessment and management strategies in laboratory, healthcare settings, and for biotechnology products derived from recombinant	**K1, K2, K3, K4 and K5**

	DNA research, including evaluating the environmental release of genetically modified organisms.	
CO3	Understand the rationale both for and against intellectual property rights, with particular emphasis on patents	**K2, K5 and K6**
CO4	Gain familiarity with national and international institutions and regulations governing bioethics, intellectual property rights, and biosafety; understand the rationale behind adoption of the National IPR Policy.	**K1 and K2**
CO5	Understand the fundamental concepts of entrepreneurship and identify business opportunities for biotechnology products.	**K2 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I

Bioethics

10 Lectures

Introduction, ethical conflicts in biological sciences - interference with nature, framework for ethical decision making; biotechnology and ethics – 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; ELSI of human genome project. Biotechnology in agriculture and environment: GM crops- benefits and risks of genetic engineering, Protection of environment and biodiversity – biopiracy. National Biodiversity Authority (NBA). Ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and bio warfare.

Unit II

Biosafety

Biosafety and Biosecurity - introduction; historical background; Biosafety issues in biotechnology – risk assessment and risk management – GRAS organisms,

10 Lectures	biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals; definition of GMOs & LMOs, operation of Biosafety guidelines and regulations – food and feed safety assessment; problem formulation – protection goals, compilation of relevant information, risk characterization and development of analysis plan, risk assessment and containment of crops; genome editing tools, transgenic crops vs cisgenic plants or products derived from RNAi.
Unit III **Intellectual Property Rights** **12 Lectures**	Introduction to intellectual property, Types: patents, copyrights, trade-marks, design rights, geographical indications – importance of IPR – patentable and non-patentable – patenting life – legal protection of biotechnological inventions – patent databases - country-wise patent searches (USPTO, EPO, India) – IP as a factor in R&D; IPs of relevance to biotechnology and few case studies; filing of a patent application; precautions before patenting-disclosure/non-disclosure - patent application-forms and guidelines; fee structure, time frames; types of patent applications: provisional and complete specifications; PCT and conventional patent applications; international patenting-requirement, procedures and costs; financial assistance for patenting- introduction to existing schemes; publication of patents-gazette of India, status in Europe and US; patent infringement- meaning, scope, litigation, case studies and examples; commercialization of patented innovations; collaborative research - backward and forward IP; benefit/credit sharing among parties/community, commercial (financial) and non-commercial incentives.

Unit IV **National and International regulations** **10 Lectures**	Introduction and History of GATT, WTO, WIPO and TRIPS. Patent databases – USPTO, EPO; Budapest Treaty; Patent cooperation Treaty (PCT), Cartagena Protocol, OECD concensus, Codex Alimentarius. Indian Patent act (1970), National IPR Policy; Indian Patent offices; Publication of patent gazette of India. PPVFR Act, Registration Protection of Plant variety and Plant breeders' rights in India. Biosafety regulation in INDIA: RGCM, GEAC, IBSC and other regulatory bodies; FSSAI and its role.
Unit V **Entrepreneurship** **10 Lectures**	Commercialization of Biotechnology Products: Technology transfer of innovation, challenges in innovation and translational of laboratory findings to market. Models of technology transfer- Government Interface, Funding Support, University technology transfer offices, Triple Helix Model. Good practices of technology commercialisation in India: CSIR, NRDC, BCIL, BIRAC, KIHT. Technology readiness- for Drugs, Vaccines, Biosimilars, Regenerative medicine, Medical Devices and Diagnosis, Big Data Analysis and Bioinformatics. Candidate Optimization and Non-GLP technology development. cGMP pilot scale and scale up. Marketing fundamentals and strategies: communicating value proposition strategy, Freedom to Operate, start-up strategies, B2B & B2C marketing, and case studies for sales force development, branding, and promotion.
Contemporary issues	Guest lectures by academic/industry experts, online seminars - webinars
Total Lectures – 52	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	L	S	S	S
CO2	S	L	S	S	S

CO3	L	L	S	S	S
CO4	L	L	S	S	S
CO5	L	L	S	S	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. Beauchamp TL and Childress JF (2019). Principles of biomedical ethics, Oxford University Press, 8th Edition.
2. Resnik DB (2012). Ethics of science: An introduction, Routledge.
3. WHO Laboratory Biosafety Manual (2020). World Health Organization, 4th edition.
4. Ganguli P (2001). Intellectual property rights: Unleashing the knowledge economy, Tata McGraw-Hill.
5. Mukherjee PK (2003). GMP for botanicals: Regulatory and quality issues on phytomedicine, Business Horizons.
6. Deb T (2014). Commercialization of biotechnology products, Academic Press.
7. National IPR Policy (2016). Department of Industrial Policy & Promotion.
8. FSSAI Manuals, Food Safety and Standards Authority of India.
9. BIRAC (India), Annual reports and guidelines. Biotechnology Industry Research Assistance Council.

Related online contents:

1. https://swayam.gov.in/nd1_noc20_hs18/preview

Published Articles:

1. Morrato EH, Hamer MK, Sills M, Kwan B and Schilling LM. Applying a Commercialization-Readiness Framework to Optimize Value for Achieving Sustainability of an Electronic Health Data Research Network and Its Data Capabilities: The SAFTINet Experience. EGEMS (Wash DC). 2019 Aug 29;7(1):48. doi: 10.5334/egems.295. PMID: 31523697.

2. Smanski MJ, Aristidou A, Carruth R, Erickson J, Gordon M, Kedia SB, Lee KH, Prather D, Schiel JE, Schultheisz H, Treynor TP, Evans SL, Friedman DC and Tomczak M. Bioindustrial manufacturing readiness levels (BioMRLs) as a shared framework for measuring and communicating the maturity of bioproduct manufacturing processes. J Ind Microbiol Biotechnol. 2022 Oct 13;49(5): kuac022. doi: 10.1093/jimb/kuac022. PMID: 36150719.

Course adapted from DBT and handled by Dept. of Biotechnology	**Dr. S. R. Prabagaran, Professor** **Dr. M. A. Shibu, Assistant Professor (DBT-RLS)**

SEMESTER FOUR

Training in Sophisticated Instruments

Credits 2

Marks 50

Course Code	26MB1VO2	Course Type	Value added Course 2	L	T	P	C	Syllabus version	2026-2027
				2	✓	✓	2		
Pre-requisite	A Basic Knowledge in Instrumentation								

Name of the Department	Department of Biotechnology
Name of the Faculty Member	All faculty
Collaboration if any with Companies	Relevant industry partners
Job Opportunities: Academic and research laboratories, Pharmaceutical and Biotechnology industries	
The **objectives of this course are,**	
1	To impart hands on skill sets in the advanced instrumentations
2	To operate the instrument
3	To interpret the obtained data
Course Content	Offline

Course objectives:

1. Provide hands-on training in the operation and applications of advanced analytical and molecular biology instruments used in biotechnology research and industry.
2. Develop technical competence in instrument handling, experimental procedures, and standard operating practices for sophisticated laboratory equipment.
3. Enable students to analyze, interpret, and report experimental data generated from advanced instrumentation while adhering to laboratory safety and quality standards

Expected Course Outcomes:

On the successful completion of the course, studentS will be able to:		
CO1	Explain the principles and applications of sophisticated analytical and molecular biology instruments used in biotechnology.	**K2 and K3**
CO2	Operate advanced laboratory instruments by following standard operating procedures and laboratory safety guidelines.	**K3 and K4**
CO3	Perform experiments using sophisticated instruments for molecular, cellular, and biochemical analyses.	**K3, K4 and K5**
CO4	Analyze and interpret experimental data generated using advanced instrumentation for research and industrial applications.	**K3, K4 and K5**
CO5	Demonstrate professional competency in handling advanced instrumentation for biotechnology research, diagnostics, and industrial applications.	**K1, K4, K5 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Module 1	Bioreactor	3 Hours
Module 2	ELISA	3 Hours
Module 3	Flowcytometry	3 Hours
Module 4	Real-Time PCR	3 Hours
Module 5	DNA sequencer	3 Hours
Module 6	Fluorescence Microscope	3Hours
Module 7	Micromanipulator	3 Hours
Module 8	GC-MS/MS	3 Hours
Module 9	Contemporary	2 Hours
	Total Training hours	**26 hours**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	L	L	M
CO2	S	S	M	M	M
CO3	S	S	M	M	M
CO4	S	S	M	M	M
CO5	S	S	S	S	S
***S-Strong; M-Medium; L-Low**					

Handled by all the faculty, Dept. of Biotechnology and
Central Instrumentation Centre, BU

SEMESTER FOUR

Disaster Management

Credits 2

Marks 50

Course Code	26MBDM01	Course Type	Value added Course 2	L	T	P	C	Syllabus version	2026-2027
				2	✓	-	2		
Pre-requisite	Basic Knowledge about Natural Calamities								

Name of the Department	Department of Biotechnology
Name of the Faculty Member	All faculty
The **objectives of this course are,**	
1	Understand disaster management concepts
2	Identify and classify disasters
3	Examine India's disaster management framework, policies, and institutions
4	Apply disaster risk reduction strategies
5	Develop emergency response plans with effective coordination
Course Content	Offline

Course objectives:

1. Provide fundamental knowledge of disasters, hazards, vulnerability, and disaster management principles.
2. Develop an understanding of disaster risk reduction, preparedness, mitigation, response, and recovery strategies.
3. Familiarize students with disaster management frameworks, policies, and institutional mechanisms in India.
4. Equip students with the knowledge and skills required for effective emergency response and community resilience during disasters.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:		
CO1	Explain the concepts, types, causes, and impacts of natural and human-induced disasters.	**K1 and K2**
CO2	Describe the disaster management framework, institutional mechanisms, and disaster management practices in India.	**K2 and K3**
CO3	Apply the principles of disaster preparedness, mitigation, and disaster risk reduction in different disaster scenarios.	**K3 and K4**
CO4	Analyze disaster response strategies, emergency management systems, and community resilience measures.	**K4 and K5**
CO5	Evaluate disaster management plans and propose appropriate strategies for effective emergency response and sustainable disaster risk reduction.	**K5 and K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create		

Unit I **Introduction to Disaster Management** **6 Lectures**	Concepts, scope, and Importance. Phases of disaster management (mitigation, preparedness, response, recovery). multidisciplinary nature of disaster management.
Unit II **Types of Disasters** **5 Lectures**	Natural disasters: earthquakes, floods, cyclones, droughts, landslides; Human-made disasters: industrial accidents, chemical spills, nuclear hazards, terrorism; Emerging risks: climate change, pandemics, cyber disasters.
Unit III	Institutional framework: NDMA, SDMA, DDMA; Policies and legal provisions (Disaster Management Act,

Disaster Management in India **5 Lectures**	2005); Role of government, NGOs, and community-based organizations; Case studies of major disasters in India

Unit IV

Disaster Risk Reduction **5 Lectures**	Risk assessment and vulnerability analysis; Mitigation strategies and resilience-building; Community participation and capacity building.

Unit V

Emergency Response and Management **5 Lectures**	Emergency preparedness planning; Incident command system and coordination mechanisms; Relief, rehabilitation, and recovery processes; Ethical issues and leadership in disaster response.

Total Lectures –26

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	L	M	M
CO2	M	S	M	S	M
CO3	M	S	M	S	S
CO4	M	S	M	S	S
CO5	M	S	S	S	S
***S-Strong; M-Medium; L-Low**					

Recommended Textbooks and References:

1. National Institute of Disaster Management (2025). Comprehensive course on disaster risk management, Ministry of Home Affairs, Government of India.
2. Alexander D (2018). Principles of emergency management and planning, Oxford University Press.

Course designed by **Dr. M. A. SHIBU**, Assistant Professor (DBT-RLS), Department of Biotechnology