SCHOOL OF BIOTECHNOLOGY & GENETIC ENGINEERING
DEPARTMENT OF MICROBIAL BIOTECHNOLOGY

Syllabus
M.Sc., Microbiology (CBCS –UD)
2025-2026 BATCH & ONWARDS

Bharathiar University
Coimbatore-46

BHARATHIAR UNIVERSITY: COIMBATORE 641046

DEPARTMENT OF MICROBIAL BIOTECHNOLOGY

MISSION

To empower young minds with scientific knowledge facilitating the grandaunts to have an array of career options allowing them to emerge as either a scientist or an entrepreneur commercializing microbial product or an entrepreneur establishing diagnostic laboratory or an Industrial expert in quality control. Education process is aimed at creating manpower with not only scientific knowledge but also with moral values and social responsibilities.

Program Educational Objectives (PEOs)	
The **M. Sc. Microbiology** program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	Graduate would become a microbiologist involved in research
PEO2	The candidate shall become an entrepreneur commercializing his own microbial product
PEO3	The candidate would be able to join Industries maintaining quality of products
PEO4	The candidate would be able to establish a clinical diagnostic laboratory
PEO5	The graduate can become a teacher of microbiological subjects in schools or colleges
PEO6	The graduate can become a bioprocess engineering designing fermentation processes

Program Specific Outcomes (PSOs)	
After the successful completion of M.Sc. program, the students are expected to	
PSO1	Know the role of microorganisms in human life
PSO2	Explain the causes of infectious diseases
PSO3	Capable of identifying microorganisms from various sources
PSO4	Capacity to design a fermentation process using a microbe
PSO5	Capable of constructing a recombinant strain for commercial purpose

Program Outcomes (POs)	
On successful completion of the M. Sc. Microbiology program	
PO1	Able to have a deep insight into the world of microorganisms that exist in all environments
PO2	Candidate is able to explain the role of microbes in the human health and diagnosis of infectious diseases
PO3	Able to comprehend the Importance of Microorganism in Agriculture, Environment and attain competency to get placed in industry sectors
PO4	The student is able to understand the genetics of microbes and how microbe adapt to the environment
PO5	Able to explain the impact of the beneficial and pathogenic microorganism on human system
PO6	Able to emphasis the precautions to be taken at various levels of handling microbes in laboratory and Industry
PO7	Able to understand the products of microbes and production / fermentation process of microorganisms
PO8	Able to exploit the knowledge of microbes for futuristic research
PO9	The student is able to perform genetic engineering of microorganism and manipulate the genes in microbes, animal and plant systems for human welfare
PO10	Able to comprehend the role of artificial intelligence in microbiological applications and attain competency in teaching techniques.

BHARATHIAR UNIVERSITY: COIMBATORE – 641 046
M.SC., MICROBIOLOGY (UNIVERSITY)
FOR THE STUDENTS ADMITTED DURING THE ACADEMIC YEAR
2025 – 2026 BATCH & ONWARDS
SCHEME OF EXAMINATION

Semester/ Code No.	Paper	Subject	University examination			Credit
			Internal Mark	External Mark	Total Mark	
SEMESTER I						
25MBTBC01	Paper-I	Bacteriology and Mycology	25	75	100	4
25MBTBC02	Paper - II	Virology and Parasitology	25	75	100	4
25MBTBC03	Paper - III	Microbial physiology and Biochemistry	25	75	100	4
25MBTBC04	Paper - IV	Microbial genetics and recombinant DNA technology	25	75	100	4
25MBTBE12A	Elective 1 A		25	75	100	4
25MBTBE12B	Elective 1 B		25	75	100	
	Supportive 1		12	38	50	2
25MBTBCP1	Practical - I	Basic Microbiological Techniques	40	60	100	4
SEMESTER II						
25MBTBC05	Paper-V	Immunology and Immunotechniques	25	75	100	4
25MBTBC06	Paper - VI	Agricultural Microbiology	25	75	100	4
25MBTBC07	Paper - VII	Food Microbiology	25	75	100	4
25MBTBC08	Paper - VIII	Environmental Microbiology	25	75	100	4
25MBTBE13A	Elective 2 A		25	75	100	4
25MBTBE13B	Elective 2 B		25	75	100	
25MBTBE13C	Elective 2C		25	75	100	
25MBTBE13D	Elective 2D		25	75	100	
	Supportive 1		12	38	50	2
25MBTBCP2	Practical - II	Advanced Microbiological Techniques	40	60	100	4
SEMESTER III						
25MBTBC09	Paper-IX	Bioprocess Technology	25	75	100	4
25MBTBC10	Paper – X	Molecular Diagnostics	25	75	100	4
25MBTBC11	Paper – XI	Cell culture techniques	25	75	100	4
25MBTBC12	Paper – XII	Molecular techniques and Biostatistics	25	75	100	4

25MBTBE14A	Elective 3 A		25	75	100	4
25MBTBE14B	Elective 3 B		25	75	100	
25MBTBE14C	Elective 3C		25	75	100	
	Supportive 1		12	38	50	2
25MBTBCP3	Practical - III	Applied Microbiological Techniques	40	60	100	4
SEMESTER IV						
25MBTBE15A	Elective 4	Artificial Intelligence in Life Sciences	25	75	100	4
		Project viva voce*	60	90	150	6
		Industrial / Institute visit and Summer Training (Viva voce)**	50		50	2
		Grand total			2150	90
	Value Added	Value Added Courses Offered	50	--		2
	Job Oriented Course	Industrial Training Related to Microbiology	--	50		2

* The report should be a bonafide work carried out by the candidate in the department or any other recognized institute or laboratory under the guidance of a faculty/external guide and should be authenticated and countersigned by the HOD. This project work must be presented and defended by the candidate in the department attended by all faculties and reviewed by external examiner. Candidate who has presented the work as 'Not qualified as per CBCS' must resubmit the project again in the ensuing academic year.

** The Industrial training report should be submitted by the candidate. This report must be presented and defended by the candidate in the department attended by all faculties.
Highlighted in red new papers introduced
Highlighted in green are papers modified

ELECTIVE COURSES OFFERED

Semester/ Code No.	Paper	Subject	University examination			Credit
			Internal Mark	External Mark	Total Mark	
SEMESTER I						
25MBTBE12 A	Elective 1A	Molecular Cell Biology	25	75	100	4
25MBTBE12B	Elective 1B	Inheritance and Developmental Biology	25	75	100	4
SEMESTER II						
25MBTBE13A	Elective 2A	Biosafety, Bioethics , IPR and Good Manufacturing Practices	25	75	100	4
25MBTBE13B	Elective 2B	Pharmaceutical Chemistry	25	75	100	4
25MBTBE13C	Elective 2C	Biomolecular Metabolism	25	75	100	4
25MBTBE13D	Elective 2D	System Physiology	25	75	100	4
SEMESTER III						
25MBTBE14 A	Elective 3A	Experimental Animal Care	25	75	100	4
25MBTBE14B	Elective 3B	Bioinformatics and Nanobiotechnology	25	75	100	4
25MBTBE14C	Elective 3C	Ecology	25	75	100	4
SEMESTER IV: FINISHING SCHOOL PAPER						
24MBTBE15A	Elective 4	Artificial Intelligence in Life Sciences	25	75	100	4

SUPPORTIVE COURSES OFFERED

Semester	Paper	Subject	Hrs Per week	University examination		Credits
				Duration in Hrs.	Max. Marks	
SEMESTER I	25MBTBS1	Microbial Biotechnology	2	3	50	2
SEMESTER II	25MBTBS2	Clinical microbiology	2	3	50	2
SEMESTER III	25MBTBS3	Probiotics and Prebiotics	2	3	50	2

JOB ORIENTED COURSE*

Paper	Subject	No. of Days	Max. Marks	Credits
24MBTJOC1	Industrial Training Related to Microbiology	15	50	2

* The Mark obtained will be Added in the Four semester Mark statement.

VALUE ADDED COURSES OFFERED**

Paper Code	Subject	Hrs. Per week	University examination		Credits
			Duration in Hrs.	Max. Marks	
24MBTVAC1	Scientific writing	2	2	50	2
24MBTVAC2	Spirulina cultivation	2	2	50	2
24MBTVAC3	Functional foods	2	2	50	2
24MBTVAC4	Organic Farming	2	2	50	2
24MBTVAC5	EM (Effective microorganisms)	2	2	50	2

** Offered in the department
** One paper has to be completed among the five papers offered before the end of third semester.
** The Mark obtained will be Added in the Four semester Mark statement.

Course Code	**25MBTBC01**	**BACTERIOLOGY AND MYCOLOGY**	**L**	**T**	**P**	**C**
Core Paper: I			**4**	**1**	**-**	**4**
Pre-requisite		**Prior exposure to bacteriology and mycology**	**Syllabus version**		**2024-2025**	

Course Objectives:

The main objectives of this course are to:

- Provide knowledge on medically important bacteria and handling of clinical specimens for diagnosis
- Provide knowledge on gram positive organisms: characteristics, diseases and diagnosis
- Provide knowledge on gram negative organisms: characteristics, diseases and diagnosis
- Provide knowledge on cutaneous fungal characteristics, classification and its diseases
- Provide knowledge on systemic fungal characteristics, classification and its diseases

Expected Course Outcomes:

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

1.	Proper handling of clinical specimens for processing the samples and storage	K1
2.	Understand about medically important Gram-positive bacteria: morphology and characteristics	K2
3.	Identify the disease caused by medically important Gram-negative bacterial pathogens	K4
4.	Diagnose and predict treatment of non-systemic diseases caused by medically important fungal pathogens	K5
5.	Study on systemic infection caused by fungus	K5

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**- Analyze; **K5**-Evaluate; **K6**- Create

Unit I	**Specimen collection and diagnosis**	**12 Hours**

Classification of medically important bacteria, Normal flora of human body, Collection, transport, storage and processing of clinical specimens, Microbiological examination of clinical specimens, antimicrobial susceptibility testing.

Unit II	**Bacteriology-Gram positive organisms**	**12 Hours**

Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by species of *Staphylococci*, *Streptococci*, *Pneumococci*, *Neisseriae*, *Bacillus*, *Corynebacteria*, *Mycobacteria* and *Clostridium*.

Unit III	**Bacteriology-Gram negative organisms**	**12 Hours**

Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by *Enterobacteriaceae* members, *Pseudomonas*, *Vibrio*, *Helicobacter*, *Rickettsiae*, *Chlamydiae*, *Spirochaete*s Nosocomial, zoonotic and opportunistic infections - prevention and control.

Unit IV	**Mycology – Cutaneous**	**12 Hours**

Morphology, taxonomy, classification, detection and recovery of fungi from clinical specimens. Superficial and subcutaneous mycoses: Trichophyton, Epidermophyton and Microsporum. Opportunistic infections – *Candida, Cryptococcus*. Mycotoxins.

Unit V	**Mycology – Systemic**	**12 Hours**
Systemic mycoses - *Histoplasma, Blastomyces*. Fungi causing Eumycotic Mycetoma, Immunodiagnostic methods in mycology- Antifungal agents.		

Case Study

- Students can visit microbiological laboratories and hospitals and submit a report on sample collection.
- Identify patients infected with Gram-positive bacteria and submit a report detailing symptoms, treatment, and medicines prescribed by the doctor.
- Identify patients infected with Gram-negative bacteria and submit a report detailing symptoms, treatment, and medicines prescribed by the doctor.

Visit patients with fungal infections, take photographs of wounds (with appropriate consent), and submit the doctor's prescription.

	Total Lecture Hours	**60 Hours**

Text Book(s)

1.	Joanne Willey and Kathleen Sandman and Dorothy Wood, (2020). Prescott's Microbiology 11th Ed. Mc. Graw Hill Book
2.	Dubey R.C. and Maheshwari, (2010). Text book of Microbiology, S.Chand Publications
3.	Medical Mycology – JagadeshChander. Fourth Edition- 2018

Reference Book(s)

1.	Prescott L M, J P Harley and DA Klein (2005). Microbiology. Sixth edition, International edition, McGraw Hill.
2.	Microbiology: An Introduction, 12th Edition. Gerald J Tortora

Course Designed by: Dr. K. Preethi

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**S**	**M**	**L**	**L**	**S**	**S**	**L**	**M**	**S**	**L**
CO2	**S**	**S**	**M**	**S**	**S**	**S**	**M**	**L**	**L**	**L**
CO3	**S**	**S**	**M**	**S**	**S**	**S**	**M**	**L**	**L**	**L**
CO4	**S**	**S**	**M**	**S**	**S**	**S**	**M**	**L**	**L**	**L**
CO5	**S**	**S**	**M**	**S**	**S**	**S**	**M**	**L**	**L**	**L**

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

Course code	**25MBTBC02**	**VIROLOGY AND PARASITOLOGY**	**L**	**T**	**P**	**C**
Core Paper: II			**3**	**1**	**-**	**4**
Pre-requisite		**Basic Knowledge on microbial pathogens and its diagnosis**	**Syllabus Version**		**2024-25**	

Course Objectives:

The main objectives of this course are to:

1. Understanding viruses, comprehending their classified and the ways viruses can be analysed in the laboratory for experimental procedures
2. Enhanced understanding of how viruses invade the human host, their prevalence, clinical symptoms, and the diverse treatment modalities available for managing such infections
3. Explore details regarding viruses that infect bacteria, their replication mechanisms, and their application in health care. Additionally, examine the variety of vaccines and anti-viral agents formulated to combat viral infections
4. Learning significant parasitic organisms, including their occurrence, life cycles, disease mechanisms, diagnostic methods, and treatments for human infections
5. Gaining insight into helminths and their role in causing infections, focusing on notable cestodes, nematodes, and trematodes

Expected Course Outcomes:

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

1	Gain wide information regarding various types of viral and parasitic infections	K1, K2
2	Decipher the disease mechanism of virus & parasites to be able to identify them.	K2, K3
3	Understand the methods used to diagnose and treat viral and parasitic infections	K4
4	Make appropriate professional decisions in the processing of viral/parasitic samples as well as clinical specimen used to identify the pathogens	K4, K5
5	Role of updated diagnostic methods in the disease understanding	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Introduction to virology**	**12-- hours**

General properties of viruses - Structure and Classification - viroids, prions, satellite RNAs and virusoids. Cultivation of viruses - embryonated eggs, experimental animals and cell cultures. Purification and Assay of viruses – Physical and Chemical methods (Electron Microscopy,Protein and Nucleic acids studies.) Infectivity Assays (Plaque and end-point).

Unit:2	**Viral infections**	**12-- hours**

Virus Entry, Host Defenses Against Viral Infections, Epidemiology, Pathogenesis, laboratory diagnosis, treatment for the following viruses: DNA Viruses- Pox , Herpes, Adeno, RNA Viruses- Picorna, Rhabdo, Rota, HIV and Hepatitis viruses, Arbo – Dengue virus, Ebola virus.

Unit:3	**Bacterial viruses**	**12-- hours**

Morphology and characteristics of M13, T4, lambda; Structural organization, lytic lysogenic life cycle and phage production. Antiviral agents and viral vaccines.

Unit:4	**Protozoa**	**12-- hours**

Classification, Epidemiology, life cycle, pathogenic mechanisms, laboratory diagnosis, treatment for the following: Protozoa causing human infections – *Entamoeba*, *Giardia*, *Trichomonas*, *Toxoplasma*,

Leishmania, and*Trypanasoma.*		
Unit:5	**Helminths**	**12-- hours**
Classification, life cycle, pathogenicity, laboratory diagnosis and treatment for parasites – Helminthes - Cestodes – *Taenia solium, T. saginata*. Trematodes – *Fasciola hepatica*, Schistosomes. Nematodes - *Ascaris, Enterobius, Strongyloides*and*Wuchereria*.		
	Total Lecture hours	**60 hours**
Text books		
1	Textbook of Medical Parasitology – Subash. C. Parija.	
2	Luria. S.E. Darnall. J.E. Baltimore. D. and Compare. A. 1978. General Virology, 3ed.	
Reference books		
1	Essentials of Diagnostic Microbiology – Lisa Anne Shimeld, Anne T. Rodgers	
2	Manual of Clinical Microbiology – Lenetle, E, Balows H.A.	
3	Medical Microbiology - Geo. F. Brooks. S	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	M	S	M	L	S	L	L
CO2	S	S	L	L	S	L	L	S	L	L
CO3	M	S	L	L	S	L	L	M	L	L
CO4	L	S	L	L	S	M	L	M	L	L
CO5	L	S	L	L	S	M	L	M	L	L

Course code	25MBT BC03	**MICROBIAL PHYSIOLOGY & BIOCHEMISTRY**	**L**	**T**	**P**	**C**
Core Paper: III			**4**	**-**	**-**	**4**
Pre-requisite		**Organization and metabolism of microbial cells**	**Syllabus Version**		**2024-25**	

Course Objectives:

The main objectives of this course are to:

1. To provide the information about the nutritional uptake of microbial cells.
2. To familiarize the energy driven process of the microbes from inorganic substances.
3. To know the regulatory responses of the environmental stress and changes in microbes.
4. To describe the mechanism of microbial fermentation process.
5. To learn the basics of microbial biochemistry aspects.

Expected Course Outcomes:

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

1	The students will learn the biochemical pathways and processes are integrated into a network, which provides robustness to life.	K2
2	Able to analyze the role of fermentation in the overall cell function.	K4
3	To learn the microbial regulations in their structure and metabolism in response to environmental stimuli.	K3
4	Design, carry out, and report on lab experiments in microbial metabolism and regulation.	K4
5	The students will learn about the enzymes and coenzyme.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Mode of Nutritional Uptake**	**12 hours**

Common nutrient requirements, Nutritional classification of microorganisms, Growth factors. Entry of nutrition in the cell, passive diffusion, facilitated diffusion and different mechanisms of active diffusion (Proton Motive Force, PTS, role of permeases in transport, different permeases in E. coli. Transport of aminoacids and inorganic ions in microorganisms and their mechanisms. Utilization of nutrients that cannot enter the cell.

Unit:2	**MICROBIAL GROWTH & BIOENERGETICS**	**12 hours**

Phases of bacterial growth, Bacterial growth curve. The mathematics of growth – determination of generation or doubling time. Growth of bacterial cultures- Batch culture, Continuous culture – Turbidostat& chemostat, Synchronous culture. Balanced and unbalanced growth, shift-up and shift down experiment. Measurement of microbial growth- cell number(The petroff-Hausser counting chamber, Membrane filtration procedure). Measurement of cell mass – turbidity and microbial mass measurement. Energy & work: Energy currency(ATP), The cell's energy cycle, The laws of Thermodynamics, Free Energy and reactions- enthalpy, entropy, equilibrium constant, endergonic and exergonic reactions. Molar growth yield, Coupling reactions, Role of ATP in Metabolism.

Unit:3	**PRINCIPLES OF MICROBIAL METABOLISM**	**12 hours**

Microbial metabolism-Types, Heterotrophic, Special metabolic properties- Methyl trophy, Syntrophy, Aerobic respiration (EMP, HMP, ED, TCA, ETC). Anaerobic respiration - Denitrification – nitrate as electron acceptor, Sulfate reduction – sulfate as electron acceptor , Acetogenesis – carbon dioxide as electron acceptor

Unit:4	**FERMENTATION AND PHOTOSYNTHESIS**	**12 hours**
Lactic acid fermentation, Ethanolic fermentation, Propionic acid fermentation, Mixed acid fermentation, hydrogen oxidation, nitrogen oxidation, sulphur and iron oxidation, Nitrification & Ammonification. Photosynthesis – Oxygenic photosynthesis (Cyanobacteria), Anoxygenic photosynthesis (Bacteria).		
Unit:5	**ENZYMES AND CO –ENZYMES**	**10 hours**
IUBMB classification and nomenclature of enzymes, Factors affecting enzyme activity, Enzyme Kinetics-Michaelis –Menten constant, Line weaver – Burk plot, Active site, Enzyme specificity-Lock and key model or Fischer's template theory and induced fit theory or Koshland's model, Substrate strain theory. Enzyme kinetics- enzyme inhibition: Reversible – Competitive, Non-competitive. Irreversible inhibition. Co-enzymes.		
E-learning		**2 hours**
https://ocw.mit.edu/courses/biology/7-343-sophisticated-survival-skills-of-simple-microorganisms-spring-2008/ https://ocw.mit.edu/courses/chemistry/5-07sc-biological-chemistry-i-fall-2013/module-i/session-3/ Enzymes and catalysis https://swayam.gov.in/nd2_cec20_bt14/preview - Microbial Physiology & Metabolism https://swayam.gov.in/nd2_cec20_ag01/preview - Nutritional & Clinical Biochemistry		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	Microbial Physiology, 4thEdition Michael P. Sector),Albert G. Moat(Editor),John W. Foster(Editor),Michael P. Spector
2	Chemical microbiology –An introduction to microbial physiology –AH Rose, Butterworth, London
Reference Books	
1	Brock Biology of Microorganisms (14thEdition) Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley,David A. Stahl, January 12, 2014; ISBN-10:0321897390; ISBN-13:978-0321897398
2	The Physiology and Biochemistry of Prokaryotes-4thEdition David White, James Drummond ,Clay Fuqua,December 2011
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://ocw.mit.edu/courses/biology/7-343-sophisticated-survival-skills-of-simple-microorganisms-spring-2008/
2	https://ocw.mit.edu/courses/chemistry/5-07sc-biological-chemistry-i-fall-2013/module-i/session-3/Enzymes and catalysis
3	https://swayam.gov.in/nd2_cec20_bt14/preview - Microbial Physiology &Metabolism
4	https://swayam.gov.in/nd2_cec20_ag01/preview - Nutritional & Clinical Biochemistry
Course Designed By: Dr. M. Gnanadesigan	

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	L	S	L	M	M	M	L	S	L

CO2	M	L	S	L	S	L	L	S	S	L
CO3	S	L	L	L	S	L	L	L	L	L
CO4	M	L	L	L	M	L	L	S	L	L
CO5	L	L	M	M	L	L	L	L	L	L

Course code	25MBTBC04	MICROBIAL GENETICS AND rDNA TECHNOLOGY	L	T	P	C
Core Paper: IV			3	1	-	4
Pre-requisite		Should have the knowledge about the structure of DNA	Syllabus Version	2024-25		

Course Objectives:

The main objectives of this course are to:

1. Understand the mechanism of genetic mutations
2. Recalling the molecular genetics concepts and genetic transformation
3. To familiarize gene expression in prokaryotes
4. To learn gene cloning strategies and expression analysis
5. Applications of recombinant DNA technology in various fields

Expected Course Outcomes:

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

1	Comprehend the evolution of microbial genome and speciation	K3
2	Differentiate between natural and artificial transformation in prokaryotes	K4
3	Understand the genetic flow of information	K5
4	Design a vector for cloning and Construct a recombinant strain for expression studies	K6
5	Understand the skills required for genetic engineering	K4,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	ORIGIN OF MICROBIAL GENETICS	14 hours

Microbial genomics -

Concepts of genome flux, genome regression, and genome expansion, concept of mobile genetic elements (plasmids, transposons, integrons and phages),various mechanisms used by microbial organisms to regulate gene expression at different levels from signals to cell responses, signals integration and global regulatory networks (concepts of regulon, modulon, and stimulon), stress adaptation, microbial differentiation process (e.g., sporulation), cell to cell signalling (quorum sensing) and microbial collectivism (e.g., biofilms formation, toxins production, virulence onset, altruistic behaviours in microbial populations), phase variation mechanisms

DNA mutation diagnosis: allele specific oligonucleotides (ASO), protein truncation test, single strand conformational polymorphism (SSCP), Nucleotide sequencing, Denaturing gradient gel electrophoresis, heteroduplex analysis, DNA micro array analysis; Reversion - AMES Test

Unit:2	GENE TRANSFER IN BACTERIA	12 hours

Transformation - discovery and its significance- factors involved in competence and recombination, joint transformation and its uses; **Conjugation** - F+ and F^- nature of *E.coli*; Origin of Hfr and $F^{\cdot\cdot}$ strains - Zygotic induction -Chromosome transfer by Hfr - circular nature of *E.coli* DNA -Use of Hfr strains in genetic mapping; **Transduction** - Specialized transduction and λ phage - Generalised transduction - P1 phage-origin of transducing particles, Co-transduction-fine structure mapping of genes by P1 transduction-Wu's Formula-Ratio Test, C-value paradox; **Transposons**: Types - class II, class I (Retrotransposons); Mechanism; Characteristics; regulation of transposition; **Prokaryotic**

DNA Replication- Semiconservative mechanism, Rolling circle, Replication phases – initiation, elongation, termination; **DNA damage** - SOS response, DNA repair; **DNA damage detection strategies** TUNEL assay, Immuno dot-blot assay, NMR spectroscopy		
Unit:3	**ELUCIDATION OF GENETIC CODE**	**10 hours**
Benzer, Khorana and Crick's contributions-Triplet nature of the Genetic code and Adaptor hypothesis-Wobble hypothesis; **Prokaryotic transcription** – Initiation, elongation and termination, regulation; **Prokaryotic translation** and regulation; Regulation of gene expression- well studied operon models-*lac*, *trp*and *ara*operon		
Unit:4	**BASICS OF r-DNA TECHNOLOGY**	**12 hours**
Restriction enzymes and their role in r-DNA technology - Restriction-modification system methylase, ligase, adaptors, linkers, homopolymer tailing; **Vectors**: Plasmids (pBR 322) Bacteriophages (λ, M13) mediated vectors; Eukaryotic expression vectors, prokaryotic expression vectors; Vectors for protein over expression, protein secretion and controlled expression; **Cloning strategies**: Cloning into gram negative, gram positive bacteria and Yeast; Screening of recombinants- α complementation and blue-white selection.		
Unit:5	**APPLICATION OF rDNA TECHNOLOGY**	**12 hours**
Types of PCR - Real-Time PCR (quantitative PCR or qPCR), Reverse-Transcriptase (RT-PCR), Multiplex PCR, Nested PCR, High Fidelity PCR, Fast PCR, Hot Start PCR, GC-Rich PCR; **Library construction** - Construction of cDNA Library - use of phagemids and Cosmids; **Genome editing**: Double stranded DNA breakage - Homologous recombination - Non homologous recombination - site specific recombination - engineered nuclease - mega nucleases, Zinc finger nucleases, TALEN, MAGE – CRISPR; Base editing **DNA sequencing**- DNA and RNA hybridization- Southern and Northern blotting - Sangers method - Basics of pyrosequencing, Next Generation Sequencing strategies - western blotting for proteins; **Application** in human genetics and forensic science - RAPD, RFLP, AFLP, Dot and colony blotting		
E-learning		**2 hours**
• https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=3 • Genetic Engineering & r DNA technology – site directed mutagenesis Cloning strategies • Molecular therapeutics – gene editing, gene regulation and gene silencing • https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2 Molecular Biology, genetic engineering & Biotechnology – DNA repair; DNA damage; Genetic recombination		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Principles of Gene Manipulation and Genomics- S.B.Primrose and R.M.Twyman, John Wiley & Sons Ltd, 7th edition, 2006
2	Molecular Genetics: An introductory narrative, Second Edition - Gunther.S.Stent and Richard Calendar, 2002. CBS Publishers and distributors.
3	Gene cloning and DNA analysis, T.A. Brown, John Wiley & Sons, 2013

Reference Books

1	Microbial Genetics, Stanley R Maloy; John E Cronan; David Freifelder, Boston : Jones and Bartlett Publishers, second edition, ©1994.

2	A Short Course in Bacterial Genetics: A Laboratory Manual and Handbook for Escherichia coli and Related Bacteria- Jeffrey. H. Miller, 1992.CSHL Press
3	Genetics of microbes**,** Brian W. Bainbridge, **DOI**https://doi.org/10.1007/978-1-4615-7093-6
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd1_noc20_bt32/preview - Genetic engineering
2	Synthetic Biology, Artificial Intelligence, and Quantum Computing DOI: http://dx.doi.org/10.5772/intechopen.83434
3	Machine Learning in Genomics – Current Efforts and Future Applicationshttps://emerj.com/ai-sector-overviews/machine-learning-in-genomics-applications/
4	DNA digital data storage https://geneticeducation.co.in/dna-digital-data-storage/; https://www.nature.com/articles/s41576-019-0125-3
Course Designed By: Dr. J. Angayarkanni	

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	M	M	M	S	S	L
CO2	L	L	L	S	L	L	L	S	S	L
CO3	S	L	L	S	L	L	M	S	S	L
CO4	M	M	M	S	M	L	M	S	S	L
CO5	L	S	S	S	M	L	S	S	S	L

Course code	25MBTBCP1	**BASIC MICROBIOLOGICAL TECHNIQUES**	**L**	**T**	**P**	**C**
Practical -I			**-**	**-**	**-6**	**4**
Pre-requisite		**Basic Knowledge in handling of Microbial cultures**	**Syllabus Version**		**2025-26**	

Course Objectives:

The main objectives of this course are to:

1. Hands on training on staining and sterilization techniques.
2. To prepare microbiological media for organism isolation and cultivation.
3. Identify the bacterial culture through microscopic and Biochemical techniques.
4. Gain adequate knowledge on various intrinsic factors of growth and growth rate of bacteria
5. To provide the insight of the Microbial Metagenomic approach.

Expected Course Outcomes:

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

1	Gain a strong foundation on basic microbiological techniques.	K3
2	Pursuing high skills and hands on training on isolation of microbes from various niches	K4
3	Acquires knowledge on various intrinsic factors of growth and growth rate of bacteria.	K5
4	Identify a microbe to a general level	K5
5	Identify industrially important microbes	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Isolation of Microbes

Bacteria

1. Isolation of bacteria from soil/Marine sediment using spread plate technique.
2. Isolation of Endophytic bacteria using pour plate technique.
3. Isolation of bacteria from water samples using Membrane filtration technique .
4. Isolation of bacteria from air samples using Passive (Settle plate) technique.
5. Genetic analysis of an environmental sample – Metagenomics (Demonstration)

Fungi

6.From soil

a. Isolation of fungi from soil using serial dilution techniques

7.From water/marine

b. Isolation of fungi from water sample by serial dilution technique

8.From plant(plant pathogens)

c. Isolation of pathogenic fungi from tomato/any crop

Actinomycetes

9.Isolation of actinobacteria from soil

10.Isolation of actinobacteria from plant

Screening of Industrially important organisms

11.Enzyme producing bacteria and fungi (Amylase, Protease)

12. Screening of Amylase producing bacteria using Starch agar-Gram's iodine method.

13. Screening of Protease producing bacteria using Skim milk agar method.

14.Antibiotics producing Actinobacteria/fungi
15.Pigment producing bacteria/actinobacteria

Identification of Microbes
Morphological identification-Staining techniques
16.Gram staining
17.Simple staining
18.Spore staining
19.Capsule staining
20.Negative staining
21. Identification of fungi- LPCB method.
22.Biochemical Characterization of bacteria
23.IMVIC
24.H_2S test
25.Oxidase
26.Catalase
27.Urease
28.Nitrate reduction
29.Polymer degradation- Starch, Casein, Gelatin
30.Carbohydrate fermentation test
Metagenomic identification

Total Practical hours	**90 Hours**

Reference Book(s)

1	Cappuccino, J and Sherman, N. (2014) Microbiology. A Laboratory Manual. 10th Edition. Pearson Education Publication, New Delhi
2	Emanuel Goldman and Lorrence H. Green (2015) Practical Hand Book of Microbiology, 3rdEdition, CRC Press. Taylor and Francis Group.
3	Alfred E. Brown (2010) Benson's Microbiological Applications: Laboratory Manual in General Microbiology, 11th Edition, McGraw-Hill Companies.
4	Practical Microbiology- Dr.D.K.Maheshwari and Dr.R.C.Dubey

E –Learning

1. Labster.com/microbiology-virtual-labs/
2. http://www.microbiologyonline.org.uk/media/...sgm_basic_practical_microbiology_2.pdf_

Course Designed By: Dr.K.Preethi

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	M	S	S	L
CO2	S	S	S	S	L	L	L	M	M	L
CO3	S	S	S	S	L	L	M	M	S	L
CO4	S	S	S	S	L	L	M	M	L	L
CO5	S	S	S	S	L	L	L	M	L	L

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

Course Code	**25MBTBC05**	**IMMUNOLOGY AND IMMUNO-TECHNIQUES**	**L**	**T**	**P**	**C**
Core Paper: V			**4**	**1**	**-**	**4**
Pre-requisite		**Prior exposure to bacteriology and mycology**	**Syllabus version**		**2024-25**	

Course Objectives:

The main objectives of this course are to:

- Provide knowledge on the mechanism of action of immune system.
- Understanding principle and methodology of various immunological techniques.
- Learning the fundamental mechanism behind organ transplantation, autoimmune disorders and hypersensitive reactions.
- To learn about various vaccines and vaccination methods.

Expected Course Outcomes:

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

1.	Able to know about the importance of immune system	K1
2.	Able to understand the structure, principles and functions of various cells and organs of the immune system.	K2
3.	Equipped to perform various immunological assays.	K3
4.	Able to understand disorders and diseases related to immunology and apply knowledge on transplantation techniques	K2, K3
5.	Able to understand the principles and applications of vaccines in immunotherapy	K2, K3, K4

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**- Analyze; **K5**-Evaluate; **K6**- Create

Unit I	**Immunity and Types**	**11 Hours**

History and Scope of Immunology, Immunity:Types-innate and acquire, active and passive, Cell mediated and Humoral Immunity. Hematopoiesis- origin, development and differentiation of immune cells.

Unit II	**Cells and Organs of the Immune System**	**12 Hours**

Antigen- types and properties (foreignness, molecular size, heterogeneity) Haptens, adjuvants, carriers, Bacterial, Viral and Tumour antigens, autoantigens, blood group antigens and Rh factors. B and T cell epitopes, T-cell dependent and T -cell independent antigens.

Antibody- structure, function, properties, Immunoglobulin- structure, types and functions. Antigenic determinants (isotype, allotype, idiotype). Hybridoma technology- Monoclonal antibody production and applications in diagnosis and therapy, abzymes, catalytic antibodies.

The complement system: components, Mode of activation and pathways (classical, alternative and lectin pathway).

Unit III	**Immunological Techniques**	**12 Hours**

Antigen-Antibody reactions- precipitation, agglutination, immunodiffusion, immunoelectrophoresis, ELISA and its types, Immunofluorescence, Flow cytometry. Immune electron microscopy. Factors governing antigen-antibody interactions; affinity, avidity, valency, cross reactivity.

Transplantation immunology: MLR, HLA Typing. Types of graft, immunologic basis of graft rejection, properties and types of rejection. Bone -marrow transplantation, organ

Unit IV	**Transplantation Immunology**	**12 Hours**

Primary and Secondary antibody response, Response of B cell to antigen, B cell and T cell activation.

MHC molecules -Structure, types and Functions . Antigen processing and presentation.

T cell products- Cytokines; properties, functions and types.

Unit V	**Vaccines and Immunotherapy**	**12 Hours**

Hypersensitivity reactions and types. Auto immune diseases-Hashimoto's thyroiditis, Good Pasture's syndrome, SLE, RA, Immunodeficiency disease- SCID, CGD, Congenital neutropenia and Chediak-Higashi syndrome. Cancer of the immune system, Immunotherapy. FACs., Vaccine Technology in Immunotherapy.

E- Learning **2 hours**

- History of Immunology - link.springer.com>chapter
- Applications of modern immunological techniques – link.springer.com>chapter
- Applications of Immunology- www.lamission.edu>lifesciences>steven
- Immunity types- health.mil>clinical-consultation-services>Immunology
- www.narayanahealth.org>organ-transplant

Total Lecture Hours **61 Hours**

Text Book(s)

4.	Rao, C.V. (2012) An Introduction to Immunology. 2nd Edition, Narosa Publishing House, India.
5.	Janeway, C.A., Travers, P., Walport, M. and Shlomchik, M.J. (2001) Immunobiology: The Immune System in Health and Disease, 5th Edition, Garland Publishing, USA.
6.	Immunology, an Introduction: Tizard, Ian R, 1984

Reference Book(s)

1.	Kubey, J. 1993. Immunology Freeman and company.
2.	Ivan M. Roitt and Peter J. Delves (2016) Essential Immunology, 13th Edition, Blackwell Science Ltd. Oxford.

Course Designed by: Dr. K. Preethi

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	M	L	L	L	M	M	L	M	L
CO2	L	M	L	L	L	M	M	L	M	L
CO3	L	M	L	L	L	M	M	L	M	L
CO4	S	S	M	S	S	M	S	M	M	M
CO5	L	L	L	L	M	M	S	S	S	M

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

Course code	25MBTBC06	**AGRICULTURAL MICROBIOLOGY**	**L**	**T**	**P**	**C**
Core Paper: VI			**3**	**1**	**-**	**4**
Pre-requisite		**Basic knowledge in microbiology and agriculture**	**Syllabus Version**		**2024-25**	

Course Objectives:

The main objectives of this course are to:

1. To gain knowledge about the basics of Agricultural Microbiology.
2. To understand the concept of microbial interactions with plants and diseases caused by microbes.
3. To learn about Biopesticides, Bioherbicides and Biofertilizers.
4. To learn the scope and applications of Biocontrol agents.
5. To learn about the symbiotic relationship of plants &microbes.

Expected Course Outcomes:

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

1	To understand the basic information about soil microbiology.	K3
2	To remember the interaction of plants and microbes in the soil	K1
3	Able to understand the concept of Phytopathology and its management	K4
4	To understand the importance of microbes as Biocontrol agents	K5
5	Able to apply and guide the usage of biopesticides, bioherbicides and biofertilizers to the needy farmers	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**BASICS OF SOIL MICROBIOLOGY**	**10 hours**

Soil Microbiology-Structure, Types, Physical and Chemical properties-Soil microbes (Types and Enumeration)-Weathering and Humus formation, Soil pollution-Sources. Biogeochemical cycling-Nitrogen, Carbon, Phosphorous, Sulphur, Iron cycles and its importance.

Unit:2	**MICROBIAL INTERACTIONS**	**15 hours**

Microbial interaction-among microbes- Neutralism, Commensalism, Symbiosis, Synergism, Amensalism, Parasitism, Predation and Competetion. With plants- Phyllosphere, Rhizosphere, Mycorhizzae - vesicular arbuscular mycorrhizae -VAM) - ecto, endo, ectendomycorrhizae .

Symbiotic and free-living nitrogen fixers (Rhizobium, Azotobacter, Azospirillum, Frankia, BGA and Azolla -Phosphate solubilizers (Phosphobacterium and Aspergillus) Interrelationships between soil microbes and plants, Rhizosphere concept, R: S ratio, rhizoplane; spermosphere; phyllosphere, Mycorrhizae-types, Rumen flora, Insects microbial interactions.

Unit:3	**PHYTOPATHOLOGY**	**10 hours**

Phytopathology – Classification of plant diseases, signs, and related terminology. Bacterial disease – Citrus canker, Blight of paddy, Fungal Disease- Red rot of sugarcane, Black stem rust of wheat, Tikka leaf spot, Wilt of cotton, Viral Disease – TMV, Vein clearing disease. Principles and methods of plant disease management, integrated plant disease management.

Unit:4	**BIOCONTROL AGENTS**	**10 hours**

Interaction of pesticides with soil microorganisms. Biopesticides- *Bacillus thuringiensis, B. Sphaericus, B. Popilliae, Psuedomonassyringae*. Microbial control of plant pathogens-

Trichoderma, Use of Baculovirus, NPV virus, Protozoa & Fungi in biological control. Microbial herbicides-Useful genes from microorganisms for agriculture (Herbicide resistant, Bt, Viral). Agricultural antibiotics.		
Unit:5	**SYMBIOTIC MICRO ORGANISMS**	**13 hours**
Earthworms and microorganisms- The effects of earthworms on the number, biomass and activity of microorganisms, Role of Earth worms in organic agriculture. Production, formulation, packing and marketing of single cell proteins (mushrooms, spirullina and yeast); Biofertilizers- Introduction, biofertilizers using nitrogen fixing microbes- phosphate solubilisation- Rhizobium, Azospirillum, Azolla; Anabaena symbiosis, Blue green algae and Ecto and Endomychorizae. Cultivation, mass production and inoculation of Rhizobium, Azobacter, Azospirillum, Azolla and Cyanobacteria, Carrier- based inoculants, methods of application, quality control and agronomic importance. Application methods. Microorganisms for Bioassay and Biological warfare.		
E-learning		**2 hours**
https://apsjournals.apsnet.org/doi/full/10.1094/PDIS-03-15-0340-FE https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6482238/ https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0215502 https://www.frontiersin.org/articles/10.3389/fmicb.2019.00827/full https://www.softwebsolutions.com/resources/plant-diseases-detection-using-iot.html		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Dirk J, Elas V, Trevors JT, Wellington, EMH (1997) Modern Soil Microbiology, Marcel Dekker INC, New York.
2	Agricultural Microbiology by G.Rangaswamy and D.J.Bagyaraj, Prentice Hall India.
3	Bio-fertilizers in Agriculture and Forestry, 1995, by N.S. SubbaRao.
4	Microbes for Sustainable Agriculture by K.V.B.R. Tilak, K.K. Pal, RinkuDey
5	Soil Microbiology and Plant Growth, 1995, by N.S. SubbaRao.
6	Plant Growth and Health Promoting Bacteria by Dinesh K. Maheshwari

Reference Books

1	Plant-microbe interactions, Volume 1 by Gary Stacey and Noel T. Keen 8. Biological control of crop diseases Volume 89 of Books in soils, plants, and the environment by S. S. Gnanamanickam
2	Plant-microbe interactions and biological control Volume 63 of Books in soils, plants, and the environment by Greg J. Boland, L. David Kuykendall
3	Plants, genes and agriculture by M.J. Chrispeels and D.F. Sadava.2000.The American Scientific Publishers, USA.
4	Practical Application of Plant Molecular Biology by R.J. Henry.1997. Chapmans and Hall.
5	Plant Biotechnology and Transgenic Plants, Edited by Kirsi-MarjaOksman- Caldentey and Wolfgang H. Barz. 2002, Marcel Dekker, Inc. New York.
6	Chauhan, A. (2012)Vermitechnology, Vermiculture, Vermicompost and Earthworms: Vermiculture, Vermicomposting, Vermitechnology and Mirobes,Lambert Academic Publishing, Germany

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/126/105/126105014/
2	https://swayam.gov.in/nd1_noc19_ag04/preview
3	https://www.youtube.com/watch?v=-UFiFpMxM3M
4	https://www.youtube.com/watch?v=mU1tlx0JGM8
5	https://www.youtube.com/watch?v=gsH3kR-6mG4
6	http://agrimoon.com/agricultural-microbiology-icar-ecourse-pdf-book/
7	https://www.youtube.com/watch?v=U9sDkDhmf08
8	https://www.frontiersin.org/articles/10.3389/fpls.2019.01457/full
9	https://www.youtube.com/watch?v=8YuqlgsC4ns
10	https://www.frontiersin.org/articles/10.3389/fpls.2016.01419/full

Course Designed By:**Dr.G.KAPILDEV**

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	M	S	S	S	M	L
CO2	L	M	M	M	L	S	L	S	M	M
CO3	L	L	L	L	L	S	L	S	L	L
CO4	M	L	L	M	L	S	M	S	M	M
CO5	M	L	S	S	L	M	M	L	S	M

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

Course code	25MBTBC07	**FOOD MICROBIOLOGY**	L	T	P	C
Core Paper: VII			**3**	**1**	**-**	**4**
Pre-requisite		**Basic Knowledge about food safety and the role of microorganisms in food**	**Syllabus Version**		**2025-26**	

Course Objectives:

1. To impart knowledge about the various areas related to food science as a discipline
2. To encode the importance of the role of microorganisms in food industries both in beneficial and harmful ways
3. To develop an understanding of food composition, principles of preservation, new product development, food quality and analysis and food safety standard law.

Expected Course Outcomes:

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

1	Explain the importance and various types of ferment products.	K3
2	Used to study the advantages of disadvantage of food additives	K4
3	Able to identify the characteristics of food borne, water borne of food sport age micro organisms	K4
4	Acquire knowledge on indictor organism and its solution methods	K3
5	Apply traditional methods for food preservation food safety stand and law of their importance in food industry.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Unit:1	**Fermentation Products**	**10-- hours**

Dairy products: - Production of starter cultures; Cheese - principles of cheese making. Cheddar Cheese, Swiss Cheese, Surface ripened Cheeses; Mold ripened Cheeses. General principles of manufacture of Yogurt, acidophilus milk, Kefir, Koumiss. Fermented foods: Soy sauce, Miso, Sufu, Natto, Idli, fermented fish products. Fermented vegetables: Sauer kraut, pickles, Olives. Fermented sausages.

Unit:2	**Distilled beverages &Food additives**	**10-- hours**

Alcohol, wine, brandy and beer. Production of additives - organic acid (acetic acid, lactic acid and citric acid), amino acids (glutamic acid, lysine, threonine, arginine and histidine), food flavourants and pigments

Unit:3	**Food Spoilage and Public Health & Food Preservation**	**12-- hours**

Staphylococcal, Salmonellosis, E.coli, Botulism, aflatoxin and amine production; food spoiling enzymes; Deterioration of foods- vegetables, meat, poultry, sea food and fruits, Principles of food preservation – methods of preservation: Physical (irradiation, drying, heat processing, chilling and freezing, high pressure and modification of atmosphere); Chemical (Sodium benzoate Class I & II); Biological: Probiotics and bacteriocins.

Unit:4	**Indicator Organisms**	**8-- hours**

Indicators of food microbial quality and safety, some indicators of product quality and safety- Coliforms, *Enterococci, Bifidobacterium, Coliphages.*Direct examination – culture techniques – enumeration methods – plate – Viable & Total Count; Alternative methods – Dye reduction

tests, electrical methods, ATP determination: Rapid methods, immunological methods – DNA / RNA methodology.		
Unit:5	**Food Process Technology**	**12-- hours**
Packaging and canning of foods – preparation for packaging, thermal processing of foods: Microwave heating, thermal inactivation of microorganisms, thermal process, evaluations, freezing and thawing of foods. Food process operations: Evaporation - single and multi-effect evaporation, dehydration, psychomatric charts, drying-tunnel, tray, spray, drum, freeze, distillation; food processing aid through biotechnology, Food sanitation: Good manufacturing practices – Personnel hygiene, Hazard analysis and Critical control points (HACCP) system for food safety, HACCP Principles, applications of HACCP principles, Food safety regulations and practices in India, FDA, ISI.		
E-learning		2 hours
● https://www.studocu.com/row/document/egerton-university/food-nutrition-and-dietetics/lecture-notes/food-science-and-technology-module-pdf/5275169/view ● https://www.studocu.com/row/document/jagannath-university/food-microbiology/lecture-notes/food-microbiology-lecture-notes-1/3561336/view ● http://ecoursesonline.iasri.res.in/course/view.php?id=131		
Case study • Students can visit food industries such as milk products and milk processing, and submit a report on waste discharge and management practices. • Visit beverage industries and distilleries to observe product manufacturing processes. • Study the food processing techniques used in the industries and submit a report on the methods observed. • Students can visit hospitals for patients admitted for food poisoning and submit report on the causative agents, symptoms and treatment.		
	Total Lecture hours	**58 hours**

Text Book(s)	
1	Industrial Microbiology, 1983, 4th Edition, Prescott and Dunn's, Gerald Reed, AVI Publishing Company Inc. Conneticut.
2	Food Microbiology- Frazier, 1987, Tata McGraw-Hill Education
Reference Books	
1	Food Biotechnology. 1982. by Knorr, D. Marcel Dekker, New York
2	Biotechnology, 1983, VI-VIII, Rehm, H.J. and Reed,G, Verlag Chemie,Wainheim
3	Genetic Engineering Applications for Industry, 1981, Paul,J.K.,Noyer Corporation, New Jersey
4	Fundamentals of Food Process Engineering, 1980, Toledo,R.T., AVI Publishing Co., USA.
5	Food Engineering Operations, 1979, 2nd Edition, Brennan,J.G., Bulters,J.R., Gowelx,N.D and Lilly, A.E.V., Applied Science Publishers
6	Food Process Engineering, 1977, 2nd Edition, Heldman, D.R., AVI Publishing
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	

1	Food Science and Processing https://swayam.gov.in/nd2_cec19_ag05/preview
2	Food Microbiology and Food Safety https://swayam.gov.in/nd2_cec20_ag13/preview
3	Food Preservation Technology https://swayam.gov.in/nd2_cec19_ag01/preview
4	Introduction to food Microbiology https://nptel.ac.in/courses/126/103/126103017/

Course Designed By: Dr.K. Preethi

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	M	L	M	L	M	M	M
CO2	S	M	S	S	M	M	S	S	S	S
CO3	S	S	S	S	S	M	L	S	S	S
CO4	S	M	S	S	M	M	M	S	M	S
CO5	S	S	S	S	M	S	S	M	S	S

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

Course code	25MBTBC08	ENVIRONMENTAL MICROBIOLOGY	L	T	P	C
Core Paper: VIII			4	-	-	4
Pre-requisite		Aware of environmental problems	Syllabus Version	2024-25		

Course Objectives:

The main objectives of this course are to:

1. To understand the role of microbes in biogeochemical processes in differenecosystems.
2. To provide the knowledge of microbes in the air pollution control measures.
3. To give information about various water pollution sources and their preventive measures.
4. To learn about the importance of microbes in the solid waste managment.
5. To improt the knowledge of the methodology skills in Microbial effluent treatment process.

Expected Course Outcomes:

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

1	The students will aware about the Microbial roles in Ecology aspects and biogeochemical cycles	K2
2	The students will gain the knowledge of the air microbial quality analysis and their control measures	K2
3	The students can assess the water quality analysis.	K3
4	The student will aquire the knowledge of various solid waste management methods.	K4
5	It enalbes the student to learn methods of various effluent treatment methods	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Basic Concepts of Ecology	10 hours

Interaction between environment and biota; Concept of habitat and ecological niches; Limiting factor; Energy flow, food chain, food web and tropic levels; Ecological pyramids and recycling, biotic community-concept, structure, dominance, fluctuation and succession; N.P.C and S cycles in nature. Soil Microbiology-Structure, Types, Physical and Chemical properties-Soil microbes (Types and Enumeration)-Weathering and Humus formation, Soil pollution-Sources.

Unit:2	Aerobiology	12 hours

Aerobiology-Microbial contamination of air-Sources of contamination-Biological indicators of air pollution. Enumeration of bacteria from air, Air sampling devices. Significance of air Microflora, Air sanitation. Air pollution : Types, source, method of sampling, measurement, impact on ecosystem and control. Control of noise and air pollution by biotechnological methods. Gaseous pollutants and odours: General sources, methods of control; fundamentals of adsorption, mechanism of adsorption.Application of adsorption for control of gaseous and odour emission. Noise pollution: Source, measurement, impact on ecosystem and control.

Unit:3	Aquatic Microbiology	12 hours

Microbiology of water (Aquatic environment-Fresh and Marine)-Water pollution: Impurities in water, water pollution by industrial waste, examination of water, collection of water samples, water analysis – physical, chemical and biological. Assessment of water quality (Chemical and Microbial-indicator organisms) Water treatment processes: Primary treatment, screening, skimming with coagulants, flocculation, filtration, aeration and disinfection; Secondary treatment: Aerobic processes – activated

sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactors; Tertiary treatment: Activated carbon treatment, reverse osmosis and electro dialysis. Water borne pathogens.		
Unit:4	**Solid Waste Management**	**10 hours**
Sewage sludge treatment and utilization, refuse disposal, excreta disposal in unsewered area; composting and vermiculture.; bioconversion of cellulosic wastes into protein and fuel ;biodegradation of noncellulosic wastes for environmental conservation; bioaugmentation and biostimulation,; biodegradation of xenobiotics; bioremediation of contaminated soils and waste lands; radioactive product waste disposal.		
Unit:5	**Effluent Treatment**	**12 hours**
Case studies: Sources of pollution, impact on ecosystem and treatment of following industrial effluents: starch, paper and pulp, tannery, dairy, textile, distillery, oil refineries and pharmaceutical. Significance of ETP, STP, AHU, Bio inactivation plant. Microbes in mining, ore leaching, oil recovery, biopolymers, biosurfactants.		
E-learning		**2 hours**
https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14 Environmental Science – All modules https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-89-environmental-microbiology-fall-2004/syllabus/ Environmental Microbiology – study materials of MIT **Swayam course:** https://swayam.gov.in/nd1_noc20_ce17/preview - Applied Environmental Microbiology		
	Total Lecture hours	**61 hours**

Text Book(s)

1	Environmental Biotechnology by Alan Scragg.(2005). IInd edition. Pearson Education Limited, England.
2	Environmental Biotechnology by S.N. Jogdand. (1995). Ist edition. Himalaya Publishing House.Bombay.

Reference Books

1	Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy, Inc., Tata McGraw Hill, NewDelhi.
2	Environmental chemistry by A.K. De Wiley Eastern Ltd. NewDelhi.
3	Introduction to Biodeterioration by D. Allsopp and k.J. Seal, ELBS/Edward Arnold.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14 Environmental Science – All modules
2	https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-89-environmental-microbiology-fall-2004/syllabus/ Environmental Microbiology – study materials of MIT
3	https://swayam.gov.in/nd1_noc20_ce17/preview - Applied Environmental Microbiology

Course Designed By: Dr.M. Gnanadesigan

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	L	L	L	S	L	L	L	L	L
CO2	S	L	L	L	S	L	L	L	L	L
CO3	M	L	M	M	S	L	L	L	M	L
CO4	M	L	M	M	S	L	L	L	M	L
CO5	M	L	M	L	S	L	L	L	M	L

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

Course code	25MBTBCP2	**ADVANCED MICROBIOLOGICAL TECHNIQUES**	**L**	**T**	**P**	**C**
Practical –II			**-**	**-**	**6**	**4**
Pre-requisite		**Basic Microbiological Techniques**	**Syllabus Version**		**2024-25**	

Course Objectives:

The main objectives of this course are to:

1. Hands on training of isolation of different bacterial isolates
2. To provide the Isolation of DNA and Protein biomolecules.
3. To assess the water Quality analysis

Expected Course Outcomes:

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

1	Gain a strong foundation on environmental and agriculture microbiological techniques.	K3
2	Pursuing high skills and hands on training on Microbial Molecular analysis.	K4
3	Acquires knowledge on water quality analysis parameters	K5
4	Identify novel microbial product	K5
5	Design production process of microbial products	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Practical

Production of metabolites

a. Amylase production (*Aspergillus niger*)
b. Inoculum development
c. Optimization of conditions (pH, temperature, time)
d. Purification of enzyme
e. Precipitation of protein
f. Ion exchange chromatography by FPLC
g. Gel filtration chromatography by FPLC
h. Construction of purification table by calculating specific activity of enzyme
i. SDS PAGE analysis for purity
j. Citric acid production/Antibiotic production (Fungus/Actinobacteria)
k. Pigment purification by TLC and HPLC (Actinobacteria/Bacteria)

Antibody production

a. Antibody production- Egg
b. Antibody purification.
c. Electrophoresis for antibody titre determination
d. Immunoelectrophoresis - Counter current and Rocket Immunoelectrophoresis
e. Precipitation reaction - ODD test
f. Blood analysis
g. Blood grouping and Rh typing
h. Identification of lymphocytes Waste water analysis
i. Determination of MPN in water sample

j. Isolation of Bacteriophage from Sewage sample
k. BOD
l. COD
m. Metal analysis

Clinical pathogen identification

a. Isolation of pathogen from Sore Throat / Dental Caries
b. Hemolysis
c. Identification of isolated pathogen using Mitis-Salivaris Agar medium
d. Antibiotic sensitivity spectrum of the isolated strain with different generation antibiotics
e. Minimum Inhibitory concentration of the antibiotic by Kirby-Bauer method using disc diffusion assay

Biofertilizer production

a. Biofertilizer production and formulation using *rhizobium* culture
b. Culturing of microorganisms.
c. Inoculum preparation
d. Processing of carrier material.
e. Mixing the carrier and the broth culture and packing.
f. Preparation of Inoculants packet

Biopesticide production

a. Biopesticide production and formulation using *Trichoderma viride*
b. Culturing of microorganisms.
c. Inoculum preparation
d. Harvesting
e. Blending
f. Drying and Packing
g. Wine production

	Total Practical hours	**90 hours**

Reference Book(s)

1	Cappuccino, J and Sherman, N. (2014) Microbiology. A Laboratory Manual. 10th Edition. Pearson Education Publication, New Delhi
2	Emanuel Goldman and Lorrence H. Green (2015) Practical Hand Book of Microbiology, 3rdEdition, CRC Press. Taylor and Francis Group.
3	Alfred E. Brown (2010) Benson's Microbiological Applications: Laboratory Manual in General Microbiology, 11th Edition, McGraw-Hill Companies.
5	Practical Microbiology- Dr. D.K.Maheshwari and Dr.R.C.Dubey

E –Learning

3. https://youtu.be/FAIyzK9cqPY
4. https://youtu.be/YJ2UiuSHpuU
5. https://youtu.be/u84bTjqrt7k
6. https://youtu.be/i_6y6Z5UvwE
7. https://youtu.be/wRHKOGM6GHA
8. https://youtu.be/Gh0hXROo2ds
9. https://youtu.be/tcPgdR9_t64

10. https://youtu.be/GsWo8dCivWs 11. https://youtu.be/1Lm2C1fzGtQ 12. https://youtu.be/m1z7RxrjHOc										
Course Designed By: Dr. M. Gnanadesigan										
Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	L	S	M	M	L
CO2	S	S	S	S	M	L	S	L	M	L
CO3	S	S	S	S	M	L	S	M	M	L
CO4	S	S	S	S	M	M	S	M	M	L
CO5	S	S	S	S	M	L	S	M	M	L

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

Course code	**25MBTBC09**	**BIOPROCESS TECHNOLOGY**	**L**	**T**	**P**	**C**
Core Paper: IX			**3**	**1**	**-**	**4**
			Syllabus Version		**2024-25**	
Pre-requisite		**Aware of industrially important microbes and its products**				

Course Objectives:

The main objectives of this course are to:

1. Impart knowledge on the Components and units of a bioprocess industry
2. Enabling the students to Design and control the process & production in the industry
3. Familiarize with the Equipments and Microbes employed for the production unit
4. Provide the student with an understanding of the Economics, Control systems, Quality analysis and assurance
5. Learning on Artificial Intelligence role in relevant industries

Expected Course Outcomes:

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

1	Parts of a fermentation unit	K1
2	Select and design a fermentation process for a specific product	K3
3	Identify industrially important microbes & its potential applications	K2, K4
4	Troubleshoot the production rate of existing fermentation processes	K5
6	The project economics of the production unit	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**DESIGN AND TYPES OF BIOREACTOR**	**12-- hours**

Fermentor Structure - Construction Material, Basic Components – Agitator, Aerator, Valves And Steam Traps, Seals And Stirrer Glands. Measurement And Control Parameters (On-Line And Off Line Sensors) – Temperature, Flow Rate, Pressure, Ph, DO, Gas Analysis; Types Of Fermentors -Air-Lift, Stirred Tank, Tower, Fluidized Bed, Packed Bed, Pulsed, Photo Bioreactors, CSTR, PFR.

Unit:2	**PROCESS KINETICS**	**12-- hours**

Growth Kinetics - Batch, Continuous And Fed Batch; Sterilization Methods – Batch, Continuous, Medium, Air, Equipment; Fermentation Methods - Solid State, Surface, Submerged, Aerobic And Anaerobic Fermentation; Inoculum Development – Yeast, Bacteria, Mycelia, Vegetative Fungi - Aseptic Inoculation - Immobilization Of Cells & Co-Immobilization; Chemical Kinetics And Classification Of Chemical Reactors; Transport Phenomena - Mass Transfer, Heat Transfer, Oxygen Transfer.

Unit:3	**PRODUCTION KINETICS**	**12-- hours**

Design Of Single Reactor, Multiple Reactor Systems For Single Reaction, Reactions In Parallel, And In Series; Kinetics Of Heterogeneous, Non Catalytic, Catalytic Reactions; Non Ideal Flow - Residence Time Distribution (RTD) Studies, C,E, F And I Curves; Models For Non Ideal Flow – Zero, One And Two Parameter

Unit:4	**DOWNSTREAM PROCESSING**	**8-- hours**

Removal Of Microbial Cells And Solid Matter, Foam Separation, Precipitation, Filtration, Centrifugation; Cell Disruptions, Liquid-Liquid Extraction, Chromatography, Membrane Process; Drying And Crystallization.

Unit:5	**QUALITY ASSURANCE**	**10-- hours**
Quality Analysis And Product Formulation - Product Appearance, Product Stabilization And Shelf Life Analysis; Fermentation Economics Of Citric Acid – Process & Project Economics;		
	Total Lecture hours	**64-- hours**

Text Book(s)	
1	Principles of fermentation technology, Peter F. Stanbury, Allan Whitaker and Stephen J. Hall, Third edition, Elsevier publications, 2017
2	Bioprocess engineering- second edition, DG. Rao, Tata McGrawHill Publishing Co. Ltd., New Delhi, 2010
Reference Books	
1	Instrumentation, measurement and analysis, II edition, Nakra BC and Chaudhry KK, Tata McGrawHill Publishing Co. Ltd., New Delhi, 2004
2	Fermentation Microbiology and Biotechnology, Mansi El-Mansi and Charlie Bryce, CRC press, 4th edition, 2018
3	Manual of Industrial Microbiology and Biotechnology, III edition, Richard H. Baltz, Arnorld L. Demain and Julian E. Davies, ASM press, Washington DC, 2010
4	Biochemical Engineering Fundamentals, Baily, J., Bailey J. and Ollis,D.F., McGraw-Hill Book Co. New York, 2015
5	Bioprocess Engineering: Basic concepts, 3rd edition, Michael L. Schuler, Fikret Kargi, Matthew Delisa, Pearson publishers, 2017
6	Handbook of Downstream processing, Edin Goldberg, Blackie and Academic Professional, 1997
7	Ali, S., Rafique, A., Ahmed, M., & Sakandar, S., 2018. Different Type of Industrial Fermentors and Their Associated Operations for the Mass Production of Metabolite. Eur. J. Pharm. Med. Res., 5(5), 109-119.
8	Nduka Okafor,2017, Modern industrial microbiology and biotechnology, CRC Press 2nd Edition
9	Nooralabettu Krishna Prasad, 2010, Downstream Process Technology: A new horizon in Biotechnology, PHI Learning Pvt Ltd, New Delhi
10	Instrumentation, measurement and analysis, II edition, Nakra BC and Chaudhry KK, Tata McGrawHill Publishing Co. Ltd., New Delhi, 2003, Second Edition.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	SWAYAM - https://www.classcentral.com/course/swayam-principles-of-downstream-techniques-in-bioprocess-3967
2	NPTEL - https://nptel.ac.in/courses/102/105/102105064/# Aspects of Biochemical Engineering, Prof. Debabrata Das, IIT Kharagpur
3	NPTEL - https://nptel.ac.in/courses/102/106/102106083/ Transport Phenomena in Biological Systems- Prof.Suraishkumar, IIT Madras
4	Industrial Biotechnology https://online-learning.tudelft.nl/courses/industrial-biotechnology/
5	Downstream processing https://www.sartorius.com/en/knowledge/trainings/downstream-processing
6	Recent Technology biogas industry - https://www.bioprocesscontrol.com/academy/online-courses/

7	Transport Phenomena - https://online-learning.tudelft.nl/courses/the-basics-of-transport-phenomena/

Course Designed By: Dr.J.Angayarkanni

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	M	S	M	S	S	L	S	M	M
CO2	M	M	M	S	S	S	S	S	M	S
CO3	M	S	S	S	M	S	L	S	S	S
CO4	M	M	S	M	M	M	M	S	S	S
CO5	M	L	M	S	M	M	S	M	S	S
CO6	S	S	S	S	M	M	L	S	M	L

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

Course code	**25MBTBC10**	**MOLECULAR DIAGNOSTICS**	**L**	**T**	**P**	**C**
Core Paper: X			**3**	**1**	**-**	**4**
Pre-requisite		**Basic knowledge molecular techniques**	**Syllabus Version**		**2024-25**	

Course Objectives:

The main objectives of this course are to:
Impart knowledge on types of specimens
Understand methods of collection and processing of specimens

Expected Course Outcomes:

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

1	Acquire knowledge on type on specimens and their processing	K2
2	Diagnose pathogens from specimens through direct methods	K4
3	Comprehend the complexity of proteome and metobolome	K4
4	Understand the genetic disposition of inherited diseases	K5
5	Acquire knowledge on molecular diagnostic techniques	K3

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate;**K6**–Create

Unit:1 **CLINICAL SPECIMEN PREPARATION** **10hours**

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. Ethical issues related to molecular diagnostics.

Practical 1:

1. Collection of throat swab specimen
2. Isolation of pathogen from throat swab.

Unit:2 **DNA BASED DIAGNOSIS** **15hours**

PCR based assays: ARMS, methylation analysis, MLPA, competitive oligonucleotide priming, DHPLC, CSCE. Mutation screening panels (xTAG, Luminex) Micro arrays: SNP chromosomal microarrays, EST, SAGE, NGS in diagnostics

Practical 2; 1. PCR based pathogen detection; 2. NGS -DEMO

Unit:3 **PROTEOMIC AND METABOLOMICS ASSAYS FOR DIAGNOSTICS** **10hours**

Diagnostic proteomics: SELDI-TOF MS, Isotope coated affinity tag (ICAT), SILAC, i-TRAQ, Protein microarray. Metabolite profile for biomarker detection in the body fluids/tissues under various metabolic disorders.

Practical 3

1. Isolation of total protein from collected specimen;
2. Detection of specific protein using LC-MS

Unit:4 **APPLICATIONS OF MOLECULAR DIAGNOSTICS** **10hours**

Major Histocompatibility Complex (MHC): HLA typing- PCR based methods, SSO, SSP and SBT methods. Diagnosis of inherited diseases- Thalassemia, Cystic Fibrosis. Neonatal and Prenatal disease diagnostics: Noninvasive: Triple test, Ultrasonography (USG), Invasive: Amniocentesis (AC), chorionic villi sampling. Molecular diagnosis for early detection of Down syndrome. Fragile X syndrome.

Practical 4: 1. Lab visit for Ultrasonography and HLA typing

Unit:5	**APPLICATIONS IN MOLECULAR ONCOLOGY AND MICROBIAL DISEASES**	**13hours**
Molecular oncology testing in malignant disease- General methods for molecular diagnosis of cancer . Circulating tumour cell testing (CTC). Molecular diagnosis of various viral diseases: Dengue, SARS and COVID 19 comorbidities. Direct detection & identification of pathogenic-organisms - 16s rRNA typing. Practical 5; 1.Detection of comorbidities of bacterial infection through real time PCR		
Unit:6	**AI in Molecular Diagnostics**	**12hours**
1. https://genomemedicine.biomedcentral.com/articles/10.1186/s13073-019-0689-8 2. https://aacrjournals.org/clincancerres/article/27/5_Supplement/IA-19/32789/Abstract-IA-19-Machinelearning-and-AI-in 3. https://www.labcompare.com/10-Featured-Articles/576229-The-AI-Technologies-Driving-Advancements-in-Clinical-Diagnostics/		
E-learning 2hours		
https://onlinecourses.nptel.ac.in/noc20_cs42/preview		
Total Lecture hours		**72hours**

TextBook(s)	
1	Wayne W. Grady, Robert M. Nakamura, Charles M Strom and Frederick L. Kiechle. Molecular Diagnostics: Techniques and Applications for the Clinical Laboratory. Academic Press
2	PongaliRaghavendra and ThammineniPullaiah Advances in cell and molecular diagnosis. Academic Press
3	Geaorge P. Patrinos, Wilhem J. Ansorge and Philip B. Danielson Molecular Diagnostics. Maca Haley, Academic Press
4	David E. Bruns, Edward R. Ashwood and Carl A. Burtis. Fundamentals of Molecular Diagnostics. Saunders Elsivier.

ReferenceBooks	
1	Nader Rifal, Andrea Rita Horvath, Carl T. Wittwer and Janson Y. Park. Principles and applications of molecular diagnostics. Elsevier

RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]	
1	https://www.youtube.com/watch?v=LKkp457UnOY
2	https://www.youtube.com/watch?v=u0oTLNmXINE
3	https://www.youtube.com/watch?v=3NiFjm_SiFs

Course Designed By: Dr. V. BrindhaPriyadarisini

Mapping with Programme Outcomes

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	L	S	L	L	L	L	M
CO2	L	S	L	L	L	L	L
CO3	L	S	L	L	L	L	L
CO4	L	S	L	L	L	L	L
CO5	L	S	L	L	L	L	M

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

Course code	25MBTBC11	CELL CULTURE TECHNIQUES	L	T	P	C
Core Paper: XI			2	1	-	4
Pre-requisite		Basic knowledge on plants and animal cells	Syllabus Version		2024-25	

Course Objectives:

The main objectives of this course are to:

- Understand the basic and latest techniques for in vitro cell culture of plants and animal.
- Providing advanced knowledge about use of plant biotechnology in breeding and micro propagation techniques.
- Introduce the students to the theory and practice of plant tissue culture and their role from modifying plants in plant biotechnology to the propagation of endangered plants
- The practical exposure would kindle the ideas of students to come up with novel applications of the field
- The technical details would expand the knowledge on the field that would equip the students to implement their views.
- Ability to understand the components of the tissue architecture

Expected Course Outcomes:

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

1	Understand the types of plant tissue culture	K2
2	Gain knowledge on types of animal cell culture	K2
3	Culture plant cell	K6
4	Cultivate animal cell line	K6
5	Acquire knowledge on stem cell biology	K3

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate;**K6**–Create

Unit:1	**INTRODUCTION**	**10hours**

Laboratory organization and Techniques in Plant Tissue Culture. Organ culture, root, shoot tip or meristem, ovary, flower and ovule culture and their importance. Callus culture-principle, protocol and significance, Cell suspension culture – Principle, protocol and its importance. Totipotency, cytodifferentiation and organogenesis – Principle, factors influencing Organogenesis and applications.

Unit:2	**MICROPROPAGATION**	**15hours**

Somatic embryogenesis and synthetic seeds – Principle, protocol and importance. Single cell culture, embryo culture – Principle, protocol and applications. Anther and Pollen culture – Principle, protocol, and its significance. Protoplast, isolation, fusion and culture somatic hybridization, chemofusion, electrofusion, important properties of protoplast, somatic hybrids, cybrids – Principle, protocol and importance.

Unit:3	**APPLICATIONS OF PLANT TISSUE CULTURE**	**10hours**

Somaclonal variation – Causes and significance, plant tissue culture in forestry,, clonal propagation, production of useful biochemicals – Gene conservation bank – plant tissue culture in biotechnology-commercial aspects of plant tissue culture.

Development of transgenic plants: Agrobacterium mediated genetic transformation-Binary vector (Eg.pBIN19), Shuttle vector (pBR322), Biotic stress (Eg. Insect resistance: *Bt*genes and alpha amylase inhibitor). Abiotic stress: (Eg. Herbicide resistance: phosphoinothricin and glyphosate; Drought, cold and salt**.)**

Unit:4	**ANIMAL TISSUE CULTURE**	**10hours**
Animal cell culture techniques: Introduction - Biology of cultured cells. Basic requirements for animal cell culture-Equipments and consumables. Animal cell culture media- Balanced salt solutions and simple growth medium, Serum and protein free defined media; Types of animal cell culture - primary and established culture; three dimensional culture feeder layers; disaggregation of tissue and Sub culture; cell line propagation, cell separation; cell synchronization; cryopreservation.		
Unit:5	**APPLICATIONS OF ANIMAL TISSUE CULTURE**	**13hours**
Stem cells: Introduction, biology and classification-Unipotent, Pluripotent and Totipotent. Sources of stem cells-embryonic stem cells, embryonic germ cells and adult stem cells (Mesenchymal, Umbilical cord blood cells, Adipose tissue). Stem cells characterization-Genetic markers and membrane markers. **:** Therapeutic applications of stem cell **Tissue Engineering**: Principles, tissue engineering triad – Basic Constituents (Matrix molecules, Ligands, Growth factors, Biomaterials). Tissue engineering bioreactors. Biodegradable polymers in tissue engineering. Therapeutic applications of tissue engineering		
Unit:6	**AI in cell culture**	**12hours**
Machinelearningsoftwareintoxicology:asteptowardlabanimalreduction https://www.biocompare.com/Editorial-Articles/351896-Realizing-New-Possibilities-for-Cell-Line-Optimization/https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0213626https://www.sciencedirect.com/science/article/pii/S2452310018300027https://jandeboerlab.com/research/computational-sciences/machine-learninghttps://www.nature.com/articles/s41598-019-50208-x		
E-learning	**2hours**	
https://www.nature.com/articles/s41598-020-60278-xhttps://www.frontiersin.org/articles/10.3389/fpls.2016.00274/full https://nptel.ac.in/courses/102/103/102103016/https://ocw.mit.edu/courses/biology/7-013-introductory-biology-spring-2013/video-lectures/lecture-23-stem-cells/http://epgp.inflibnet.ac.in/Home/ViewSubject?catid=3 https://www.ptglab.com/support/cell-culture-protocol/introduction-to-cell-culture/		
Total Lecture hours		**72hours**

TextBook(s)

1	An introduction to genetic engineering in plants, Mantel, Mathews and Mickee, 1985. Blackwell Scientific Publishers. London.
2	Plant Biotechnology by Mantell, S.H and Smith, H. 1983. Cambridge University press, UK
3	Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Edition- R. Ian Freshney (Wiley Publishing)
4	Animal Cell Culture: A Practical Approach, 3rd Edition -John R. W. Masters (Oxford University Press)
5	Principles of Tissue Engineering, 4th Edition, Robert Lanza, Robert Langer, Joseph P. Vacanti.(Academic Press)
6	Principles of genetic manipulation; Ed. Old and Primrose, 6th Edition. Blackwell science publication.

Reference Books

1	Edwin F. George and Paul Sherington, D. 1984. Plant Propagation by Tissue Culture, Exegetics Ltd., Edington, Westbury, England.
2	Indra K. Vasil, 1980. Cell Culture and Somatic Cell Genetics of Plants. Academic Press Inc., New York.

3	Kalyanakumar De. 1997. An Introduction to Plant Tissue Culture, New Central Book Agency, Calcutta.
4	R.L.M. Pierik, 1987. In vitro culture in higher plants. MartinusNijhoff Publishers, Boston.
5	Methods in cell biology; Volume 57, Animal cell culture methods, Ed. Jennie P. Mather, David Barnes, Academic press
6	Mammalian cell biotechnology; A practical approach, Ed. M. Butler, Oxford University press.
7	Stem Cells: Scientific Progress and Future Research Directions (http://stemcells.nih.gov/)
8	Essentials of Stem Cell Biology, 2nd Edition - Robert Lanza, John Gearhart, Brigid Hogan, Douglas Melton, Roger Pedersen, E. Donnall Thomas, James Thomson and Sir Ian Wilmut (Academic Press)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://actascientific.com/ASAG/pdf/ASAG-02-0156.pdf
2	https://www.sciencedirect.com/science/article/pii/S2214317319300940
3	https://www.nature.com/articles/s41598-020-60278-x
4	https://www.frontiersin.org/articles/10.3389/fpls.2016.00274/full

Course Designed By: **Dr. G. Kapildev**

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	L	L	L	S	L	L	L
CO2	L	L	L	S	L	L	L
CO3	L	L	L	S	L	L	M
CO4	L	L	L	S	L	L	M
CO5	L	L	L	S	L	L	L

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

Course code	25MBTBC12	Molecular techniques and Biostatistics	L	T	P	C
Core Paper: XII			4	-	-	4
Pre-requisite		Basic Knowledge about Biomolecules	Syllabus version		2025-65	

Course Objectives:

- To learn the molecular tools available
- To understand usage of molecular techniques
- To gain knowledge on cloning strategies
- To learn the applications of various instrumental analysis for biomolecules characterization techniques
- To impart the knowledge of the bio-statistical applications in microbiology.

Expected Course Outcomes:

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

1	Strategize cloning experiment for specific expression studies	K2
2	Understand the application of PCR in various fields	K3
3	Understand the process of DNA sequencing and editing	K3
4	To import the knowledge of biomolecule separation and analytical methods in life science applications.	K3
5	Disentangle the data received and make valid inferences.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1 PCR **10 hours**

Types of PCR - Multiplex PCR, Nested PCR, Real-Time PCR (quantitative PCR or qPCR), Reverse-Transcriptase (RT-PCR) - cDNA Library.

Genome editing-Double stranded DNA breakage: Homologous recombination – Non- homologous recombination - site specific recombination. Engineered nuclease: mega nucleases, Zinc finger nucleases, TALEN, MAGE – CRISPR

Unit:2 Molecular Markers & DNA sequencing **12 hours**

First Generation -Sanger and Next generation Sequencing -Pyrosequencing. Nanopore - Whole Genome Sequencing.

Blotting Techniques: Southern, Northern blotting and western blotting.

Molecular Marker Techniques-RAPD, RFLP, AFLP, SSCP, SSR, SNP and ESTs.

Cytogenetic Techniques-FISH and GISH

Unit:3 Bioinstrumentation: Separation of biomolecules **12 hours**

Centrifugation-Preparative, Analytical and Density gradient centrifugation. Chromatographic Techniques-Theory and application of Paper, TLC and HPLC Chromatography, Gel Filtration, Ion Exchange, Column, Gel permeation, Chiral, Hydroxy apatitie, Immuno adsorption, Affinity Chromatography. Electrophoretic Techniques: Theory and Application of PAGE, SDS PAGE. Staining & detection methods-Isoelectrophoresis, iso electric principle.

Unit:4	**Structural analysis of biomolecules**	**12 hours**
UV, NMR, GC-MS, LC-MS, Mass Spectroscopy, MALDI-ToF, 2D gel, Fluorescence Spectroscopy, Calorimetry, flame photometry and ESR principles.		
Unit:5	**Basics of Biostatistics**	**12 hours**
Definition-Scope of Biostatistics, Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance; X 2 test; Basic introduction to Multivariate statistics, etc.		

E Learning	**2 hours**
• https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=3 • Genetic Engineering & rDNA technology–site directed mutagenesis Cloning strategies • Moleculartherapeutics–geneediting,generegulationandgenesilencing • https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2Molecular Biology, genetic engineering & Biotechnology–DNA repair; DNA damage; Genetic recombinationhttps://epgp.inflibnet.ac.in/Home/ViewSubject?catid=944 • Instrumentation: http://shodhganga.inflibnet.ac.in/jspui/bitstream/10603/222042/8/08_chapter%203.pdf •	
Total Lecture Hours	**60 Hours**

Text Book(s)	
1.	Principles of Gene Manipulation and Genomics- S.B.Primrose and R.M.Twyman, John Wiley &Sons Ltd, 7th edition, 2006.
2.	Molecular Genetics: An introductory narrative, Second Edition - Gunther. S.Stent and Richard Calendar, 2002. CBS Publishers and distributors.
3.	Gene cloning and DNA analysis, T.A. Brown, John Wiley & Sons, 2013
4.	Genome editing in Animals: Methods and protocols, I shuohatada, Springer publications, 2017
5.	Genome editing and engineering, KrishnaraoAppasani and George M. Church, Cambridge University Press, 2018
	Genome editing, KursadTurksen, Springer publications, 2016
6.	Handbook of Biomedical Instrumentation – R.S. Khandpur, Tata McGraw Hill
7.	Biophysical chemistry – Upadhyay., Upadhyay and Nath
8.	Practical Biochemistry – Principles and techniques -Wilson. K and Walker. J,
Reference Books	
1.	Microbial Genetics, Stanley R Maloy; John E Cronan; David Freifelder, Boston : Jones and Bartlett Publishers, second edition, ©1994.
2.	A Biologist‟s guide to principle and techniques of practical biochemistry – Brigan L. Williams.
3.	Experimental methods in Biophysical chemistry- Nicolau, C.
4.	Chromatographic methods- Alan Braithwaite, Frank J. Smith
5.	Gel Electrophoresis of Nucleic acids-A Practical approach. Rickwood D and BD Hames.
6.	Introduction to Spectroscopy- DonaldL.Pavia Gary M.Lipman, George S Kriz.
7.	Introductory Biostatistics, 2nd Edition - Chap T. Le, Lynn E. Eberly,ISBN: 978-0-470-90540-1 June 2016 .

Course Designed By: Dr. M. Gnanadesigan										
Mapping with Program Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	L	L	S	M	L	M	L	L	L
CO2	L	L	L	S	L	L	M	L	L	L
CO3	L	L	L	M	L	L	M	L	L	L
CO4	L	L	L	M	L	L	L	M	L	L
CO5	L	L	M	L	M	L	L	L	L	L

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

Course code	**25MBTBCP3**	**APPLIED MICROBIOLOGICAL TECHNIQUES**	**L**	**T**	**P**	**C**
Practical -III			**-**	**-**	**6**	**4**
Pre-requisite		**Aware of clinically important microbes and its diagnosis**	**Syllabus Version**		**2024-25**	

Course Objectives:

The main objectives of this course are to:

1. Provide hands on training on isolation and identification of pathogen from patient.
2. Train on characterization of pathogenic organism.
3. Develop skill on Immuno-techniques
4. Gain adequate knowledge on various method for separation of biomolecules

Expected Course Outcomes:

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

1	Perform molecular identification of microorganisms.	K4
2	Generate recombinant strains for new products	K5
3	Maintain Animal cell lines	K3
4	establish plant tissue culture	K4
5	virtually confirm compound/drug interaction	k5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Practical titles

MOLECULAR IDENTIFICATION

16SRRNA SEQUENCING OF BACTERIA/ACTINOBACTERIA

1. Isolation of bacteria/Actinobacteria
2. Isolation bacterial genomic DNA from bacteria
3. Amplification of 16SrRNA by Polymerase chain reaction
4. Sequencing of Purified PCR product

ITS REGION SEQUENCING OF FUNGI

1. Isolation of Fungi
2. Isolation fungal DNA from mycelium
3. Amplification of ITS region by Polymerase chain reaction
4. Sequencing of Purified PCR product

CLONING AND EXPRESSION

a. Restriction digestion – AGE
b. Ligation- AGE
c. Cloning
d. Competent cell preparation with BL21
e. Harvesting pET vector from DH5a cells
f. Cloning of pET vector into BL21 cells
g. Selection of recombinant strain by marker
h. Protein expression analysis of BL21 cells

ANIMAL CELL LINE ANALYSIS

a. Cell line maintenance
b. Assay – MTT, cell count

CO-CULTIVATION OF PLANT AND MICROBE CULTURE

a) INVITRO PLANT TISSUE CULTURE

i. Media Preparation and Sterilization
ii. Explant Preparation and Inoculation
iii. Micropropagation

b. CO-CULTIVATION

i. Agrobacterium mediated genetic transformation
ii. Confirmation of transformants by GUS assay.

MOLECULAR DIAGNOSIS

i. ELISA
ii. qPCR

BIOINFORMATICS

i. Molecular visualization of Proteins (PYMOL)
ii. Gene structure and Function prediction (GENEMARK)
iii. Gene structure prediction (GENSCAN)
iv. Protein sequence analysis and protein secondary structure prediction (EXPASY and Proteomics Tool)
v. Molecular Phylogeney (PHYLIP)

	Total Practical hours	**90 hours**

Reference Book(s)

1	Cappuccino, J and Sherman, N. (2014) Microbiology. A Laboratory Manual. 10th Edition. Pearson Education Publication, New Delhi
2	Lab Manual on Industrial Biotechnology, K. Swaminathan, J. Angayarkanni, V. Brindha Priyadarisini and K. Preethi, 2017, ThannambikkaiPublications,Coimbatore
3	Bailey and Scott‟s Diagnostic Microbiology (2002). Betty A. Forbes, Daniel F. Sahm, Alice S. Weissefeld, Ernest A Trevino. Published by C.V. Mosby

E –Learning

Course Designed By: Dr.V. Brindha Priyadarisini

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	L	L
CO2	S	S	M	S	S	S	M	L	L	L
CO3	S	S	M	M	S	S	M	L	L	L
CO4	S	L	L	L	S	S	M	M	L	L
CO5	L	L	L	S	S	M	M	L	L	S

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

ELECTIVE PAPERS

Elective code	**25MBTBE 12A**	**MOLECULAR CELL BIOLOGY**	**L**	**T**	P	C
Elective Paper: 1A			**3**	**1**	-	4
Pre-requisite		**Should know the basic cell structure**	**Syllabus Version**	**2024-25**		

Course Objectives:

The main objectives of this course are to:

1. Recalling the structural organization of organelles in both prokaryotic and eukaryotic cells
2. Providing information on the functional aspects of the cellular organelles
3. Understanding the molecular interaction of cells with regard to metabolism and cell cycle
4. Perceiving the molecular interactions in terms of regulation of cell cycle

Expected Course Outcomes:

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

1	Able to coordinate structural organization with functions	K3
2	Abe to differentiate the prokaryotic and eukaryotic cells	K1
3	Capable of understanding the molecular mechanism of several diseases	K2
4	Able to understand the molecular mechanisms of body movement	K3
5	Able to explain the process of development of organisms to adult	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit:1	**CELL ARCHITECTURE**	**12 hours**

Structure of cells – structure of prokaryotic and eukaryotic cells; Surface appendages – Cilia and Flagella, Capsules, Pili, Fimbriae and slime layers; Cell walls – Algae, fungi, bacteria ; Membranes of Gram positive, Gram negative bacteria and acid fast bacteria; protoplast, spheroplast and endospores; Transport across membrane – active and passive transport, transport channels and pumps, transport across nuclear membrane; Neurotransmission, neuromuscular junction.

Unit:2	**CELLULAR CONSTITUENTS**	**10 hours**

Cytoskeleton and structural components – Microfilaments, Intermediate filaments, Microtubules; Mitochondria – structure, biogenesis; Chloroplast – structure, biogenesis; Endoplasmic reticulum and Golgi complex – structure, function, vesicular transport and import into cell organelles; Structure and function of ribosomes, mesosomes, lysosomes, peroxysomes.

Unit:3	**NUCLEUS**	**10 hours**

Nucleus structure – structural organization, nucleosome, supranucleosomal structures, specialized chromosomes, polytene and lamp brush chromosomes and chromosome banding; Nucleic acid structure: DNA and RNA; Replication – prokaryotes and eukaryotes; Transcirption and regulation – prokaryotes and eukaryotes; Translation – prokaryotes and eukaryotes, regulation and posttranslational modification.

Unit:4	**CELL CYCLE**	**10 hours**

Mechanism of cell division – Mitosis, meiosis and genetic recombination; regulation of cell cycle – factors and genes regulating cell cycle (Cyclins, CDK and CDKI). Biochemistry and molecular biology of Cancer – malignant growth, tumour suppressor genes (p53, RB) and oncogenes (Ras), chemical carcinogenesis, hormonal imbalances.

Unit:5	**CELLULAR DEVELOPMENT**	**12 hours**

Extracellular matrix – cell to cell and cell-matrix adhesion, cell junctions; Cellular signalling – components of signaling, receptors (cell surface – GPCR, RTK, TGF-β, Hedgehog, Wnt, Notch-Delta, NF-Kb, ion channels; intracellular – NO, Nuclear receptor), secondary messengers, effectors ; cell differentiation; gametogenesis and fertilization; development of Drosophila and Arabidopsis – spatial and temporal regulation of gene expression.

E-learning **2 hours**

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=4

Cell biology – All modules

- https://ocw.mit.edu/courses/biology/7-06-cell-biology-spring-2007/

Cell biology – study materials of MIT

Total Lecture hours **62 hours**

Text Book(s)

1	Text book of Cell and Molecular Biology (New Edition), Ajoy Paul, 2015, Books & Allied publishers,
2	Molecular Biology of the Cell, Alberts, B et al., 5th Edition

Reference Books

1	Karp's Cell and Molecular Biology – Gerald Karp, 2016
2	Lodish's Molecular Cell biology, Lodish et al., 7th edition
3	Genes XI (9th Edition) Benjamin Lewin, Jones & Bartlett Learning, 2008
4	Gene cloning and DNA analysis – An Introduction – 6th edition, 2019

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=4 Cell biology – All modules
2	https://ocw.mit.edu/courses/biology/7-06-cell-biology-spring-2007/ Cell biology – study materials of MIT
3	Cell Biology https://swayam.gov.in/nd2_cec20_ma14/preview

Course Designed By: Dr. J. Angayarkanni

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	M	L	M	L	L	M	M	S	L
CO2	L	M	S	M	L	L	L	M	S	L
CO3	M	L	L	S	L	L	L	L	L	L
CO4	M	S	L	M	L	L	L	L	M	L
CO5	L	S	M	M	L	L	L	L	M	L

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

Elective Code	25MBTBE12B	**INHERITANCE & DEVELOPMENTAL BIOLOGY**	**L**	**T**	**P**	**C**
Elective Paper: I B			**4**	**-**	**-**	**4**
Pre-requisite		**Basics of Biology and genetics**	**Syllabus version**		**2025-2026**	

Course Objectives:

1. To help students understand how traits are inherited and how organisms develop from a single cell through genetic and molecular processes.
2. Understand basic principles of heredity and genetic variation.
3. To introduce key concepts of embryonic development and cellular differentiation.
4. To develop analytical skills for applying genetic and developmental biology in scientific research.

Expected Course Outcomes:

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

1.	Explain the basic laws of inheritance and genetic variation.	K2
2.	Describe key stages of embryonic development in model organisms.	K2
3.	Apply genetic and developmental concepts in research.	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Unit I	**CONCEPT OF GENE**	8 – Hours

Allele, multiple alleles, pseudoallele; Mendalian principles of inheritance: Dominance, segregation. Extra chromosomal inheritance

Unit II	**GENE MAPPING METHODS**	12 – Hours

Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids.

Unit III	**HUMAN GENETICS**	12 – Hours

Pedigree analysis, karyotypes, genetic disorders. Polygenic inheritance, heritability and its measurements, QTL mapping.

Unit IV	**GAMETOGENESIS, FERTILIZATION AND EARLY DEVELOPMENT**	12 – Hours

Production of gametes, cell surface molecules in sperm-egg recognition in animals; zygote formation, gastrulation and formation of germ layers in animals; embryogenesis, embryo sac development and double fertilization in plants, seed formation and germination.

Unit V	**MORPHOGENESIS AND ORGANOGENESIS IN PLANTS**	12 – Hours

Organization of shoot and root apical meristem; shoot and root development, floral development in *Arabidopsis* and *Antirrhinum.* **Organogenesis in animals:** organogenesis – vulva formation in *Caenorhabditis elegans*, regeneration in vertebrates, post embryonic development- larval formation, metamorphosis; sex determination.

Total Lecture Hours	60 – Hours

Text Book(s)

7. Verma, P. S., & Agarwal, V. K. (2006). Chordate Embryology (1st ed.). S. Chand & Company Pvt. Ltd.
8. Brooker, R. J. (2024). Genetics: Analysis and Principles (8th ed.). New York, NY: McGraw□ Hill Higher Education.
9. Verma, P. S., & Agarwal, V. K. (2006). Chordate Embryology (1st ed.). S. Chand & Company

	Pvt. Ltd.
10	Brooker, R. J. (2024). Genetics: Analysis and Principles (8th ed.). New York, NY: McGraw□ Hill Higher Education.
Reference Book(s)	
1.	Gilbert, S. F. (2000). Developmental Biology (6th ed.). Sinauer Associates.
2.	Klug, W. S., Cummings, M. R., & Spencer, C. A. (2012). Concepts of genetics (10th ed.). Benjamin Cummings
3.	Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., &Losick, R. (2013). Molecular Biology of the Gene (7th ed.). San Francisco, CA: Pearson Education.
4.	Slack, J. M. W. (2013). Essential Developmental Biology (3rd ed.). Hoboken, NJ: Wiley-Blackwell.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
	Developmental Biology https://nptel.ac.in/courses/112/104/112104115/ https://www.sdbonline.org/sites/fly/aimain1.htm https://onlinecourses.swayam2.ac.in/cec20_bt17/preview https://www.dnaftb.org/
Course Designed by:	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	L	L	L	L	L	M	L
CO2	L	L	L	L	L	L	L	L	M	L
CO3	L	L	L	L	L	L	L	L	M	L
CO4	L	L	L	L	L	L	L	L	M	L

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

Elective code	**25MBTB E13A**	**BIOSAFETY, BIOETHICS, IPR & COOD MANFAVTURING PRACTICES**	**L**	**T**	**P**	**C**
Elective Paper: 2A			**3**	**1**	**-**	**4**
Pre-requisite		**Rights and responsibilities of persons**	**Syllabus Version**	**2025-26**		

Course Objectives:

The main objectives of this course are to:

1. Study of the ethical issues emerging from advances in biology and medicine.
2. To address a broad swathe of human inquiry; ranging from debates over the boundaries of life
3. Get acquainted with principles of biosafety and gain knowledge about basic and advanced laboratory practices and safety precautions followed during biotechnological work.
4. Gain Ethical, Legal and Social Implications of Human Genome Project
5. To impart the knowkdege of the bio-statistical applications in microbiology.

Expected Course Outcomes:

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

1	Understand safety and ethical issues raised for GM crops and human cloning.	K2
2	Acquire knowledge of long-standing social and moral value system of our society.	K1
3	Apply the biosafety aspects in various health-care systems as hospitals, diagnostic laboratories, animal care systems, biological laboratories.	K3
4	Protection of ideas, businesses and individuals to reap the full benefits of their inventions.	K3
5	Disentangle the data received and make valid inferences.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Introduction to Bioethics**	**8 hours**

Principles of bioethics: Legality, morality and ethics, autonomy, human rights, beneficence, privacy, justice, equity, integrity and ingenuity. Scope of ethics from biomedical practice to biotechnology, Personal vs professional ethics: Moral Reasoning – Ethical theories Deontological, Utilitarianism, Virtue ethics – Ethical leadership (integrity and ingenuity) - framework for ethical decision making- Michael Macdonald model & Storch model.

Unit:2	**Biotechnology & Ethics**	**12 hours**

Biotechnology in agriculture and environment: GM crops and GMO's - benefits and risks – ethical aspects of genetic testing – ethical aspects relating to use of genetic information and bio-warfare. Ethical implications of cloning -Reproductive cloning, therapeutic cloning; Ethical, legal and socio-economic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research. Biotechnology and biopiracy – ELSI of human genome

Unit:3	**Introduction to Biosafety**	**10 hours**

Biosafety assessment procedures in India and abroad. International dimensions in biosafety, bioterrorism and convention on biological weapons. Social and ethical implications of biological weapons. Biosafety issues in biotechnology – risk assessment and risk management – safety protocols: risk groups – biosafety levels – biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations – types of biosafety containment. Roles of Institutional Biosafety Committee

Unit:4	**Introduction to IPR**	**12 hours**

Introduction and the need for intellectual property right Types, patents, copy rights, trade marks, design rights, geographical indications – importance of IPR – Main features of TRIPS agreement patentable and non-patentable – Methods of application of patents, process of filing, patenting life – legal protection of biotechnological inventions – world intellectual property rights organization (WIPO).		
Unit:5	**Basics of Good Manufacturing Practices**	**12 hours**
Principles and Importance of GMP – Definition of GMP, Quality management, Personnel, Risk management, Quality control, Documentation, Inspections. Supplier certification. Validation -- Definition – PQ, DQ, OQ, IQ. GMP regulations - US-FDA, Europe, Japan, ICH, PICS/S, WHO		
E-learning		**2 hours**
https://ocw.mit.edu/courses/linguistics-and-philosophy/24-06j-bioethics-spring-2009/ - bioethics- study material of MIT https://shodhganga.inflibnet.ac.in/handle/10603/83393 - Biomedical ethics **SWAYAM Course** https://swayam.gov.in/nd1_noc19_bt19/preview- Introduction to Biostatistics https://swayam.gov.in/nd2_imb19_mg18/preview - Intellectual Property.		
	Total Lecture hours	**59 hours**

Text Book(s)	
1	Bioethics by Shaleesha A Stanley (Author),Wisdom Educational Service (Publisher),2018.
2	Bioethics and Biosafety by Sateesh MK, I K International Publishing House Pvt. Ltd ISBN: 9788190675703.
Reference Books	
1	Principles of cloning, 2nd E6dition, Jose Cibelli, Robert Lanza , Keith H.S. Campbell, , Michael D. West, 2013
2	Ethics in Engineering 4th Edition by Martin, Mike W.; Schinzinger, Tata McGraw Hill Science, 2005
3	Introductory Biostatistics, 2nd Edition - Chap T. Le, Lynn E. Eberly,ISBN: 978-0-470-90540-1 June 2016 .
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://ocw.mit.edu/courses/linguistics-and-philosophy/24-06j-bioethics-spring-2009/ - bioethics-study material of MIT
2	https://shodhganga.inflibnet.ac.in/handle/10603/83393 - Biomedical ethics
3	https://swayam.gov.in/nd1_noc19_bt19/preview- Introduction to Biostatistics
4	https://swayam.gov.in/nd2_imb19_mg18/preview - Intellectual Property
Course Designed By: Dr J. ANGAYARKANNI	

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	L	M	M	L	L	L	S	L
CO2	L	L	L	L	L	L	L	L	M	L
CO3	M	L	M	L	M	L	L	L	M	L
CO4	M	L	M	M	S	L	L	L	M	L
CO5	L	L	M	L	M	L	L	L	L	L

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

Elective code	**25MBTBE 13B**	**PHARMACEUTICAL CHEMISTRY**	**L**	**T**	**P**	**C**
Elective Paper: 2B			**4**	**-**	**-**	**4**
Pre-requisite		**Basic knowledge on pharmaceuticals**	**Syllabus Version**		**2025-26**	

Course Objectives:

The main objectives of this course are to:

1. Enable the students to understand the basics of drug administration and metabolism.
2. Provide the knowledge about drug discovery, designing, and testing.
3. Impart the real-life difficulties encountered in the pharmaceutical industry.
4. Give a detailed outline on the natural resources for the drug production.

Expected Course Outcomes:

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

1	Understand the right choice mode of drug administration and pharmacokinetics	K2
2	Have an insight on various natural raw materials as resources for the drug production and the candidates will gain the ability to think of an unexplored resource for a new type of disease.	K3
3	Select various methods of drug designing through virtual-wet lab combinations and will impart the technical details of pre-clinical trials.	K5
4	Acquire knowledge of existing drugs and their mode of action	K2
5	Understand the application of proteins as drugs	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**INTRODUCTION TO PHARMACEUTICALS**	**8-- hours**

Introduction to Pharmaceuticals: Routes of drug administration, Pharmacokinetics: Absorption, Distribution, Metabolism- Oxidation, reduction, hydrolysis, conjugation and Elimination, absorption enhancement / solubility factor/ bioavailability; Pharmacodynamics; Assay systems and models (e.g., Knock-out Mice); Inter species scaling.

Unit:2	**DRUG DISCOVERY**	**7-- hours**

Need for developing new drugs: Substances derived from bacteria, plants, insects, and animals; Sources of active principles; Combinatorial Synthesis: Chemistry, Biology, and Biotechnology**.**

Unit:3	**DRUG DESIGNING**	**15-- hours**

Procedure followed in drug design; Molecular modification of lead compounds and proteins; Prodrug and soft drugs; Physico-chemical parameters in drug design; QSAR; Active site determination of enzymes; Design of enzyme inhibitors; Protein molecular modeling by computer: Docking studies; Structure based drug designing using software.

Unit:4	**PHARMACEUTICAL PRODUCTS**	**12-- hours**

Microbial products - Antibiotics (penicillin, streptomycin, Griseofulvin, Nystatin), probiotics. Plant secondary metabolites -alkaloids, flavanoids, steroids, terpenoids**. A**nimal vaccines-DNA vaccines, Subunit vaccines, peptide vaccines, attenuated and vector vaccines. Antivirals –Pencoclovir, Sofosbuvir. Clinical trials.

Unit:5	**THERAPEUTIC PROTEINS**	**12-- hours**

Insulin, human growth hormone, clotting factors, interferons, interleukins, tissue plasminogen activators, erythropoietin, DNAseI, alginate lyase, muteins; Production, advantages, limitations and

applications of monoclonal antibody.	
Total Lecture hours	**64-- hours**

Text Book(s)	
1	Daan Crommelin, Robert D Sindelar, "Pharmaceutical Biotechnology", Tailor andFrancisPublications, New york, 2002.
2	Remington"sPharamaceutial sciences, 18th edtion, Mack publishing & Co., Easton, PA (20 Ed, 2000).
Reference Books	
1	Heinrich Klefenz, "Industrial Pharmaceutical Biotechnology", WILEY-VCH Publication, Germany, 2002.
2	Jay P Rho, Stan G Louie, "Hand book of Pharmaceutical Biotechnology", Pharmaceutical products press, New York, 2003.
3	Lachman L Lieberman, HA, Kanig, J, "Theory and practice of industrial pharmacy", 3rd edition, Varghese publishing & Co, New Delhi, 1986.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Computer Aided Drug design-https://swayam.gov.in/nd1_noc19_bt22/preview
2	Medicinal Chemistry-https://swayam.gov.in/nd1_noc20_cy16/preview
3	Introduction to molecular Modelling-https://www.schrodinger.com/schrodinger-online-learning
4	Drug delivery: Principles and Engineering-https://swayam.gov.in/nd1_noc19_bt23/preview
Course Designed By: Dr. V. Brindha Priyadarisini	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	L	L	L	L	S	L	L
CO2	L	L	S	L	L	L	L	S	L	L
CO3	L	L	S	L	L	L	L	S	L	L
CO4	L	M	L	L	L	L	L	S	L	L
CO5	L	Ms	L	L	L	L	L	S	L	L

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

Elective code	**24MBTBE13C**	**BIOMOLECULAR METABOLISM**	**L**	**T**	**P**	**C**
Elective Paper: 2C			**3**	**1**		**4**
Pre-requisite		**Basic knowledge on Biochemistry**	**Syllabus Version**	**2025-26**		

Course Objectives:

The main objectives of this course are to:

1. Provide information about the significance of biomolecules
2. Recall the fundamental concepts of biochemistry
3. Learn the structure and functions of biomolecules

Expected Course Outcomes:

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

1	Get a distinct idea about principles of biophysical chemistry.	K2
2	Understand the nature of nucleic acids	K2
3	Have a knowledge on proteins	K3
4	Comprehend on carbohydrates	K3
5	Know the characteristics of lipids and vitamins	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**FOUNDATION OF BIOCHEMISTRY**	**14- hours**

Foundations of Biochemistry: Chemical foundations of Biology: pH, pK, acids, bases and buffers, Henderson-Hasselbalch Equation, biological buffer solutions.

Principles of thermodynamics: Laws of thermodynamics; Kinetics, dissociation and association constants; Concept of free energy, energy rich bonds and weak interactions; Coupled reactions; group transfer; biological energy transducers.

Unit:2	**NUCLEIC ACIDS**	**12-- hours**

Composition, structure and function of DNA and RNA, Metabolism of nucleotides, Stability of nucleic acids, Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA). Detection of nucleic acids.

Unit:3	**AMINO ACIDS**	**13-- hours**

Aminoacids: Structural features of amino acids, classification of amino acids, peptide linkage, determination of primary structure of polypeptide (N-terminal, C-terminal determination, method of sequencing of peptides), structural classification of proteins, primary, secondary, tertiary, quaternary structures of proteins, protein detection and estimation.

Unit:4	**CARBOHYDRATES**	**12-- hours**

Carbohydrates: Monosaccharides, Disaccharides and Polysaccharides, Glycoconjugates: Proteoglycans, Glycoproteins, and Glycolipids. Carbohydrate metabolism: Glycogenolysis, Gluconeogenesis, interconversion of hexoses and pentoses

Unit:5	**LIPIDS AND VITAMINS**	**12-- hours**

Lipids: Classification, chemical nature, properties. Biosynthesis of fatty acids. Oxidation of fatty acids. Storage Lipids, Structural Lipids in Membranes, Lipids as Signals, Cofactors, and Pigments. **Vitamins**: Composition, structure and function of vitamins- water soluble and fat soluble, Metabolism of vitamins

Total Lecture hours	**63-- hours**

Text Book(s)	
1	Chemistry of Biomolecules an Introduction, Richard J. Simmons, Royal Society of Chemistry, 1992
Reference Books	
1	Microbial Biochemistry-2nd Edition - Georges N. Cohen Springer, Feb 2, 2011 – SCIENCE
2	Lehninger Principles of Biochemistry by Albert L. Lehninger, David L. Nelson, Michael M. Cox
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Biochemistry: https://onlinecourses.nptel.ac.in/noc20_cy10/preview
2	Biochemistry of Biomolecules: https://onlinecourses.swayam2.ac.in/cec20_bt12/preview
3	Thermodynamics for Biological systems: https://onlinecourses.nptel.ac.in/noc20_bt14/preview
4	Henderson-Hasselbalch Equation : https://www.youtube.com/watch?v=lwj64JhMK5Y
Course Designed By: Dr. V. Brindha Priyadarisini	

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	L	L	L	L	L	L	S	L	L
CO2	L	L	L	L	L	L	L	S	M	L
CO3	L	L	L	L	L	L	M	S	L	L
CO4	L	L	L	L	L	L	M	S	L	L
CO5	L	L	L	L	L	L	M	S	L	L

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

Elective Code	25MBTBE13D	**SYSTEM PHYSIOLOGY**	**L**	**T**	**P**	**C**
Elective Paper: 2D			**4**	**-**	**-**	**4**
Pre-requisite		**Basics of cell biology and anatomy.**	**Syllabus version**		**2025-2026**	

Course Objectives:

1. To study the regulation of photosynthesis, respiration, and metabolic integration in plants.
2. To analyse how different organ systems coordinate to sustain life processes.
3. To develop a comprehensive understanding of the functional mechanisms of major organ systems in animals.

Expected Course Outcomes:

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

1.	Understand the function and integration of animal organ systems.	K2
2.	Understand water, nutrients, and signal transport in plants.	K2
3.	Apply physiological concepts in experimental contexts.	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Unit I	**SYSTEM PHYSIOLOGY - PLANTS**	12 – Hours

photosynthesis- - Light harvesting complexes, CAM pathways. photorespiratory pathway. Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

Unit II	**SENSORY PHOTOBIOLOGY**	12 – Hours

Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; photoperiodism and biological clocks. Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

Unit III	**SYSTEM PHYSIOLOGY - ANIMAL:NERVOUS SYSTEM**	12 – Hours

Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system.

Unit IV	**RESPIRATORY SYSTEM**	12 – Hours

Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Unit V	**CARDIOVASCULAR SYSTEM**	12– Hours

Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above. **Excretory system -** Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

Total Lecture Hours	**60** – Hours

Text Book(s)

1	Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2015), Plant Physiology and Development (6th ed.). Sunderland, MA: Sinauer Associates
2	Guyton and Hall Textbook of Medical Physiology (14th ed.). Elsevier.

Reference Book(s)	
1.	Taiz, L., & Zeiger, E. (2018), Fundamentals of Plant Physiology. Oxford University Press.
2.	Salisbury, F. B., & Ross, C. W. (1992), Plant Physiology (4th ed.). Wadsworth Publishing.
3.	Agarwal, R. A. (2015), Animal Physiology and Biochemistry (Latest ed.). S. Chand Publishing.
4.	Hill, R. W., Wyse, G. A., & Anderson, M. (2016), Animal Physiology (4th ed.). Sinauer Associates
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
	https://onlinecourses.swayam2.ac.in/cec25_ma19/preview https://onlinecourses.nptel.ac.in/noc20_bt42/preview https://onlinecourses.nptel.ac.in/noc25_bt22/preview
Course Designed by:	

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**M**	**L**
CO2	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**M**	**L**
CO3	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**M**	**L**

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

Elective code	**25MBTBE14A**	**EXPERIMENTAL ANIMAL CARE**	**L**	**T**	**P**	**C**
Core Paper: 3A			**3**	**1**	**1**	**5**
Pre-requisite		**Basic knowledge on Biochemistry**	**Syllabus Version**			**2025-26**

CourseObjectives:

The main objectives of this course are:
To impart knowledge on rules and regulations govern the experimentation on laboratory animals.
To understand the concepts in designing a protocol for animal experimentation.
To provide hands on experience in the various methods adopted in *in vivo* experimentation on rodents and their handling.
To provide knowledge on the alternative models available to minimize the use of laboratory animals.

Expected Course Outcomes:

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

1	Remember the various committees and laws involved in experimentation on laboratory animals.	K1&K2
2	Frame their own protocol to study *in vivo*experimentation on appropriate animal models	K6
3	Perform animal handling and various procedures like estrus cycle determination, blood collection, dissection, surgery etc.,	K3
4	Achieve various biochemical and pathological analysis to determine the effect of a particular drug	K5
5	Execute *in silico* models to study the effect of a drug and thereby reducing the usage of laboratory animals	K3 &K4

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate;**K6**–Create

Unit:1	**GUIDELINES & REGULATIONS**	**10hours**

Regulations, guidelines, and animal models: Laws, Regulations, and Guidelines Governing Research Animal Care and Use in India- General Framework and principles, Regulatory authorizations and enforcement mechanisms, guidelines and considerations of various test animals-dog, nonhuman primates, equine, genetically altered animals, Oversight and ethical review, institutional and designated personnel, Experimental procedures and euthanasia, transportation, housing and enrichment, animal husbandry and environment.

Practical session: Draft an experimentation protocol to evaluate the toxicity of a given drug using rodents

Unit:2	**BASICS IN ANIMAL EXPERIMENTATION**	**12hours**

General principles in animal housing- Handling, care and components of animal facility.Drafting of animal experimental protocol. Grouping of animals- positive and negative control. Dissection and identification of organ system, storage and transportation. Blood sample collection in small laboratory animals. Separation of plasma and serum. Principles of rodent surgery.

Practical session: Dissection of rat and mice to collect blood, identification and harvesting of organs, surgical techniques (Ovariectomy and orchidectomy).

Unit:3	**BIOCHEMICAL ASSAYS**	**12hours**

Laboratory experiments related to animal research: Assays related to animal experiments: Body and

organ weight measurement. Serum assays: Liver parameters- AST, ALT- Kidney parameters- Urea, uric acid, creatinine- Cholesterol, LDL, VLDL, HDL, triglycerides, antioxidants, histopathology, proteomic studies, gene expression studies.

Practical session: Enzyme analysis (AST, ALT) and biochemical analysis (urea, uric acid, creatinine, total cholesterol, LDL, VLDL, HDL, triglycerides) using Autoanalyzer, Histological processing of tissues (liver and kidney), Tissue sectioning using microtome, slide preparation and visualization under microscopy, and real-time interpretation

Unit:4	**ANIMAL MODELS**	**9 hours**

Use of animals in research: Commonly used strains of mice and rats in research. Production of antibodies in laboratory animals. Rodents in disease research-CVD and Cancer. Genetically engineered animal models – knock-in & knock-out technologies. Behavioural testing in animals -Open field exploration test-elevated plus maze – Light-dark exploration test – Social-interaction test.

Practical session: Estrous cycle determination using vaginal smear. Behavioural analysis (Choice test using Y-maze apparatus, forced swim test, tail suspension test and Light-dark exploration test)

Unit:5	**ALTERNATIVES TO ANIMAL RESEARCH**	**9 hours**

Concept of "Alternatives"- A brief account of Agencies / Organizations - OECD, ECVAAM, and ICCVAM - List of validated alternative methods- Scenario in India-Alternatives in education models-mannequins, plastinated specimens, CAL and digital alternatives- Daniorerio- biology; model for environmental toxicity, reproductive toxicity, investigating endocrine disruption; Hydra- model for developmental biology, apoptosis studies. Molecular modeling and docking methods –tools/software; In silico approach to Pharmacokinetics and Pharmacodynamics

Practical session: Use virtual dissection software and in silico tools (pharmacokinetics) to perform an experiment

Unit:6	**AI IN ANIMAL HANDLING**	**4hours**

https://www.youtube.com/watch?v=HYjOA8e95Vk
https://avidialabs.com/dissection/
https://www.youtube.com/watch?v=u_bJ75DkRG0

E-learning	**2 hours**

1. https://www.youtube.com/@MazeEngineers/videos
2. https://www.kenhub.com/en/library/anatomy/liver-histology
3. https://youtu.be/p6CvQtGcI84?si=ydFOsnBmZWX_XJZ5
4. https://youtu.be/mAJXBi0iSJw?si=Tl6rJEInv4j1IBxE
5. https://youtu.be/Nl6_JZdLyro?si=mJB-JVGGupXqFqbV
6. https://youtu.be/ff9-BvzNHDY?si=Thwv5E7BqEfqmntA
7. https://www.youtube.com/watch?v=Dj7pet35GL0
8. https://www.youtube.com/watch?v=JD1Ibht-acU
9. https://www.youtube.com/watch?v=m6Wa4IT57sw

	Total Lecture hours	**58hours**

Text Book(s)

1	AmbikaShanmugam's Fundamentals of Biochemistry for Medical Students (2016), 8th Edition, edited by K.Ramadevi. Published byWolterskluwerindiaPvt Ltd.ISBN 9351296822, 9789351296829

2	Clinical Biochemistry: An Illustrated Colour Text(fifth) Edition (2013) by Gaw, Allan, Rajeev Srivastava ,Murphy Edin published by Churchill Livingstone
Reference Books	
1	Quadrietal., 2018. Laws, Regulations, and Guidelines Governing Research Animal Care and Use in India, In: Laboratory Animals, Chapter 8, 2 nd Edition, edited by Javier Guillen, Academic press. https://doi.org/10.1016/B978-0-12-849880-4.00008-8.
2	Essentials of Laboratory Animal Science: Principles and Practices (2021), edited by P. Nagarajan, RamachandraGudde, Ramesh Srinivasan. Springer publication.ISBN 978-981-16-0986-2 ISBN 978-981-16-0987-9 (eBook) , ttps://doi.org/10.1007/978-981-16-0987-9
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/102104042
2	https://nptel.ac.in/courses/102103044
3	https://nptel.ac.in/courses/102106065
4	https://www.coursera.org/learn/drug-discovery-development
Course Designed By: **Dr. J. ANGAYARKANNI**	

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	L	L	S	L	L	M
CO2	L	L	S	L	L	L
CO3	L	L	S	L	L	L
CO4	L	L	S	L	L	L
CO5	L	L	S	L	L	L

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

Elective code	25MBT BE14B	**BIOINFORMATICS AND NANOBIOTECHNOLOGY**	**L**	**T**	**P**	**C**
Elective Paper: 3B			**3**	**1**	**-**	**4**
Pre-requisite		**Basic Knowledge about Bioinformatics and Nanoparticles and Nanotechnology**	**Syllabus Version**		**2025-26**	

Course Objectives:

The main objectives of this course are to:

1. This paper is aimed to provide an enhanced understanding of the basics of nanobiotechnology for the students to perceive various nanomaterial syntheses and characterization.
2. Bioinformatics provides the introductory knowledge concerning genomics, proteomics and their applications, including the primary tools used for the structural elucidation and characterization of the biomolecules.

Expected Course Outcomes:

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

1	To acquire the knowledge in the fundamentals of Bioinformatics	K2
2	Able to learn various tools to study the biomolecules	K4
3	To remember the basics of omics and its advancement	K1
4	To understand the basics of nanoscience and nanoparticles	K2
5	To analyze, characterize and the applications nanomaterials	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**FUNDAMANTALS OF BIOINFORMATICS**	**12 hours**

Bioinformatics - Definition, History, Web servers, computer systems, languages, - machine, high level and assembly. Internet basics – internet connection, web browsing and URL. Introduction to biological databases - Sequence databases, structural databases, specialized databases, sequence retrieval system from net - SRS, Entrez,

Unit:2	**TOOLS IN BIOINFORMATICS**	**8 hours**

Structure prediction –similarity and database structure tools, FASTA, BLAST - Sequence and similarity – sequence alignment – local, global pairwise and multiple sequence, introduction to phylogenetic trees.

Unit:3	**GENOMICS & PROTEOMICS**	**15 hours**

Genomics: Types of genomics-structural, functional, comparative and environmental genomics. Metagenomics–study on Uncultivable microbes. SNPs-EST- Strategies for Whole Genome Sequencing – Hierarchical and Whole Genome Shotgun Sequencing- De novo and reference based assembly. DNA microarray.

Proteomics: Protein sequencing; Protein modifications, Protein engineering; Protein chips, Types of proteomics - expression proteomics, structural proteomics and functional proteomics. Protein microarrays. Infectomics: Introduction and definitions of Infectomics. Types of Infectomics - ecological, immuno-and chemical Infectomics. Future of Infectomics.

Unit:4	**FUNDAMENTALS OF NANOTECHNOLOGY**	**11 hours**

Nanoscience basics: Definition, Nanotechnology- Nano biotechnology Nanomaterial- Nano composites- Classification of nanostructure- Top down & Bottom-up approach- Quantum dots- Bio inspired nanomaterials; Nanomaterial synthesis, Physical methods (Plasma, Laser), Chemical method (Sol-gel, Co-precipitation) & Biological method (Microbes, plant)..

Unit:5	**NANOMATERIAL CHARACTERIZATION**	**12 hours**
Nanomaterial characterization: Electron microscopy – TEM, SEM & AFM – For particle imaging, XRD and FTIR for analyze the size, shape, structure, chemistry and crystallography. Drug delivery nanoparticles in cancer therapy, military application of nanotechnology- Future perspectives.		
E-Learning		**2 hours**
1. http://thesciencepublishers.com/biomed_lett/files/v5i2-8-BML201912102.pdf 2. https://www.researchgate.net/publication/261062123_ARTIFICIAL_INTELLIGENCE_IN_BIOINFORMATICS 3. https://www.frontiersin.org/research-topics/9029/artificial-intelligence-bioinformatics-development-and-application-of-tools-for-omics-and-inter-omic		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	Introduction to bioinformatics by T.A Atwood
2	Introduction to computers by Alexis Leon and Mathews Leon
3	Genomics: The Science and Technology Behind the Human Genome Project (2000). Edited by C.Cantor and C.L.Smith, Wiley -Interscience, New York
4	J.W. Dale. (1998). Molecular Genetics of Bacteria, 3rd Edition. Wiley Publishers.
5	Singer M and Berg P. (1991). Genes and Genomes. University Science Books.
6	Lewin B. (2005). Genes IX. Oxford University press.
7	A. Pandey and M. Mann. (2000). Proteomics to study genes and genomes Nature.
8	Sheng-He Huang, Timothy Triche, Ambrose Y. Jong. (2002). Infectomics: genomics and proteomics of microbial infections. Springer-Verlag publications.
9	Fundamentals of Nanotechnology. Gabor L. Hornyak, John J. Moore, H.F. Tibbals, Joydeep Dutta. December 22, 2008 by CRC Press. Textbook - 786 Pages.
10	Introduction to Nanoscience. Stuart Lindsay. Oxford University press. Textbook – 448 pages.
Reference Books	
1	Genome Mapping – A Practical Approach (1997) by P.H. Dear, Oxford University Press, Oxford.
2	Reviews and Articles from Journals such as Nature, Science, PNAS (USA), Nucleic Acids Research, Trends Series & Current Opinion Series.
3	Protein Research: New Frontiers in Functional Genomics (1997). Edited by M.R. Wilkins, K.L. Williams, R.D. Appel and D.F. Hochstrasser, Springer – Verlag, NewYork2-D Proteome Analysis Protocols (1998). Edited by A.L. Link, Humana Press, Totowa, NJ.
4	Proteins and Proteomics. 2002. R.J. Simpson. Cold Spring Harbor Lab. Press. New York.
5	Cantor and Smith, Genomics. John Wiley & Sons, 1999.
6	Introduction to Genomics - Arthur M Lesk, Oxford University Press, 2007.
7	R.M.Twyman, Principles of Proteomics, BIOS Scientific Publishers, 2004.
8	P.Michael Conn, Handbook of Proteomic Method. Humana Press, Totowa, New Jersay, USA, 2003.
9	L.Stryer, Biochemistry, W. H. Freeman and Co., New York, 2007.
10	Introduction to Nanoscience and Nanotechnology 1st Edition by Chris Binns. Wiley publishers. 320 Pages.

11	Nanotechnology: A Gentle Introduction to the Next Big Idea by Mark A. Ratner; Daniel Ratner. Pearson Education (US). 208 Pages.
12	12. Textbook of Nanoscience and Nanotechnology. Authors: Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J. Springer, 2013. 244 Pages.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.] 2 hours	
1	https://www.researchgate.net/publication/222834503_Applications_of_artificial_intelligence_in_bioinformatics_A_review
2	https://nptel.ac.in/courses/102/106/102106065/
3	https://nptel.ac.in/courses/102/103/102103044/
4	https://swayam.gov.in/nd1_noc20_bt10/preview
5	https://nptel.ac.in/courses/118/107/118107015/
6	https://nptel.ac.in/courses/102/107/102107058/
Course Designed By: **Dr.G.KAPILDEV**	
Mapping with Programme Outcomes	

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	L	L	S	S	L	L	M
CO2	L	M	M	M	M	S	S	M	L	M
CO3	M	L	M	M	L	S	S	M	M	L
CO4	L	M	S	L	M	S	M	S	L	M
CO5	M	S	M	L	M	L	S	M	S	M

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

Elective Code	25MBTBE14C	**ECOLOGY**	**L**	**T**	**P**	**C**
Elective Paper: 3C			**4**	**-**	**-**	**4**
Pre-requisite		Knowledge of environmental sciences.	**Syllabus version**		**2025-2026**	

Course Objectives:

1. To gain knowledge of ecological processes such as energy flow, nutrient cycling, and succession.
2. To explore the structure and dynamics of populations, communities, and ecosystems.

Expected Course Outcomes:

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

1.	Explain key ecological concepts.	K2
2.	Analyze patterns of energy flow and nutrient cycling.	K4
3.	Formulate solutions to environmental and conservation challenges using ecological principles.	K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Unit I	**ECOSYSTEM STRUCTURE AND FUNCTIONS**	12 – Hours

Structures - Biotic and Abiotic components. Functions - Energy flow in ecosystems, energy flow models, food chains and food webs. Biogeochemical cycles, Ecological succession. Species diversity, Concept of ecotone, edge effects, ecological habitats and niche.

Unit II	**POPULATION ECOLOGY**	12 – Hours

Characteristics of population, concept of carrying capacity, population growth and regulations. Population fluctuations, dispersion and metapopulation. Concept of ‘r’ and ‘k’ species. Keystone species.

Unit III	**TOXICOLOGY AND MICROBIOLOGY**	12 – Hours

Absorption, distribution and excretion of toxic agents, acute and chronic toxicity, concept of bioassay, threshold limit value, margin of safety, therapeutic index, biotransformation. Major water borne diseases and air borne microbes.

Unit IV	**BIODIVERSITY AND ITS CONSERVATION**	12 – Hours

Definition, types, importance of biodiversity and threats to biodiversity. Concept and basis of identification of ‘Hotspots’; hotspots in India. Measures of biodiversity. Strategies for biodiversity conservation: in situ, ex situ and in vitro conservation. Concepts of gene pool, biopiracy and bio-prospecting. Concept of restoration ecology. Extinct, Rare, Endangered and Threatened flora and fauna of India.

Unit V	**AIMS AND OBJECTIVES OF ENVIRONMENTAL IMPACT ASSESSMENT (EIA).**	12 – Hours

Environmental Impact Statement (EIS) and Environmental Management Plan (EMP). EIA Guidelines. Impact Assessment Methodologies. Procedure for reviewing EIA of developmental projects. Life-cycle analysis, cost benefit analysis. Environmental Management System Standards (ISO14000 series). Eco-labeling schemes.

Total Lecture Hours	**60**– Hours

Text Book(s)

1	Smith, T. M., & Smith, R. L. (2015). Elements of Ecology (9th ed.). Pearson Education.
2	Sharma, P. D. (2020). Ecology and Environment (13th ed.). Rastogi Publications.

Reference Book(s)

1.	Ricklefs, R. E., & Relyea, R. (2018). Ecology: The Economy of Nature (8th ed.). W. H. Freeman and Company.
2.	Townsend, C. R., Begon, M., & Harper, J. L. (2021). Essentials of Ecology (5th ed.). Wiley-Blackwell.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
	https://onlinecourses.nptel.ac.in/noc25_ge14/preview https://onlinecourses.nptel.ac.in/noc22_ge20/preview
Course Designed by:	

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**L**	**M**	**L**
CO2	**S**	**L**	**L**	**L**	**S**	**L**	**L**	**S**	**M**	**L**

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

Elective code	**25MBTBE15A**	**ARTIFICIAL INTELLIGENCE IN LIFE SCIENCES**	**L**	**T**	**P**	**C**
Elective Paper: 4A			**2**	**-**	**-**	**2**
Pre-requisite		Requires- Understanding of computer fundamentals in applied Microbiology.	**Syllabus Version**	**2025-26**		

Course Objectives:

The main objectives of this course are to:

1. Provide the students with the importance of the AI and their tools in Life sciences.
2. To import the knowledge of the AI in cellular structural identification and Drug discovery process.
3. Students will learn the various disease diagnostic methods and environmental monitoring process with AI tools.

Expected Course Outcomes:

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

1	The students will gain the knowledge about the basics and principles of ANN and Machine learning process in Life science applications.	K2
2	Able to get the information regarding the different AI methods in Cell biology research and Immunological diagnostic methods.	K3
3	The students will learn the disease diagnostic methods in plant tissue culture and plant-microbe interactions with AI tools.	K2
4	To learn the importance of the AI tools with the environmental sensor applications.	K2
5	To learn the importance of the AI in the Drug discovery and Nanotechnology research.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**INTRODUCTION**	**10 hours**

Introduction to Artificial Intelligence, Problems, Approaches and tools for Artificial Intelligence. Introduction to search, Search algorithms, Heuristic search methods, Optimal search strategies. Role of Python in Life sciences. Introduction to Artificial Neural Networking and Machine learning.

Unit:2	**AI IN CELL BIOLOGY& IMMUNOLOGY**	**12 hours**

Machine learning in cell biology – teaching computers to recognize phenotypes; Deep learning for biology; Deep learning sharpens views of cells and genes; Deep Learning Algorithms Identify Structures in Living Cells; The application of convolutional neural network to stem cell biology; Artificial intelligence on cell developmental dynamics.
Artificial Intelligence in Autoimmune diseases; Immunotherapy; PCR diagnosis; Bioimaging; disease diagnosis and Predictive Analytics.

Unit:3	**AI in AGRICULTURAL MICROBIOLOGY AND PLANT TISSUE CULTURE**	**12 hours**

DNA as digital storage tool; Scope of Artificial intelligence (AI) -Disease detection-health monitoring of crops. Applications of machine learning (ML)-prediction of microbial species-microbial communities to predict disease-interaction between microbes; Microbiome –disease association. Optimization of culture conditions in plant tissue culture using ANN.

Unit:4	**AI IN ENVIRONMENT, FOOD PROCESSING AND IPR**	**12 hours**

Artificial Intelligence in monitoring the environment, species protection, saving energy and efficient agriculture. Applications of Artificial Intelligence in Bio-Industry – Clinical Trials, Big Data Processing. Machine learning in food industry; AI in Food Processing. AI for identification of documentation forging. Machine learning algorithms for IPR screening and classification, medical ethics considerations on AI.		
Unit:5	**AI IN DRUG DISCOVERY AND NANOTECHNOLOGY**	**10 hours**
AI in drug discovery; Developing Deep Learning Applications for Life Science and Pharma Industry; Artificial Intelligence for Clinical Trial Design; AI and machine learning in translational medicine. Applications of AI &ML in Nanotechnology-AI in scan probe microscopy (SPM)- Classification of material properties at the nanoscale using artificial neural network (ANN)- Designing nano systems-AI in Nanoscale Simulations-Nanocomputing and artificial intelligence.		
E learning		**2 Hours**
1. **https://bit.ly/2GNBaSW** 2. **https://files.eric.ed.gov/fulltext/ED532172.pdf** 3. **https://bit.ly/3iOH97H**		
Total Lecture hours		**60 hours**
Reference Books		
1	Application of machine learning /Artificial intelligence in Microbiology-Review article https: //doi.org/10.3389/fmicb.2019.00827	
2	Raman, K., & Chandra, N. (2009). Flux balance analysis of biological systems: applications and challenges. Briefings in bioinformatics, 10(4), 435-449.	
Course Designed By: Dr. M. Gnanadesigan		

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	L	L	L	L	L	L	S
CO2	L	L	L	L	L	M	L	L	L	S
CO3	L	L	L	L	L	L	L	L	L	S
CO4	L	L	L	L	L	L	L	L	L	S
CO5	L	L	L	L	L	L	L	L	L	S

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

SUPPORTIVE PAPERS

Course code	**25MBTBS1**	**MICROBIAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
Supportive Paper: I			**2**	**-**	**-**	**2**
			Syllabus Version		**2024-25**	
Pre-requisite		**Aware of Biological Sciences**				

Course Objectives:

The main objectives of this course are to:

1. Give insights on the Components and units of a bioprocess industry
2. Impart knowledge on the various industrial bioproducts
3. Familiarize with various sectors of industrial biotechnology

Expected Course Outcomes:

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

1	Basic Designing principles of fermentor and its unit	K2
2	Production of various industrial bioproducts from industrially relevant microbes	K1
3	Able to understand the role of different agricultural beneficiary 0microbes.	K2
4	The students will learn the importance of the microbial pathogens.	K3
5	The students will understand the role of microbes in environmental applications.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**FERMENTATION**	**5-- hours**

Isolation, Preservation and Maintenance of Industrial Microorganisms. Fermenter parts and components; Media for industrial fermentation; Sterilization.

Unit:2	**Industrial Bioproducts**	**7-- hours**

Microbial synthesis of organic acids (Citric acid), alcohol (ethanol), antibiotics production (penicillin), vitamin(B12) and amino acid (Tryptophan), beverage (wine), food (soy sauce/cheese).

Unit:3	**Agricultural Microbiology**	**5-- hours**

Microbial herbicides, Agricultural antibiotics, Bio-fertilizers and Bio-insecticides

Unit:4	**Medical Microbiology**	**5-- hours**

Methods of isolation of pathogenic organisms; Production of vaccine, Hormones, Pharmaceuticals.

Unit:5	**Environmental Biotechnology**	**5-- hours**

Microbes in waste water treatment, microbial ore leaching and mineral recovery, oil recovery.

Total Lecture hours	**30-- hours**

Reference Text Book(s)

1. Peter F Stanbury, Allan Whitaker, Steohen J Hall, 2013, Principles of Fermentation Technology, Elsevier Science Ltd, Second Edition.
2. Manual of Industrial Microbiology and Biotechnology, III edition, Arnold. L. Demain and Julian Davies, ASM press, Washington DC, 2010.
3. Handbook of Downstream processing, Edin Goldberg, Blackie and Academic Professional, 1997.
4. Medical Microbiology – Ananthanarayanan and Panicker, Orient Blackswan, 2006
5. Bio-fertilizers in Agriculture and Forestry, 1993, by N.S. Subba Rao.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Industrial Biotechnology https://online-learning.tudelft.nl/courses/industrial-biotechnology/
2	Recent Technology biogas industry - https://www.bioprocesscontrol.com/academy/online-courses/
3	Microbes in waste water treatment - https://www.open.edu/openlearn/nature-environment/microbes-friend-or-foe/content-section-2
4	Microbial Leaching - https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/16%3A_Microbial_Ecology/16.6%3A_Microbial_Bioremediation/16.6A%3A_Microbial_Ore_Leaching
5	Vaccine production -https://www.chop.edu/centers-programs/vaccine-education-center/making-vaccines/how-are-vaccines-made
6	Insulin production - https://www.youtube.com/watch?v=OYvav8aDGCc
Course Designed By: Dr.M. GNANADESIGAN	

Course code	**25MBTBS2**	**CLINICAL MICROBIOLOGY**	**L**	**T**	**P**	**C**
Supportive Paper: II			**2**	**-**	**-**	**2**
Pre-requisite		**Basics of Microbiology**	**Syllabus Version**	**2024-25**		

Course Objectives:

The main objectives of this course are to:

1. Providing information on types of infections and their epidemiology
2. Imparts knowledge on host defense and immune system
3. Understanding the preventive measures towards infection

Expected Course Outcomes:

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

1	Able to predict the epidemiology of disease	K2
2	Identify proper diagnosis and treatment of various infections caused by pathogens	K2
3	Make appropriate and effective on-the-job professional decisions in the processing of clinical samples.	K2
4	Differentiate the proper and inappropriate sample for analysis	K2
5	The students will learn the basics about the blood analysis	

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Infection and immunity**	**3 hours**

Infection and immunity: General principles of infection, antigens, antibodies, antigen – antibody reactions, complement system.

Unit:2	**Pathogenic/Parasitic organisms**	**6 hours**

Pathogenic/Parasitic organisms: Bacterial, viral and protozoal infections of the gastrointestinal system, nervous system, lung, liver, and eye; sexually transmitted diseases, skin infections, zoonoses, arthropod borne diseases. Transmission and spread of diseases – disease epidemiology

Unit:3	**Control and prevention of infections**	**6 hours**

Control and prevention of infections: Drugs and antibiotics, drug resistance, mycobacteria, leprosy and malarial parasite – importance, life cycle, spread and control. Control of vectors – mosquito control – biotechnological approaches.

Unit:4	**Vaccines**	**4 hours**

Vaccines: Types and methods of action. Biotechnological approaches to disease control and vaccine production. Genetic disorders and gene therapy.

Unit:5	**Biochemical changes due to infections**	**4 hours**

Biochemical changes due to infections: Blood test and tissue analysis. Isolation and identification of organisms from tissue samples. Disease detection – conventional and molecular techniques.

Expert lectures, online seminars – webinars

- Use of artificial intelligence in infectious diseases https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7153335/
- Deploying Artificial Intelligence Against Infectious Diseases

https://www.uspharmacist.com/article/deploying-artificial-intelligence-against-infectious-diseases • Image analysis and machine learning for detecting malaria. https://europepmc.org/article/med/29360430 • **The potential for artificial intelligence in healthcare** https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/	
E learning	**2 Hours**
• Immunity to pathogens https://nptel.ac.in/content/storage2/courses/102103038/download/module5.pdf • Cellular and Molecular Immunology https://nptel.ac.in/content/storage2/courses/102103038/download/module1.pdf • Mechanism of immune response https://nptel.ac.in/content/storage2/courses/102103038/download/module4.pdf • Essentials in Immunology https://nptel.ac.in/courses/104/108/104108055/ • **Basic Vaccinology: Why Vaccines Work or Don't Work https://youtu.be/iCej1gMWD4o**	
Total Lecture hours	**30 hours**
Text Book(s)	
1	Text book of microbiology, C.J.K. Panicker.
2	Immunology, Roitt,I.M., Brestoff and Male D.K., 1996.
Reference Books	
1	Molecular biotechnology, Glick.
2	Clinical microbiology, Ananthanarayanan.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Medical Microbiology: http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/248
Course Designed By: Dr. M. Gnanadesigan	

Course code	**25MBTBS3**	**PROBIOTICS AND PREBIOTICS**	**L**	**T**	**P**	**C**
Supportive Paper: 3			**2**	**-**	**-**	**2**
Pre-requisite		**Aware of microorganism and its importance in food**	**Syllabus Version**		**2024-25**	

Course Objectives:

1. To give an insight on the role of microorganism in food industries
2. Categorize harmful and beneficial microorganism in food industries

Expected Course Outcomes:

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

1	Understand the history of probiotics	K1
2	Compare and contrast the use of lactic acid bacteria, Bifidobacterium and Propionibacterium as probiotics.	K1
3	Understand the range of proposed probiotics and the challenges in ensuring their safety and efficacy	K2
4	Compare and contrast the mechanisms used by probiotic microorganisms to modulate the host immune responses in the animal and in the human host	K3
5	List the proposed uses of probiotic microorganisms for the prevention or treatment of animal and human diseases.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**PROBIOTICS**	**6- hours**

Introduction, Development, Safety consideration, Validation,Types of probiotics, Lactic acid bacteria, Bifidobacteria and propionebacteria, Probiotics the beneficial bacteria, Guidelines and regulation for probiotics

Unit:2	**PREBIOTICS**	**5-- hours**

Sources, mechanism, types, function. novel prebiotic, prebiotics as excellent therapeutic agent,futuristic challenges and goals. Microencapsulation and nanotechnology.

Unit:3	**SYNBIOTICS**	**6-- hours**

Definition, function of synbiotics. benefits, action and safety of synbiotics

Unit:4	**GUT MICROFLORA**	**5-- hours**

Introduction, Importance in Gut Microflora, inflammatory disease, Faecal transplants, types of fermentation, healing power of fermented foods

Unit:5	**HUMAN MICROBIOME RESEARCH**	**6-- hours**

Probiotics and reduction in adult lactose tolerance, colonic metabolism,clinical symptoms of lactose intolerance,Use of probiotics to manipulate colonic fermentation.

E-learning **1 hour**

- https://www.ncbi.nlm.nih.gov/books/NBK553134/
- https://www.routledge.com/Probiotics-A-Comprehensive-Guide-to-Enhance-Health-and-Mitigate-
- Disease/Rashid-Sharma-Khan/p/book/9781032586946

	Total Lecture hours	**30 hours**
Text Book(s)		
1	Textbook of probiotics,by Ashutosh Kaur,2021 4th Edition, CBS Publishers & Distributors Pvt. Ltd. (1 January 2021). ISBN-10 : 9390709849 ISBN-13 : 978-9390709847	
2	Probiotics, Prebiotics and Synbiotics: Technological Advancements Towards Safety and Industrial Applications Editor(s): Parmjit Singh Panesar, Anil Kumar Anal First published:1 February 2022Print ISBN:9781119701200 |Online ISBN:9781119702160 |DOI:10.1002/9781119702160 © 2022 John Wiley & Sons Ltd.	
Reference Books		
1	Probiotics and Prebiotics: Current Research and Future Trends,Edited by: Koen Venema and Ana Paula do Carmo Published: 2015Book: 978-1-910190-09-8. Ebook: 978-1-910190-10-4	
2	Lactic Acid Bacteria and Bifidobacteria: Current Progress in Advanced Research Edited by: Kenji Sonomoto and Atsushi Yokota Published: 2011 Book: 978-1-904455-82-0. Ebook: 978-1-912530-62-5	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Functional Foods and Nutraceuticals, https://onlinecourses.swayam2.ac.in/cec22_ag08/preview	
2	The Human microbiome https://www.futurelearn.com/courses/the-human-microbiome	
Course Designed By: Dr. K. Preethi		