The proposed structure Frameworkof PG Course Content in Microbiology as per NEP guidelines MCB2P

Semester	Paper	Theory/ Practical	Title of the Paper	Paper Full marks	Semester Full marks	Paper Credit	Semester credit
Semester 1	MCB2PCOR01T	Theory	Genetics	50		4	
	MCB2PCOR02T	Theory	Biophysical Techniques	50		4	
	MCB2PCOR03T	Theory	Cell Biology	50		4	
	MCB2PCOR04P	Practical	Biophysical Techniques	50		4	
	MCB2PCOR05P	Practical	Enzyme kinetics	50		4	
	MCB2PAEC01M	AECC	Laboratory Safety Measures	50		2	
Total					**300**		**22**
Semester 2	MCB2PCOR06M	Theory	Genomes & Genomics	50		4	
	MCB2PCOR07M	Theory	Microbial Diversity	50		4	
	MCB2PCOR08T	Theory	Microbial Metabolism	50		4	
	MCB2PDSE01T (Bioethics and Intellectual Property Rights) OR MCB2PDSE01T (Bioprocess Technology)	DSE 1 Theory	Bioethics and Intellectual Property Rights Or Bioprocess Technology	50		4	
	MCB2PCOR9M	Mixed	Biostatistics and Bioinformatics	50		4	
Total					**250**		**20**
Semester 3	MCB2PCOR10M	Theory	Immunology	50		4	
	MCB2PCOR11T	Theory	Virology & Medical Microbiology	50		4	
	MCB2PCOR12T	Theory	Food and Industrial Microbiology	50		4	
	MCB2PDSE02M (Agricultural Microbiology) OR MCB2PDSE02M(Application of Microbial Technology)	DSE 2 Mixed	Agricultural Microbiology Or Application of Microbial Technology	50		4	
	MCB2PCOR13M	Mixed	Environmental Microbiology	50		4	
	MCB2PSEC01M	SEC	Diagnostic Microbiology	50		2	
Total					**300**		**22**
Semester4	MCB2PCOR14M	ProjectWor	Attendance	50		4	

	MCB2PCOR15M MCB2PCOR16M MCB2PCOR17M MCB2PCOR18M	k1 ProjectWork2 ProjectWork3 ProjectWork4 ProjectWork5	External Evaluation Write-up Presentation Question answer	50 50 50 50		4 4 4 4	
	MCB2PCOR19P	Grand Viva		50		4	
Total					**300**		**24**
					1150		**88**

WEST BENGAL STATE UNIVERSITY

Draft Syllabus for M.Sc in Microbiology (NEP)- MCB2P

Program Specific Outcome (PSO):

Program Purpose:

Microbiology is a broad discipline and students have a wide range of options for the study of microbiology including: microbial physiology, microbial genetics, microbial ecology, pathogenesis, immunology, virology, parasitology, epidemiology, evolution and diversity. Students of this program commonly pursue careers in academics, industry, and medicine. Microbiology major program guidelines are to be used for assessment, maintenance, and formation of strong programs in microbiology. Microbiology is a laboratory-based science, and as such, our curriculum supports laboratory components in most of the courses taught in the program.

Consequently, the program educational objectives are:

1. To prepare a new generation of microbiologists that are capable of excelling in careers of their choosing.
2. To provide an educational environment that fosters the development of appropriate scientific vocabulary, reasoning skills, and effective oral and written communication abilities.
3. To provide opportunities for students to engage in productive scholarly research projects that complement their classroom training and instruction.

Outcomes:

Microbiology Fundamentals **:**Exhibit mastery of various areas of the discipline like microbial physiology, microbial genetics, microbial ecology, medical microbiology, virology, and immunology.

Experiment Design :Devise experiments with appropriate hypotheses and controls.

Data and Research Interpretation :Interpret experiments from primary scientific (biological) literature, analyzing the use of the scientific method, critiquing the rationale, methods, and conclusions in light of relevant scientific principles.

Effective Communication :Effectively communicate scientific information using both oral and written methods

Semester 1

Paper MCB2PCOR01T:
Genetics

Course Outcome (CO):

Objectives of the course:

1. Know the terms and terminologies related to genetics and understand the properties, structure and function of genes in living organisms at the molecular level
2. Explain the concept of recombination, linkage mapping and elucidate the gene transfer mechanisms in prokaryotes and eukaryotes.

Outcome of the course:

After completing the Genetics course, students will be able to:

1. Handle and independently work on lab protocols involving molecular and genetic techniques.
2. Demonstrate scientific quantitative skills, such as the ability to evaluate experimental design, read graphs, and understand and use information from scientific papers.

3. Demonstrate skill in communication of scientific data in standard format.

Bacterial & Viral Genetics: The Genetic Organization of Bacteria and Viruses**,** Mutation and its different types**,** mutagens and mutagenesis, Bacterial Mutants**,** Bacterial Transformation**,** Conjugation – Plasmids; Hfr Cells; Time-of-Entry Mapping; F' Plasmids**,**Transduction**,** Bacteriophage Genetics - Plaque Formation and Phage Mutants; Genetic Recombination in Virulent Bacteriophages; Fine Structure of the rII Gene in Bacteriophage T4**,** Genetic Recombination in Temperate Bacteriophages – Lysogeny; Generalized and Specialized Transducing Phages and the mechanism of gene transduction**,**Transposable Elements - Transposons in Genetic Analysis

Human Genetics

Introduction to Human Genetics & Mendelian Inheritance: History, Mendel's laws, pedigree construction and analysis, inheritance patterns (autosomal dominant/recessive, sex-linked), and gene interactions.

Cytogenetics & Chromosomal Basis: Chromosome structure, karyotyping, mitotic/meiotic non-disjunction, numerical and structural chromosomal rearrangements, and syndrome analysis.

Molecular Genetics & Genome Organization: DNA replication, transcription, translation, gene expression regulation, DNA technology (PCR, sequencing), and structural organization of the human genome (transposons, repetitive DNA).

Clinical and Medical Genetics: Inborn errors of metabolism, hemoglobinopathies, genetic diseases (e.g., cystic fibrosis, Huntington's), cancer genetics, pharmacogenetics, and prenatal diagnosis.

Population & Quantitative Genetics: Hardy-Weinberg equilibrium, genetic polymorphism, mutation rates, multifactorial inheritance, and genetic counseling.

Books

1. **Concepts of Genetics** by Charlotte A. Spencer, Darrell Killian, Michael A. Palladino, and Michael R. Cummings
2. **Genetics: From Genes to Genomes** by Leland Hartwell, Michael Goldberg, et al
3. **Principles of Genetics** by D. Peter Snustad and Michael J. Simmons
4. **Emery's Elements of Medical Genetics and Genomics** by Peter D. Turnpenny and Sian Ellard
5. **Human Molecular Genetics** by Tom Strachan and Andrew Read:

Paper MCB2PCOR02T:
Biophysical Techniques

Course Outcome (CO):

Course objectives:
To acquaint students with principles, working and applications of Microscopic techniques, spectroscopy and Chromatography.

Learning outcomes:
By the end of the course the student will be able to: • Gain an understanding of the basic principles of Atomic force, Fluorescence, Confocal and Electron Microcopy. • Understand the principles and analysis using Spectrocopy including, fluorescence, CD, ORD, NMR and ESR. Also gaining insights in the applications of chromatography and immunotechniques such as FISH, CISH etc.

Microscopy
Optical microscopy: the nature of light—its particle and wave character. Ray diagrams and image formation.

Simple and compound microscopes, Applications of optical microscopes, Numerical Aperture (NA), Resolution, Contrast, magnification, Spherical aberration, Chromatic aberration of optical system (definitions only). Mathematical expression for limit of resolution in terms of Rayleigh criteria. Empty magnification. Basic principles of oil immersion microscope. Limitations of optical microscopes. Confocal microscopy, Electron microscopy---TEM and SEM, sample preparation for EM. Advantages of electron microscope over optical microscope, Electrostatics and magnetostatics electron microscopes, characteristics and use of lasers, Relation between the applied voltage and wavelength of electrons.

Diffusion:
Diffusion in fluids, Fick's laws (Statement and explanation) Facilitated diffusion e.g. gas exchanges in lungs and regulating principle relating to partial pressure of O_2 and CO_2.

Osmosis:
Definition, contrast with diffusion, Tonicity and isotonic solutions. Effect of tonicity on R.B.C. Cell nutrition.

Viscosity:
Definition, Laminar and turbulent flow, Concept of Reynolds number, Newton's law of viscosity, Newtonian and non-Newtonian fluids, Coefficient of viscosity, Relative viscosity and fluidity. Measurement by Ostwald's viscometer. Dependence of viscosity on temperature and other factors e.g. size and shape of solutes (general idea), Viscosity of human blood (general idea).

Centrifugation:
Theory of ultracentrifugation, Relative centrifugal force (RCF), Sedimentation rate, sedimentation coefficient, Isopycnic (equilibrium) sedimentation (discussion with example e.g. Meselson and Stahl Experiment).

Spectrophotometry:
Electromagnetic spectrum, Introduction to concepts of absorption and emission spectroscopy, Absorption of light, Transmittance, Absorbance (Optical density), Lambert-Beer's law and its limitations, Concept of Molar extinction co-efficient, Study of absorption spectra of Proteins and Nucleic Acids, Analysis of Proteins and Nucleic Acids using UV and Visible spectroscopy, Raman spectroscopy, circular dichroism (CD), optical-rotatory dispersion (ORD) and their application in the study of macromolecules.
Nuclear magnetic resonance; principles behind splitting, spin-spin interaction, spin-lattice interactions, Nuclear Overhauser Effect, nuclear quadruple effects, spectral interpretations; Electron Spin Resonance (ESR), Zero Field Splitting

Chromatography:
Partition co-efficient, paper chromatography and its applications (including 2-D), Thin layer chromatography. Column packing and fraction collection, Gel filtration chromatography, Ion- exchange chromatography and affinity chromatography, GLC, HPLC.

Electrophoresis:
Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis and its application in determining molecular size of protein (principle only), difference between native and SDS-PAGE; 2D gel electrophoresis, Agarose gel electrophoresis.

Proteomics:
Proteome, nature of proteome, overview of the tools to study proteome, two-dimensional gel electrophoresis (2D-PAGE), Mass Spectrometry (MALDI/MALDI-TOF), Interpretation of Mass Spectra, MS/MS of peptide, Mass spectrometry search engines: Mascot, structural proteomics –protein-protein interactions, Yeast 2-hybrid, Co-immunopurification/Mass-spectrometry, application, Metabolomics (in brief)

Books: Biophysical Chemistry-Cantor and Shimmel, Physical Biochemistry- Van Holde, Physical Biochemistry-David Freifelder, Biochemistry-Voet and Voet, Fundamentals of Light microscopy and Electronic Imaging-Douglas B. Murphy

Paper MCB2PCOR03T

Cell Biology

Course Outcome (CO):

Objectives -

(A) Structure and function of Cell;

(B) Coordination between different cell- cell, cell matrix interactions;

(C) Understanding of Pathology of various disease conditions and understanding the effectiveness of the treatment modalities

Outcome-

Students will be taught about different types of cells in brief followed by emphasis on Eukaryotic cells. Also the course colntent includes structure and functions of plasma membrane and cytoplasmic organelles such as Mitochondria, Endoplasmic reticulum, Golgi complex, peroxisomes, Lysosomes and nucleus. Cytoskeletal component giving shape to the cell is also included. In addition, the students will be taught about Cell Division and its regulation as well as cell signalling.

Cell as basic unit of life, Cell Theory, Common Structural Features of Living Cells, Prokaryotic and Eukaryotic Cells: Their characteristics and differences, Structure of Model Prokaryotic Cell.

Cell wall and membranes: Prokaryotic-peptidoglycan wall, Plant cell wall; Cell membrane: Membrane structure; Membrane constituents, phospholipids, glycolipids, cholesterol, membrane proteins, receptors and phospholipases, phospholipid bilayer, structure asymmetry, fluid mosaic model of random diffusion of membrane components; Domains in membrane, natural and artificial membranes, Modern methods to study the cell membrane, FRAP, Scanning colorimetry, Chemiluminescence, Freeze-etching, Freeze-fracturing, Hydrophobicity plot

Complexities and compartmentalization of Eukaryotic Cells: Cell Organelles: their structures and functions, nucleus, other membrane bound organelles eg. Mitochondria and chloroplast, Ribosomes, Endoplasmic reticulum, golgi bodies and secretory vesicles, trafficking, targeting, sorting and localization of proteins and other macromolecules Peroxisomes and Lysosomes; Cytoplasm.

Cytoskeleton: Microtubules and microfilaments, intermediate filaments, microtubule polymerization dynamics, actin polymerization dynamics, cell crawling, contractile structures, actomyosin complex, muscle contraction.

Other Granular bodies: Extracellular appendages eg. flagella, cillia and extracellular matrix. Cell Function: Dynamic movements, and signal transduction in the living cells.

Cell cycle: mitosis, meiosis and cytokinesis, animal and yeast cell division, cdc mutants, cell cycle control, cell cycle checkpoint, metaphase-anaphase transition, antimitotic drugs, cytoskeletol diseases, microtubule dependent drugs and actin targeted drugs. Loss of cell cycle control and cancer, programmed cell death and apoptosis;

Cell junctions and cell-cell signalling: General characteristics, specificity, amplification, desensitization or adaptation and integration; non-receptor mediated cell signaling - gaseous messengers (NO and CO); receptor mediated, cell signalling – ligands (membrane diffusible, eg. steroid hormones and non-diffusible, e.g. peptide hormones and other peptide or protein ligands) and receptors (intracellular, e.g. steroid hormone receptors and cell surface); ion-channel-linked receptors –

neurotransmitters; G protein coupled receptors - heterotrimeric G proteins and its effectors (second messengers like cAMP); desensitization process, bacterial toxins as tools in study of receptor signaling; calcium homeostasis calcium signalling.

Books:

- Molecular Biology of the genes by James D. Watson.
- The Cell by Geoffrey M. Cooper.
- Cell and Molecular Biology by Gerald Karp.
- Molecular Cell Biology by Harvey Lodish.
- Molecular Biology of Cells by Bruce Alberts.
- Genes by Benjamin Lewin.
- The world of cells by Wayne and Levis.
- Molecular biology by David Clark

Paper MCB2PCOR04P

Biophysical Techniques

Course Outcome (CO):

1. Explain the principles and applications of major biophysical techniques used in microbiological research
2. Demostrate the understanding of spectroscopic methods like UV-vis spectroscopy for biomolecular analysis
3. Evaluate the suitability of different biophysical methods for solving biological research problems.
4. Analyse the working principles and applications of microscopy.

Learning outcomes:

1. Operate basic biophysical instruments and follow laboratory safety and standard procedures
2. Integrate theoretical and practical knowledge to solve real-life biological problemsusing biopgysical approaches
3. Analyze and interpret experimental data obtained from different biohysical experiments

1. Properties of water, Concept of pH and buffers, preparation of buffers and Numerical problems to explain the concept
2.Quantitative Estimation of protein (Lowry Method, Bradford method)
3.Determination of R_f value and separation of amino acids by paper chromatography.
4. Measurement of refractive index of a biological solution with the help of travelling microscope.
5. Measurement of viscosity of unknown sample by Ostwald viscometer.

Paper MCB2PCOR05P
Enzyme Kinetics

Course Outcome (CO):

Course objectives:
The objective of this course is to gain an insight into the fundamentals of enzyme structure and function and kinetics of soluble and immobilized enzymes. Also it deals with current applications and future potential of enzymes.

Learning outcomes:
Describe structure, functions and the mechanisms of action of enzymes. The student will learn kinetics of enzyme catalyzed reactions and enzyme inhibitory and regulatory processes. The student will be able to perform immobilization of enzymes. The student will get exposure of wide applications of enzymes and their future potential.

- To study activity of any enzyme under optimum conditions.
- To study the effect of pH, temperature on the activity of amylase enzyme.
- Determination of - pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) on the enzyme activity.

- Determination of Km and Vmax by Lineweaver Burk Plot.
- Study of enzyme kinetics – calculation of *V*max , Km, Kcat values.
- Study effect of temperature, pH and Heavy metals on enzyme activity

Paper MCB2PAEC01M
Laboratory safety Measures

Course Outcomes (CO)

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

CO1: Demonstrate awareness of laboratory safety principles and biosafety regulations applicable to microbiology laboratories.

CO2: Identify physical, chemical, biological, ergonomic, electrical, and fire hazards encountered in laboratory environments.

CO3: Perform risk assessment and implement appropriate control measures to minimize laboratory accidents.

CO4: Apply emergency preparedness procedures including first aid, spill management, fire response, and evacuation protocols.

CO5: Demonstrate proper use of personal protective equipment (PPE), biological safety cabinets, and laboratory safety devices.

CO6: Understand occupational health, ergonomics, environmental regulations, and quality management systems relevant to laboratory operations.

Learning Objectives
Development of laboratory safety skills and professional responsibility.
Recognition and identification of laboratory hazards.
Assessment and evaluation of risks associated with laboratory activities.
Minimization of risks through implementation of safety measures.
Preparation for emergencies and disaster management situations.

Theory
Unit I: Concepts and Techniques of Laboratory Safety

This unit introduces the evolution of modern laboratory safety concepts and the principles of safety management. Topics include planning and implementation of safety measures for optimization of laboratory quality and safety, development of safety culture, laboratory hygiene and housekeeping practices, and the importance of safety leadership. The unit also covers identification of training needs, safety education methods, workshops, seminars, conferences, motivation for safe practices, accident prevention strategies, accident reporting procedures, incident investigation and analysis, safety audits, disaster preparedness, disaster mitigation, and relevant environmental regulations including the Environmental Protection Act, Biomedical Waste Management Rules, Hazardous Waste Management Rules, Gas Cylinder Rules, Explosives Act, ISO 14001 Environmental Management Systems, and Occupational Health and Safety Management Systems (OHSAS 18001/ISO 45001).

Unit II: Physical and Chemical Hazards

This unit focuses on the identification, assessment, and control of physical and chemical hazards encountered in microbiology laboratories. Topics include ionizing and non-ionizing radiation, biological effects of radiation exposure, monitoring instruments and control programs, environmental monitoring, determination of relative humidity, recognition of chemical hazards such as dusts, fumes, vapours, mists, fogs, gases and aerosols, exposure and dose

relationships, toxic and hazardous chemicals, interpretation and use of Safety Data Sheets (SDS), air sampling techniques, gas and vapour monitoring systems, dust collection devices, measurement procedures, chemical spill management, and methods for prevention and control of chemical exposure.

Unit III: Biological and Ergonomic Hazards

This unit covers biological hazards associated with microorganisms and laboratory work environments. It includes classification of biohazardous agents, bacterial, viral, fungal, parasitic, rickettsial, and chlamydial pathogens, laboratory-acquired infections, biosafety levels, biohazard control programs, employee health surveillance, laboratory safety programs, animal handling and care, biological safety cabinets, and biosafety laboratory design. The unit also addresses ergonomic hazards such as work-related musculoskeletal disorders, carpal tunnel syndrome, tendon disorders, neck and back injuries, occupational health services, concepts of health and wellness, and pre-employment and periodic medical examinations.

Unit IV: Fire, Explosion and Electrical Hazards

This unit deals with the causes, prevention, and management of fire, explosion, and electrical hazards in laboratories. Topics include fire properties of solids, liquids, and gases, fire spread mechanisms, toxicity of combustion products, theory of combustion and explosion, fire triangle and fire tetrahedron concepts, sources of ignition, fire prevention and extinguishment principles, active and passive fire protection systems, classifications of fire, fire extinguishers, hydrants, sprinkler systems, standpipes, alarm and detection systems, and first aid for burns. The unit also covers electrical hazards including electric shock, burns, insulation systems, excess current, short circuits, earthing, earth resistance maintenance, fuses, circuit breakers, overload relays, over-voltage and under-voltage protection, conductor safety, electrical connections, and safe laboratory electrical practices.

Unit V: Human Behaviour, Ergonomics and Artificial Intelligence

This unit introduces the application of ergonomic principles and human factors in laboratory safety. Topics include laboratory workstation design, seating arrangements, posture and body mechanics, anatomy of the spine and pelvis, posture stability and adaptation, prevention of low back pain, risk factors for musculoskeletal disorders, behavioural aspects of posture, ergonomic layout of laboratory equipment, and applications of artificial intelligence in laboratory management and safety monitoring. The unit also discusses the historical development of artificial intelligence, its applications, misconceptions, and limitations in occupational safety and laboratory environments.

Unit VI: Cognitive and Stress Psychology in Occupational Health

This unit explores psychological factors influencing workplace safety and efficiency. Topics include perception, cognition, memory mechanisms, information processing, decision-making, problem solving, planning, artificial vision systems, image processing, object recognition technologies, and factory vision systems. The unit further discusses occupational work capacity, physiological requirements of laboratory work, stress, strain, fatigue, shift work, personal hygiene, personality factors, accident proneness, motivation, job satisfaction, frustration, conflict management, emotional behaviour, attitude formation and modification, learning processes, forgetting, and motivational requirements for maintaining workplace safety.

Unit VII: Storage Systems, Personal Protective Equipment and Accident Management

This unit covers principles of safe storage and accident management in laboratories. Topics include storage tank design, vessel storage, segregation and compatibility of chemicals, secondary containment systems, venting and relief systems, atmospheric vents, pressure and vacuum valves, flame arrestors, fire prevention systems, storage of LPG, compressed gases, toxic chemicals, chlorine, ammonia, and other hazardous substances. The unit also includes detailed study of personal protective equipment such as respirators, gloves, goggles, face shields, safety shoes, gumboots, aprons, antistatic materials, and protective clothing. Accident management concepts including permit-to-work systems, accident causation, human factors, safety regulations, documentation, compensation, safety education, and training are also discussed.

Unit VIII: Six Sigma and Laboratory Quality Management

This unit introduces Six Sigma concepts and their application in laboratory quality management. Topics include the definition and philosophy of Six Sigma, organizational readiness, implementation strategies, DMAIC methodology, roles and responsibilities of leaders, champions, Black Belts and Green Belts, Six Sigma tools and techniques, management responsibilities, laboratory process improvement, quality assurance systems, continuous monitoring, performance evaluation, and methods for sustaining Six Sigma initiatives in laboratory environments.

Demonstrative Practical Component
Demonstration of laboratory safety rules, biosafety signs, and hazard communication systems.
Identification and assessment of physical, chemical, biological, fire, and electrical hazards.
Risk assessment and preparation of laboratory risk management plans.
Demonstration of proper use, maintenance, and disposal of personal protective equipment.
Operation and certification requirements of biological safety cabinets.
Biomedical waste segregation, collection, treatment, and disposal practices.
Environmental monitoring including temperature, humidity, and air quality measurements.
Ergonomic assessment of laboratory workstations.
Accident reporting, documentation, and investigation exercises.
Laboratory safety audit and inspection procedures.
Emergency preparedness and disaster management simulation exercises.

Textbooks

1.Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards (Updated Edition). National Research Council. National Academies Press, Washington, DC.
2.Biosafety in Microbiological and Biomedical Laboratories (BMBL), 6th Edition. Centers for Disease Control and Prevention (CDC) and National Institutes of Health (NIH), U.S. Department of Health and Human Services.
3.Laboratory Biosafety Manual, 4th Edition. World Health Organization (WHO), Geneva.
Safety in Academic Chemistry Laboratories, 8th Edition. American Chemical Society Committee on 4.Chemical Safety. American Chemical Society, Washington, DC.
5.Fundamentals of Occupational Safety and Health, 7th Edition. Mark A. Friend and James P. Kohn. Bernan Press, Maryland, USA.

Semester2

Paper MCB2PCOR06M
Genomes & Genomics

Course objective:

Molecular Biology gives in-depth knowledge of biological and/or medicinal processes through the investigation of the underlying molecular mechanisms.This course will cover isolation and purification of nucleic acids, mechanisms of gene cloning, practical aspects of recombinant DNA technology, model organisms in recombinant DNA technology, recombinant gene expression systems.

Target knowledge and understanding
• will gain an understanding of chemical and molecular processes that occur in and between cells. The understanding will become such that students will be able to describe and explain processes and their meaning for the characteristics of living organisms.
• will gain insight into the most significant molecular and cell-based methods used today to expand our understanding of biology.
This course will cover isolation and purification of nucleic acids, mechanisms of gene cloning, practical aspects of recombinant DNA technology, model organisms in recombinant DNA technology, recombinant gene expression systems.

Learning Outcomes

Having completed a master's degree, students will be able to:
• Conduct independent work in a laboratory.
• Read scientific articles and gain a critical understanding of their contents.
• Give a spoken and written presentation of scientific topics and research results.
• Present hypotheses and select, adapt and conduct molecular and cell-based experiments to either confirm or reject the hypotheses.

- isolate and purify nucleic acids for routine laboratory procedures,
- explain the underlying mechanisms of gene cloning,
- discuss the practical aspects of applying recombinant DNA technology,
- explain the significance of model organisms in recombinant DNA technology,
- describe recombinant gene expression systems

Demonstration of DNA as genetic material, Fundamentals of Molecular Processes, Central Dogma Fundamental Processes, Propagation and Maintenance of Genome, Genome Organization in prokaryote and Eukaryotes: Bacterial Nucleoid Structure, Chromosome Structure and Organization, Histones and non-histone proteins, Nucleosome Structure, and organization.

DNA replication in Prokaryotic and Eukaryotic Cells, Enzymology and general features, Detailed mechanisms of intiation, elongation and termination, experiments underlying each steps and role of individual factors, regulation and control of replication, Problem of linear DNA replication, Telomere and Telomerases.

Recombination at the molecular Level: Homologous recombination, Rec A and RecBCD system, Chi-Sequence, Holliday junction and Ruv System, Site specific Recombination and Transposition.

DNA damage and Repair: Replication Errors, mutations and other kinds of damages, Enzymology, Genetics and mechanisms of DNA Repair, Photoreactivation, Base and Nucleotide excision repair system, Mismatch Repair System, SOS Repair System.

Flow of genetic information and Mechanism of Transcription: Prokaryotic Transcription: Promoters, Sigma Factors, Initiation, Elongation, Rho-dependent and independent terminatios, Eukaryotic Transcription: Eukaryotic Promoter, Enhancers: General Transcription factors, Activators, mediators. Transcription Termination.

RNA processing: Capping and Polyadenylation, mRNA splicing, *cis*- and *trans* splicing, Chemistry of Splicing, Spliceosome and SR proteins, Alternative Splicing and Exon Shuffling, Splicing of Group I and II introns, Tetrahymena self splicing introns, Ribozyme, mRNA editing, folding, export.

Protein Synthesis and translation: Ribosome structure and function, Genetic code, tRNA and Wobble hypothesis, Fidelity and control of translation, mRNA degradation, Protein Sorting and targeting to ER.

Regulation of prokaryotic and eukaryotic genes: Concept of regulation at different layers, negative vs. positive regulations; regulations in prokaryotes, concepts of operons and regulatory molecules eg. inducers, repressors etc., model operons eg. lac and trp operons, , Positive regulation in eukaryotic cells at transcriptional and post-transcriptional levels, basic and accessory transcription factors, enhancers and alternative splicing and polyadenylation; NPCs and another control point of gene regulation, regulation of gene expression after export eg. at the levels of mRNA localization, translation and decay, Regulation of gene expression by micro RNAs,

RNA interference, Doing reverse genetics with RNAi. Concept of quality control of gene expresssion and coupling of different steps of gene expression.

Books:

1. "Molecular Biology" by Friefelder David.
2. "Gene VIII" by Lewin Benjamin.
3. "Molecular Biology of the Gene" by Watson J D.
4. "Molecular Biology" by Weaver R F.

Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods; analysis of RNA, DNA and proteins by gel electrophoresis, isoelectric focusing gels; molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems; expression of recombinant proteins using bacterial, animal and plant vectors; isolation of specific nucleic acid sequences; generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors; in vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms; protein sequencing methods, detection of post-translation modification of proteins; DNA sequencing methods, strategies for genome sequencing; methods for analysis of gene expression at RNA and protein level, large scale expression analysis, such as micro array based techniques; isolation, separation and analysis of carbohydrate and lipid molecules; RFLP, RAPD and AFLP techniques.

Genome Sequences, Gene Numbers, Clusters and Repeats: Gene Numbers in Bacteria and Eukaryotes, Fundamentals of Human genome, Distribution of genes and other sequences, Essential genes, Patterns of expression of Genes in the genome. Gene Clusters and their origin, Sequence divergence is the Basis for the evolutionary clock. Duplication,crossing over and other kinds of Rearrangements, Pseudogenes, Tandem Repeats of different clusters, Satellite DNA sequences.

The Interrupted Gene: Interrupted Gene consists of Exons and introns, Organizations of interrupted genes, Nature of Exon and intron sequences, Wide distribution of intron and exon sequences, Some DNA sequences code for more than one proteins, Evolution of interrupted genes, Members of a gene family have a common organization.

Regulation of gene expression by micro RNAs: RNA interference, Doing reverse genetics with RNAi. Concept of quality control of gene expresssion and coupling of different steps of gene expression.

Prions

Genome projects : Creating the sequence map of a genome. Making sense of DNA sequence. DNA sequence variation and SNP, Application of SNP-technology-mapping genes underlying monogenic and multigenic disorder. Comparative genomics, transcriptomics, and Functional Genomics. Gross chromosome abnormalities and Cytogenetics.

Books:

1. Principles of Gene Manipulation and Genomics by Twyman and Primrose
2. Gene Cloning and DNA Analysis by T.A Brown

Paper MCB2PCOR07M
Microbial Diversity

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

Course Outcome

1. Explain the origin and evolution of life and the diversification of microorganisms on Earth.
2. Describe principles of microbial systematics, taxonomy, phylogeny, and nomenclature.
3. Classify and differentiate major groups of prokaryotic and eukaryotic microorganisms based on phenotypic and molecular characteristics.
4. Explain the diversity, structure, replication, and significance of acellular infectious agents including viruses, viroids, and prions.
5. Apply molecular and polyphasic approaches for microbial identification and classification.
6. Understand biodiversity conservation strategies, wildlife protection measures, biosafety concepts, and sustainable development practices.

Learning Objectives

- Understand microbial diversity and evolutionary relationships among microorganisms.
- Learn modern approaches for microbial classification, identification, and molecular characterization.
- Study microbial distribution in diverse habitats and their ecological significance, Use AI tools and EIA studies.
- Understand microbial metabolism and environmental interactions.
- Gain knowledge of phenotypic, biochemical, and molecular methods used in microbial identification.
- Develop awareness regarding biodiversity conservation, biosafety regulations, and sustainable resource management.

Unit I: Microbial Systematics and Taxonomy

This unit covers the principles of microbial systematics, taxonomy, classification, and nomenclature. Artificial, natural, phenetic, and phylogenetic classification systems; species concepts; monophyletic, paraphyletic, and polyphyletic groupings; molecular taxonomy and molecular phylogeny; molecular chronometers; polyphasic taxonomy; procedures for describing new prokaryotic species; rules governing valid publication of bacterial names; and the role of microbial culture collections in taxonomy and preservation.

Unit II: Diversity of Prokaryotic, Eukaryotic and Acellular Microorganisms

This unit provides an overview of microbial diversity with emphasis on bacteria, archaea, fungi, algae, and protozoa Classification and characteristic features of major bacterial phyla according to Bergey's Manual of Systematic Bacteriology, diversity and ecological significance of Archaea, modern fungal classification and phylogeny, fungal nutrition, growth, life cycles, parasexuality and heterothallism. Algal distribution, classification, reproduction, culture techniques, algal blooms and toxins, economic importance of algae, and the structure, reproduction, and classification of protozoa. Viroids, and prions as acellular infectious agents. Xenobiotics, Extremophiles and zoonotics.

Unit III: Biodiversity Conservation and Sustainable Development

This unit examines the importance of biological diversity and the factors threatening species survival. Topics include extinction processes, extinction vortex, causes of biodiversity loss, population viability analysis, and the use of Red Data Books. Conservation approaches at local, national, and international levels are discussed with emphasis on in situ and ex situ conservation strategies, protected area networks, wildlife sanctuaries, national parks, and biosphere reserves. Concepts of biosafety, sustainable development, and environmental stewardship, environmental audits and integration of AI.

Suggested Practical Components (Demonstrative)

- Identification and classification of microorganisms using Bergey's Manual.
- Construction and interpretation of phylogenetic trees using molecular data.
- Observation of fungal, algal, and protozoan diversity through microscopy.
- Demonstration of culture collection databases and microbial taxonomy resources.

- Study of viral morphology using diagrams and electron micrographs.
- Case studies on biodiversity hotspots and conservation strategies.
- Analysis of IUCN Red List and Red Data Book categories.
- Demonstration of GIS, remote sensing, and radiotelemetry applications in biodiversity studies.

Textbooks
1.Madigan, M.T., Bender, K.S., Buckley, D.H., Sattley, W.M. & Stahl, D.A. Brock Biology of Microorganisms. Pearson Education, USA.
2.Whitman, W.B. (Ed.). Bergey's Manual of Systematics of Archaea and Bacteria. Wiley-Blackwell, USA.
3.Tortora, G.J., Funke, B.R. & Case, C.L. Microbiology: An Introduction. Pearson Education, USA.
4.Prescott, L.M., Harley, J.P. & Klein, D.A. Prescott's Microbiology. McGraw-Hill Education, USA.
5.Atlas, R.M. & Bartha, R. Microbial Ecology: Fundamentals and Applications. Benjamin Cummings / Pearson, USA.

Reference Books
6.Woese, C.R. and Fox, G.E. Evolutionary Microbiology and Phylogeny. Academic Press.
7.Sneath, P.H.A., Mair, N.S., Sharpe, M.E. and Holt, J.G. Bergey's Manual of Determinative Bacteriology. Williams & Wilkins.
8.Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. Microbiology. Tata McGraw-Hill.
9.Primrose, S.B. and Twyman, R.M. Principles of Genome Analysis and Genomics. Blackwell Publishing.
10.Hunter, M.L. and Gibbs, J.P. Fundamentals of Conservation Biology. Wiley-Blackwell.

Paper MCB2PCOR08T
Microbial Metabolism

Course Outcome (CO):

Course objectives: To aquaint students with an understanding of: (1) the basic metabolic pathways; (2) inborn errors of metabolism and the application of DNA technology to their study; (3) the control and integration of metabolism.

Learning Outcomes

By the end of the course the student will be able to:

- describe the principles of metabolism and the differences between anabolism and catabolism;
- demonstrate an ability to handle simple mathematical treatments of biological processes.
- discuss the role of coenzymes, such as NAD+, FAD and ATP, in metabolism;
- outline the metabolic pathways involving glucose, fatty acids and amino acids;
- show how the energy released by catabolism is recouped by substrate level and oxidative phosphorylation;
- describe the various types of genetic mutation and inborn errors of metabolism
- describe the methods for detecting and correcting inborn errors of metabolism
- outline the hormonal regulation of metabolism and discuss the role of protein phosphorylation in this context;
- describe the regulation of metabolism in physiological and pathological situations (e.g. exercise, starvation and diabetes);

Bioenergetics: Concept and Importance of Gibb's free energy in living System, High energy compounds: Basic mechanism of ATP synthesis, Energy currency of the cell, Electron Transport Chain (ETC), Idea of Redox Potential, Chemiosmotic Hypothesis and Oxidative Phosphorylation, Inhibitors and Uncouplers.

Carbohydrates Metabolism: Catabolism and Anabolism, Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis.TCA cycle, Entner-Doudoroff pathaway, phosphoketolase pathway.

Catabolism of amino acids: Amino acids- Essential, non-essential, glucogenic and ketogenic, Transamination and oxidative deamination, Central role of Glutamic acid, Removal of nitrogen waste from the body, Urea cycle and excretion of Nitrogen.

Catabolism of fatty acids: Transport of fatty acids into Mitochondria, β-oxidation of saturated odd and even chain fatty acids (Reactions and Energetics), Ketogenesis, Biosynthesis of fatty acids and cholesterol (outline).

Nucleotide Metabolism: Biosynthesis of purine & pyrimidine (de novo & salvage pathways);

degradation of purine & pyrimidine.

Books: Voet and Voet, L. Stryer, H.W Dolle, Nelson & Cox.

Paper MCB2PDSE01T

Bioethics & Intellectual Property Rights
OR
Bioprocess Technology

Bioethics & Intellectual Property Rights

Course outcome (CO):

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

1. Understand the principles and significance of Intellectual Property Rights (IPR) in biological sciences.
2. Explain patenting procedures, patentability criteria, and legal protection of biotechnological inventions.
3. Interpret national and international laws, agreements, and organizations related to IPR.
4. Evaluate ethical issues associated with modern biotechnology and biomedical research.
5. Apply principles of research integrity, plagiarism prevention, and responsible conduct of research.
6. Understand biosafety regulations, containment practices, and Good Laboratory Practices (GLP) in microbiological research.

Learning Objectives

- To acquire knowledge of Intellectual Property Rights and patent systems.
- To understand ethical, legal, and social issues associated with biotechnology.
- To familiarize students with national and international IPR regulations.
- To develop awareness of research ethics and scientific integrity.
- To understand biosafety guidelines and laboratory safety practices.
- To promote responsible and safe conduct of microbiological research.

Unit I: Bioethics and Research Integrity

This unit introduces the principles of bioethics and their application in biological research. Ethical decision-making processes, responsible conduct of research, and the importance of maintaining scientific integrity. Scientific misconduct, including plagiarism, fabrication, and falsification of data, along with issues related to data management, research accountability, publication ethics, authorship, peer review, conflict of interest, and ethical responsibilities of researchers.

Unit II: Biotechnology and Ethical Issues

This unit focuses on the ethical, legal, and social issues associated with modern biotechnology in brief. Guidelines regarding Reproductive and therapeutic cloning, gene therapy and its ethical implications, stem cell research involving embryonic, adult, germline, and somatic cells, and concerns related to genetically modified organisms and genetically

modified crops. Environmental and societal impacts of biotechnology, issues of biopiracy and traditional knowledge, and ethical considerations.

Unit III: Intellectual Property Rights

This unit provides an overview of Intellectual Property Rights and their significance in biological sciences and biotechnology. Intellectual property, including patents, copyrights, trademarks, design rights, and geographical indications. Patentable and non-patentable inventions, protection of microorganisms and biotechnological innovations, patenting of life forms, Role and functions of the World Intellectual Property Organization (WIPO).

Unit IV: Patent Laws and International Agreements

This unit examines national and international frameworks governing intellectual property protection. Objectives and functions of GATT and the World Trade Organization (WTO), the provisions of the TRIPS Agreement, and the principles of patent laws and patentability criteria. Patent filing and granting procedures, the Indian Patent Act of 1970 and its amendments, patent protection in biotechnology, and important case studies such as the Super Bug, Basmati Rice, Turmeric, and Neem patents. Issues related to traditional knowledge and patent disputes are also discussed.

Unit V: Biosafety and Good Laboratory Practices

This unit introduces the principles of biosafety and their importance in microbiological research and biotechnology. Biosafety levels from BSL-1 to BSL-4, risk assessment and risk management strategies, recombinant DNA safety guidelines, and biological and physical containment measures. Containment laboratory design and operation, Good Laboratory Practices (GLP), laboratory safety protocols, waste management procedures, emergency response measures, and the biosafety regulatory framework in India, including the roles of IBSC, RCGM, and GEAC. The Food Safety and Standards Act and Regulations, 2011, are also included AI in Bioprocessing.

Text Books:

1.Beauchamp, T.L. & Childress, J.F. Principles of Biomedical Ethics. Oxford University Press, USA.

2.Sateesh, M.K. Bioethics and Biosafety. I.K. International Publishing House Pvt. Ltd., New Delhi, India.

3.Subbaram, N. Patents: Law and Practice. Pharma Book Syndicate, Hyderabad, India.

4.Singh, K. Intellectual Property Rights in Biotechnology. Springer India Pvt. Ltd., New Delhi, India.

5.WIPO. Understanding Intellectual Property. World Intellectual Property Organization (WIPO), Geneva, Switzerland.

Reference Books:

1.Dutfield, G. & Suthersanen, U. Global Intellectual Property Law. Edward Elgar Publishing, UK.

2.Primrose, S.B. & Twyman, R.M. Principles of Gene Manipulation and Genomics. Wiley-Blackwell, UK.

3.Bawa, R. & Bawa, A.S. Genetically Modified Foods: Safety, Risks and Public Concerns. Academic Press, USA.

4.World Trade Organization (WTO). TRIPS Agreement and Related Documents. WTO Publications, Geneva.

5.National Academy of Sciences. On Being a Scientist: Responsible Conduct in Research. National Academies Press, USA.

OR

Bioprocess Technology

Course Outcomes (CO)

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

1. Explain the fundamental concepts, principles, and applications of bioprocess technology and industrial fermentation.
2. Describe the isolation, screening, preservation, maintenance, and strain improvement of industrially important microorganisms.
3. Analyze the composition and optimization of fermentation media and apply sterilization and contamination control strategies in bioprocesses.
4. Explain the design, operation, monitoring, and control of bioreactors and various fermentation systems.
5. Apply principles of microbial growth kinetics, aeration, agitation, oxygen transfer, and process scale-up in industrial fermentation.
6. Evaluate downstream processing techniques and industrial production processes for commercially important microbial products.

Learning Objectives

- To understand the scope, significance, and applications of bioprocess technology in modern biotechnology industries.
- To study the characteristics and selection of industrial microorganisms and methods for their improvement and maintenance.
- To learn the formulation and optimization of fermentation media and the principles of sterilization and aseptic processing.
- To understand the design, operation, and control of bioreactors and different fermentation processes.
- To gain knowledge of bioprocess engineering principles including microbial growth kinetics, mass transfer, aeration, agitation, and scale-up.
- To explore downstream processing methods and the industrial production of value-added microbial products.

Unit I: Introduction to Bioprocess Technology and Industrial Microorganisms

Concept and scope of bioprocess technology. History and importance of industrial microbiology and fermentation. Primary and secondary metabolites. Characteristics of industrial microorganisms. Isolation, screening, preservation, maintenance, and strain improvement of industrially important microbes. Inoculum development and starter cultures for fermentation processes.

Unit II: Fermentation Media and Sterilization

Components of fermentation media: carbon sources, nitrogen sources, minerals, vitamins, growth factors, buffers, and antifoaming agents. Media formulation and optimization. Sterilization of media, air, and fermentation equipment. Contamination control in fermentation industries. Principles of aseptic techniques and quality assurance in bioprocesses.

Unit III: Bioreactor Design and Fermentation Processes

Design and construction of fermenters and bioreactors. Components of a fermenter: agitators, spargers, baffles, valves, sensors, and control systems. Types of fermentation processes: batch, fed-batch, continuous, submerged, and solid-state fermentation. Aerobic and anaerobic fermentations. Monitoring and control of fermentation parameters.

Unit IV: Bioprocess Engineering and Scale-Up

Principles of microbial growth kinetics. Aeration and agitation in fermentation systems. Oxygen transfer and volumetric oxygen transfer coefficient (KLa). Mass transfer and mixing in bioreactors. Scale-up and scale-down of fermentation processes. Process monitoring, instrumentation, and control in industrial bioprocesses.

Unit V: Downstream Processing and Industrial Applications

Principles of downstream processing. Cell harvesting, filtration, centrifugation, extraction, precipitation, membrane separation, chromatography, and drying techniques. Recovery and purification of fermentation products. Industrial production of microbial products including antibiotics, organic acids, amino acids, enzymes, biofuels, vitamins, and recombinant proteins. Economic and regulatory aspects of bioprocess industries.

Textbooks
Stanbury, P.F., Whitaker, A. & Hall, S.J. Principles of Fermentation Technology. Butterworth-Heinemann, Elsevier.
Shuler, M.L. & Kargi, F. Bioprocess Engineering: Basic Concepts. Prentice Hall.
Doran, P.M. Bioprocess Engineering Principles. Academic Press.
Crueger, W. & Crueger, A. Biotechnology: A Textbook of Industrial Microbiology. Sinauer Associates.
Bailey, J.E. & Ollis, D.F. Biochemical Engineering Fundamentals. McGraw-Hill.

Reference Books
Casida, L.E. Industrial Microbiology. New Age International Publishers.
Waites, M.J., Morgan, N.L., Rockey, J.S. & Higton, G. Industrial Microbiology: An Introduction. Blackwell Publishing.
Glazer, A.N. & Nikaido, H. Microbial Biotechnology: Fundamentals of Applied Microbiology. Cambridge University Press.

Paper MCB2PCOR09M
Biostatistics and Bioinformatics

Course Outcome:

Course objectives: Biostatistics course for those students will acquaint students to enable them to continue learning more advanced techniques in future statistical and biostatistical course work. It can also serve as the necessary base course in biostatistics for those who will go no further in acquiring advanced skills in biostatistics but who can use the knowledge they acquire to intelligently read journal articles that use biostatistical methods, interact effectively with professional biostatisticians in collaborative endeavours and understand the terminology of one of the core disciplines of public health. The objective of Bioinformatics course is learning and understanding basic concepts of Bioinformatics.

Learning outcomes:
For the Biostatistics course:

- be able to discuss and explain what biostatistics is and how it is used in the field of public health
- be able to understand the common statistical techniques and terminology used in studies that are presented in the popular press and health related journals
- be able to use and understand the principal numeric and graphical techniques to display and summarize medical and health related data
- be able to understand the basic principles of probability and how they relate to biostatistics
- be familiar with the common probability distributions that are used in statistical inference
- be able to know what drawing a random sample from a population means and why it is important
- be familiar with the most common sampling distributions used in biostatistics
- be familiar with the concept of statistical inference
- be able to estimate the value of various population parameters from a sample of data
- be able to test the hypothesis that the value of a population parameter equals a certain value
- be familiar with the sources of vital statistics data, how to interpret such data and how to perform basic tests to evaluate them

By the end of the course in Bioinformatics the student will be able to: • Gain an understanding of the basic concepts of Bioinformatics. • Understand the tools used in Bioinformatics.

Theory
Idea of Computational Biology and it's need in biological study. Central dogma of bioinformatics. Concept of databases, characteristics and classification of database. Sequencs information sources, EMBL, GENBANK, Entrez, Unigene. Nucleic acid and protein sequence database and information retrieval; sequence file formats - FASTA & GENBANK. Sequence alignment - pairwise and multiple sequence alignment. Pairwise alignment tool - BLAST and multiple sequence alignment tool - Crustal W. Protein and nucleic acid structure database: Protein information

Sources,PDB,SWISSPROT,TREMBL. The Protein Database (PDB); information retrieval from structural database, Dendogram, Claudogram, Evolutionary relationship.

Introduction to Biostatistics
Keywords and terms used in biostatistics. Concept of frequency distribution (frequency distribution table, simple and group frequency distribution, data presentation), mean, median, mode, standard deviation; Simple problems on mean, median, mode and standard deviation.

Statistical Distribution
Normal, binomial, poisson's distribution.

Books: Zin Xiong, Mount, Das and Das, Misra

Practical

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Using various BLAST and interpretation of results.
5. Retrieval of information from structural database.
6. Sequence alignment using BLAST

Semester3

Paper MCB2PCOR10M
Immunology

Course Outcome (CO):

After completing the Immunology course, students will be able to:

- Understand the salient features of antigen antibody reaction & its uses in diagnostics and various other studies.
- Learn about immunization and their preparation and its importance
- Demonstrate scientific quantitative skills, such as the ability to evaluate experimental design, read graphs,and understand and use information from scientific papers.
- Demonstrate skill in communication of scientific data in standard format.
- Undertake teaching assignments in the subject of Medical Microbiology

Learning objective:

1. Demonstrate an understanding of key concepts in immunology.
2. Understand the overall organization of the immune system.
3. Understand pharmacological basis of immunology.

Overview of Immune System: General features of immune responses; Clonal selection hypothesis; cell, tissues & organs of immune system.

Innate, Adaptive & Humoral immunity: Anatomic barriers, Physiologic barriers, Phagocytic/endocytic barriers, inflammatory barriers. B lymphocytes, T lymphocytes, Antigen-Presenting Cells,

Antigen-Immunoglobulin, Generation of immune Diversity: Overview of Antibody structure, Antigem-Antibody interactions, antibody heterogeneity and hybridoma technology.

Antigen presentation, Major Histo-compatibilityComplex, T-Cell maturation etc.

Cytokines: Properties of Cytokines; Cytokine Receptors; Cytokine Antagonists; Cytokine Secretion by TH1 and TH2 Subsets; Cytokine-Related Diseases; Therapeutic Uses of Cytokines and Their Receptors; Cytokines in Hematopoiesis

Autoimmunity and immunodeficiency Syndromesetc.

Books

Kuby Immunology, Cellular and Molecular immunology by Abul K. Abbas, janeway's Immunology

Paper MCBP2COR11T

Virology and Medical Microbiology

Course Outcome (CO):

The aim is to promote the knowledge and expertise in microbiology with a particular focus on virology and various aspects of basic medical microbiology like Medical Diagnostic Microbiology which includes theory of pathogenesis, infectious diseases, principles of antimicrobials and their applications and modern methods of diagnostic procedures. Students will develop an understanding of the scientific basis of virology concepts, as well as the specialist knowledge, and critical awareness required to enable students to pursue a career in medical microbiology.

To acquaint the students with **Outcome of the course**

After completing the Virology and Medical Microbiology course, students will be able to:

1. Understand fundamentals of viral biology; the structure of viruses and their genomes; virus gene expression, modes of replication and transmission, the interaction of viruses with cells and pathogenesis of virus-induced diseases, the detection, treatment and prevention of virus infections; virus epidemiology and the genetics and evolution of viruses.

2. Intellectual Skills and other Attributes to understand the nature of viruses and their role in disease pathogenesis; integrate and evaluate information and data from a variety of sources

3. State the recent advances in the field of Medical Microbiology and apply this knowledge in understanding pathogenesis and diagnosis of diseases caused by micro-organisms.

4. Carry out fundamental or applied research involving microbiological work.

5. Undertake teaching assignments in the subject of Medical Microbiology

Lytic and lysogenic cycles of bacteriophage λ - marvels of transcriptional control; spite-specific recombination in lambda (generalized and specialized transduction); problems in replication of the ends of linear DNA and how viruses circumvent the problem with examples of T-4 (terminal redundancy and circular permutation), λ (rolling circle model of replication, concatemers, site-specific cleavage), adenovirus and retrovirus; viruses as vectors for recombinant DNA technology – M13, fd, TMV, Ti, Baculovirus, Adenovirus, Retrovirus; oncogenic viruses; oncolysis - VSV. Incidence and etiology of cancer, genetics of cancer, hallmarks of cancer, metastasis, molecular and cellular events, such as regulation of gene expression, genome maintenance, cell growth and death, differentiation, cell-cell recognition, signaling, and homeostasis.

Pathogenicity of microorganism*:* Host parasite relationship, Pathogenesis of viral diseases, bacterial pathogenesis. Toxigenicity, Host defence against microbial invasion, microbial mechanism for escaping host defences.

Antimicrobial chemotherapy*:* Development of chemotherapy, Determining the level of antimicrobial activity, Antimicrobial/ bacterial drugs, Drug Resistance, Antiviral, fungal, protozoan drugs.

Human diseases caused by bacteria: *Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacterium, Bacillus, Clostridium, Shigella, Salmonella, E.coli, Vibrio, Mycobacterium.* Meningitis, Tuberculosis, Diptheria, Leprosy, Cystic fibrosis, Typhoid, Enteritis, Gastritis *(Helicobacter pylori), Cholera, Pneumonia*.

Human diseases caused by viruses and prions

Human diseases caused by fungi and protists

Biology of obligate parasites: *Rickettsia, Chlymadia, Trypanosomes, Spirochetes*

Microbial production of therapeutic agents

Structural variations in bacteria: Uncommon bacterial genera- Rickettsia, Chlamyda, Mycoplasma etc.

Antimicrobial Agents and Chemotherapy**:** Antibiotics - Definition, genera of antibiotics, mode of action of antibiotics, assay of antibiotics, Antibiotics vs probiotics, Antibiotic resistance, MAR(its significance), Methods of action of antibiotics and antibacterial agents

Bioterrorism and Bioweapons: Introduction to Bioterrorism and Bioweapons, Pathogenic microorganisms used for these purpose and their properties, Infectious agents and their epidemiology

Books for reference

- Molecular Biology of the genes by James D. Watson.

- The Cell by Geoffrey M. Cooper.
- Cell and Molecular Biology by Gerald Karp.
- Molecular Cell Biology by Harvey Lodish.
- Molecular Biology of Cells by Bruce Alberts.

Paper MCB2PCOR12T

Food and Industrial Microbiology

Course Outcomes (CO)

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

1. Explain the diversity, physiology, and industrial significance of microorganisms used in food and fermentation industries.
2. Describe microbial roles in food production, preservation, spoilage, and food safety.
3. Analyze intrinsic and extrinsic factors affecting microbial growth and survival in foods.
4. Apply principles of industrial microbiology for the production of antibiotics, enzymes, vitamins, vaccines, and other value-added products.
5. Understand the design, operation, and scale-up of bioreactors and fermentation processes.
6. Explain downstream processing techniques used for recovery and purification of industrial products.
7. Evaluate industrial safety, biosafety, bioethics, and intellectual property rights related to food and biotechnology industries.
8. Develop knowledge of quality control and sustainable practices in food and industrial microbiology.

Learning Objectives

- To understand the role of microorganisms in food production, preservation, and spoilage.
- To study microbial fermentation processes involved in dairy, cereal, vegetable, and beverage industries.
- To learn factors influencing microbial growth, food quality, and food safety.
- To understand industrial production of antibiotics, enzymes, vitamins, vaccines, and recombinant products.
- To gain knowledge of fermentation technology, bioreactor design, and process optimization.
- To study downstream processing and product recovery techniques.
- To understand industrial biosafety, bioethics, and intellectual property rights.
- To develop practical knowledge of quality assurance and industrial applications of microorganisms.

Unit I: Industrial Production of Antibiotics and Bioactive Compounds

Introduction to industrial microbiology and microbial products. Industrial production of antibiotics including penicillins, cephalosporins, streptomycin, and erythromycin. Microorganisms involved, fermentation processes, strain improvement, and process optimization. Overview of commercially important bioactive compounds. Production of Pharmaceuticals and Industrial Products. Concepts of microbial biotransformation and production of hormones and pharmaceutical intermediates. Industrial significance and applications. Principles of fermentation technology. Types and components of fermenters and bioreactors. Batch, fed-batch, and continuous fermentation. Aeration, agitation, sterilization, monitoring, process control, and scale-up of fermentation processes. Downstream Processing and Product Recovery. Principles of downstream processing. Cell harvesting, extraction, concentration, purification, and formulation of products. Techniques including filtration, centrifugation, chromatography, membrane separation, crystallization, and drying. Industrial applications of bioseparation processes.

Unit II: Food Microbiology

Microbial flora of milk, dairy products, fruits, vegetables, meat, poultry, and processed foods. Beneficial and harmful microorganisms in foods. Intrinsic and extrinsic factors affecting microbial growth. Foodborne microorganisms and their significance in food quality and safety. Industrial Microorganisms and Strain Improvement. Characteristics of industrial microorganisms. Isolation, screening, selection, and preservation of industrial strains. Strain improvement through mutation, recombination, and genetic engineering. Applications of recombinant DNA technology and genetically modified microorganisms in industry. GMO's

Unit III: Food Spoilage and Preservation

Microbial spoilage of foods and mechanisms of deterioration. Spoilage microorganisms associated with different food commodities. Principles and methods of food preservation including heat processing, refrigeration, freezing, drying, irradiation, chemical preservatives, fermentation, probiotics, and bacteriocins. Food safety and quality assurance systems.

Unit IV: Industrial Bioethics, Biosafety and AI in Processing Industry

Concepts of industrial bioethics and biosafety. Intellectual Property Rights (IPR), patents, copyrights, trademarks, and technology transfer. Ethical issues in food biotechnology and industrial microbiology. Regulatory aspects and commercialization of microbial products.

Textbooks

1.Prescott's Microbiology – Joanne M. Willey, Linda M. Sherwood & Christopher J. Woolverton. McGraw-Hill Education, USA.

2.Modern Food Microbiology – James M. Jay, Martin J. Loessner & David A. Golden. Springer Science+Business Media, USA.

3.Food Microbiology – William C. Frazier & Dennis C. Westhoff. Tata McGraw-Hill Publishing Company, India.

4.Biotechnology: A Textbook of Industrial Microbiology – Werner Crueger & Anneliese Crueger. Panima Publishing Corporation, India.

5.Industrial Microbiology: An Introduction – Michael J. Waites, Neil L. Morgan, John S. Rockey & Gary Higton. Blackwell Publishing Ltd., UK.

6.Principles of Fermentation Technology – Peter F. Stanbury, Allan Whitaker & Stephen J. Hall. Butterworth-Heinemann (Elsevier), UK.

Reference Books

1.Industrial Microbiology – L.E. Casida Jr. New Age International Publishers, India.

2.Food Microbiology – Martin R. Adams & Maurice O. Moss. Royal Society of Chemistry Publishing, UK.

Paper MCB2PDSE02M

Agricultural Microbiology

OR

Application of Microbial Technology

Agricultural Microbiology

Course Outcomes (CO)

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

1. Explain plant–microbe interactions and identify major plant diseases of agricultural importance.

2. Evaluate the role of beneficial microorganisms in crop productivity, plant nutrition, and plant health.

3.Analyze the contribution of soil microorganisms to soil fertility, nutrient cycling, and ecosystem sustainability.

4.Understand the production, formulation, and application of biofertilizers and biopesticides in sustainable agriculture.

5.Apply principles of composting, vermicomposting, and bioenergy generation for organic waste management.

6.Explain microbial processes involved in nitrogen fixation, nutrient mobilization, and plant growth promotion.

7. Evaluate biological control strategies for management of plant diseases and pests.

Learning Objectives

- To understand the diversity and ecological significance of soil and plant-associated microorganisms.
- To study plant–microbe interactions and microbial contributions to agricultural productivity.
- To understand microbial nutrient transformations and biogeochemical cycles.
- To gain knowledge of plant diseases, biological control agents, and sustainable crop protection strategies.
- To familiarize students with biofertilizers, biopesticides, composting technologies, and plant biotechnology applications.

Unit I: Plant–Microbe Interactions and Plant Diseases

Plant–microbe interactions and their agricultural significance. Endophytic microorganisms, plant growth-promoting microorganisms, and plant pathogens. Major bacterial, viral, and fungal diseases of crops, disease symptoms, disease cycles, epidemiology, and disease management strategies.

Unit II: Beneficial Plant–Microbe Associations

Rhizosphere, rhizoplane, and phylloplane microorganisms. Symbiotic and associative interactions including Rhizobium-legume association, mycorrhizae, endophytes, and plant growth-promoting rhizobacteria (PGPR). Role of microorganisms in nutrient acquisition, disease suppression, and crop productivity.

Unit III: Soil Microbiology and Biogeochemical Cycles

Soil as a microbial habitat. Role of microorganisms in soil formation, decomposition, humus formation, and maintenance of soil fertility. Microbial participation in carbon, nitrogen, phosphorus, and sulphur cycles with special emphasis on biological nitrogen fixation.

Unit IV: Biofertilizers,Biopesticides

Principles, classification, production, formulation, and application of biofertilizers including Rhizobium, Azotobacter, Azospirillum, Azolla–Anabaena, phosphate-solubilizing microorganisms, and liquid biofertilizers. Microbial biopesticides, biological control agents, and recent advances in integrated pest management.

Unit V: Composting, Vermicomposting and Bioenergy

Microbial decomposition of organic matter. Composting methods, farmyard manure, microbial enrichment of compost, vermiculture, vermicomposting, and super-digested compost. Biogas production and utilization of agricultural wastes for sustainable farming systems.

Unit VI: Plant Biotechnology and Sustainable Agriculture
Production of disease-free planting materials, germplasm conservation, and modern biotechnological approaches for sustainable agriculture.

Unit VII: Agricultural Environmental Microbiology and Bioremediation
Microbial applications in wastewater treatment, soil health management, biodegradation of agrochemicals, and bioremediation of contaminated agricultural ecosystems. Role of microorganisms in environmental sustainability and climate-resilient agriculture.

Text Books
1.Principles and Applications of Soil Microbiology. David M. Sylvia, Jeffry J. Fuhrmann, Peter G. Hartel and David A. Zuberer. Pearson Education, USA.
2.Soil Microbiology, Ecology and Biochemistry. Eldor A. Paul. Academic Press, Elsevier, USA.
3.Plant Pathology. George N. Agrios. Academic Press, Elsevier, USA.
4.Agricultural Microbiology.G. Rangaswami and D. J. Bagyaraj. Prentice Hall of India Pvt. Ltd., New Delhi.
5.Soil Microorganisms and Plant Growth. N. S. Subba Rao. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
6.Environmental Microbiology. Ian L. Pepper, Charles P. Gerba and Terry J. Gentry. Academic Press, Elsevier.
7.Environmental Biotechnology: Theory and Application. Gareth M. Evans and Judith C. Furlong. John Wiley & Sons Ltd.

OR

Application of Microbial Technology

Course Outcomes (CO)

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

1.Explain the principles and applications of microbial biotechnology in industrial, agricultural, environmental, and healthcare sectors.

2.Analyze microbial fermentation processes and production of industrially important metabolites, enzymes, probiotics, and bioactive compounds.

3. Evaluate the role of microorganisms in biofertilizer and biopesticide development for sustainable agriculture.

4.Apply microbial technologies for wastewater treatment, bioremediation, biosorption, and environmental restoration.

5. Assess emerging technologies including genomics, bioinformatics, nanobiotechnology, and microbial drug discovery.

6.Examine the applications of microorganisms in bioleaching, enhanced oil recovery, and mineral recovery.

7. Critically evaluate biosafety, biosecurity, ethical concerns, and regulatory aspects associated with GMOs and microbial biotechnology.

8.Develop entrepreneurial and commercialization skills related to agricultural and industrial microbial products.

Learning Objectives:

To provide rovide advanced knowledge of microbial biotechnology.
Detailed Knowledge of Industrial microbiology, environmental biotechnology, and agricultural microbial technologies.
Students will understand the role of microorganisms in production processes, environmental management, sustainable agriculture.

Learn about drug discovery, and commercialization of microbial products.

Unit I: Fundamentals of Microbial Biotechnology

Scope, history, and future prospects of microbial biotechnology. Applications in agriculture, industry, environmental management, and healthcare. Microorganisms as cell factories for the production of proteins, recombinant vaccines, industrial enzymes, polysaccharides, and biopolymers. Immobilization of microbial cells and enzymes and their industrial significance.

Unit II: Industrial Fermentation and Probiotics

Principles of industrial fermentation. Production of ethanol, organic acids, solvents, fermented foods, and dairy products. Clostridial, lactic acid, and acetic acid fermentations. Probiotics: concepts, mechanisms of action, health benefits, and industrial applications.

Unit III: Microbial Metabolites and Bioactive Products

Industrial production of amino acids, antibiotics, enzymes, and other microbial metabolites. Antibacterial, antifungal, and anticancer compounds of microbial origin. Single-cell protein (SCP), mycoprotein, and microalgal biotechnology for food, feed, biofuel, and pharmaceutical applications.

Unit IV: Environmental Microbiology and Emerging Technologies

Microbial diversity in aquatic, marine, and terrestrial ecosystems. Applications of genomics, metagenomics, bioinformatics, DNA microarray technology, and systems biology in microbial biotechnology. Nanobiotechnology and its applications in environmental management and human health.

Unit V: Agricultural Microbial Biotechnology

Biofertilizers, biopesticides, microbial insecticides, and plant growth-promoting microorganisms. Nitrogen-fixing bacteria, phosphate-solubilizing microorganisms, mycorrhizae, and genetically engineered microbes for sustainable agriculture. Integrated nutrient and pest management strategies.

Unit VI: Environmental Biotechnology and Resource Recovery

Microbial wastewater treatment and sewage management. Bioremediation, bioaugmentation, biosorption, degradation of xenobiotics, and removal of heavy metals. Microbial applications in bioleaching, mineral recovery, and enhanced oil recovery. Environmental and economic aspects of biotechnology.

Unit VII: Biosafety, Biosecurity and Commercialization

Biosafety and biosecurity principles in microbial biotechnology. Biological warfare agents and risk assessment. Regulatory frameworks governing GMOs and microbial products. Isolation, selection, mass cultivation, formulation, quality control, scale-up production, packaging, storage, marketing, entrepreneurship, and commercialization of microbial technologies.

Text Books

1.Alexander N. Glazer and Hiroshi Nikaido. Cambridge University Press.
2.Biotechnology: A Textbook of Industrial Microbiology.Wulf Crueger and Anneliese Crueger. Panima Publishing Corporation.
3.Environmental Microbiology.Ian L. Pepper, Charles P. Gerba and Terry J. Gentry. Academic Press, Elsevier.
4.Microbial Biotechnology. Alexander N. Glazer and Hiroshi Nikaido. Cambridge University Press.
5.Brock Biology of Microorganisms. Michael T. Madigan et al. Pearson Education.
6.Environmental Biotechnology: Principles and Applications. Bruce E. Rittmann and Perry L. McCarty. McGraw-Hill.
7.Molecular Biotechnology: Principles and Applications of Recombinant DNA. Bernard R. Glick, Jack J. Pasternak and Cheryl L. Patten. ASM Press.

Paper MCB2PCOR13M

Environmental Microbiology

Course Outcomes (CO)

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

1. Explain the diversity, ecology, and environmental significance of microorganisms in terrestrial, aquatic, and atmospheric habitats.

2.Analyze microbial interactions in ecosystems and their role in biogeochemical cycling and environmental sustainability.

3. Evaluate the impact of pollutants, xenobiotics, and heavy metals on microbial communities and ecosystem health.

4. Apply microbial processes in water quality assessment, wastewater treatment, and waste management.

5.Assess the role of microorganisms in biodegradation, bioremediation, bioleaching, and resource recovery.

6. Explain microbial technologies used for treatment of industrial effluents, oil spills, and hazardous wastes.

7.Understand microbial approaches for sustainable management of solid, liquid, and electronic wastes.

8.Develop skills in environmental monitoring, biosensor applications, and pollution control technologies.

Learning Objectives

- To understand microbial diversity and ecology in different environments.
- To study microbial roles in nutrient cycling and ecosystem functioning.
- To understand environmental pollution and microbial remediation strategies.
- To gain knowledge of wastewater treatment, waste management, and resource recovery technologies.
- To familiarize students with modern environmental biotechnology applications.

Unit I: Microbial Ecology and Environmental Diversity

Microbial ecology and environmental microbiology. Microorganisms in soil, water, air, and extreme environments. Extremophiles including thermophiles, halophiles, acidophiles, alkaliphiles, barophiles, and anaerobes. Impact of heavy metals and xenobiotics on microbial communities. Microbial biodeterioration of paper, leather, wood, textiles, stone, and monuments.

Unit II: Aeromicrobiology and Aquatic Microbiology.Microorganisms of indoor and outdoor air environments. Air sampling, enumeration, transmission pathways, control measures, and bioterrorism. Freshwater and marine microbiology, eutrophication, microbial food webs, aquatic animal health, zoonotic pathogens, and microbial indicators of water quality.

Unit III: Water Quality and Wastewater Microbiology.Microbiology of drinking water and domestic water supplies. Indicator microorganisms and potable water standards. Water purification systems and microbial assessment of water quality. Sewage microbiology and wastewater treatment including primary, secondary, and tertiary treatment processes. Application of treated wastewater and biosolids in agriculture.

Unit IV: Biodegradation and Bioremediation. Microbial degradation of environmental pollutants. Bioremediation strategies including bioventing, biofiltration, bioaugmentation, and biosorption. Biodegradation of hydrocarbons, pesticides, chlorinated compounds, aromatic hydrocarbons, surfactants, TNT, PCB, and oil pollutants. Biosensors for environmental monitoring and pollutant detection.

Unit V: Waste Management and Environmental Biotechnology. Microbial management of solid and liquid wastes. Composting, vermicomposting, landfill technology, incineration, and hospital waste management. Lignocellulolytic microorganisms and enzymes in biomass conversion, biopulping, biobleaching, textiles, biofuel production, and animal feed generation. Treatment of industrial effluents from textile, distillery, pulp and paper industries.

Unit VI: Microbial Resource Recovery and Bioleaching.Microbial enhanced oil recovery (MEOR). Bioleaching and biomining of copper, gold, uranium, and other minerals. Recovery of valuable resources from industrial and electronic wastes. Microbial applications in sustainable resource management and circular bioeconomy.

Unit VII: Environmental Monitoring and Sustainable TechnologiesEnvironmental pollution assessment and monitoring. Detection of metals, toxins, sediments, and organic pollutants. Biological magnification and ecological risk assessment. Emerging microbial technologies for sustainable environmental management and climate resilience.

Practical Components

Isolation and enumeration of microorganisms from soil, water, and air. Determination of microbial load in potable and non-potable water.

Estimation of BOD, COD, and dissolved oxygen in wastewater..Isolation and screening of hydrocarbon-degrading microorganisms.

Compost preparation and microbial analysis..Detection of coliform bacteria using MPN technique.

Demonstrative Study of activated sludge and sewage treatment processes..Microbial assessment of industrial effluent samples.

AMR and sustainability studies.

Text Books

1. Environmental Microbiology. Ian L. Pepper, Charles P. Gerba and Terry J. Gentry. Academic Press, Elsevier.

2. Environmental Microbiology: Fundamentals and Applications.Jean-Claude Bertrand et al. Springer.

3. Environmental Biotechnology: Principles and Applications.Bruce E. Rittmann and Perry L. McCarty. McGraw-Hill Education.

4. Manual of Environmental Microbiology.Christon J. Hurst et al. ASM Press.

5. Bioremediation and Natural Attenuation: Process Fundamentals and Mathematical Models.Pedro J. Alvarez and Walter A. Illman. Wiley-Interscience.

Paper MCB2PSEC01M

Diagnostic Microbiology

SEC:

Course poutcome (CO):

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

1.Explain the principles of host–pathogen interactions and mechanisms of microbial pathogenesis.
2.Evaluate host immune responses and microbial strategies for evasion of host defenses.
3. Understand the principles, mechanisms, and clinical applications of antimicrobial agents and rational antibiotic use.
4. Analyze antimicrobial resistance patterns and their significance in public health and healthcare settings.
5. Apply conventional and advanced diagnostic techniques for identification of infectious diseases.
6.Interpret molecular and immunological diagnostic methods used in clinical microbiology.
7.Demonstrate competency in laboratory biosafety, infection control practices, and healthcare-associated infection management.
8.Develop research and teaching skills related to medical and diagnostic microbiology.

Learning Objectives

- To understand the principles of infectious diseases and microbial pathogenesis.
- To study antimicrobial agents, mechanisms of action, and antimicrobial resistance.
- To familiarize students with conventional and advanced diagnostic microbiology techniques.
- To understand healthcare-associated infections and infection control strategies.
- To develop laboratory skills in clinical diagnosis and molecular diagnostics.

Unit I: Principles of Infection and Pathogenesis. Host–parasite relationships and mechanisms of microbial pathogenesis. Bacterial and viral pathogenesis, toxigenicity, host defense mechanisms, innate and adaptive immunity, and microbial strategies for evasion of host immune responses.

Unit II: Antimicrobials and Antimicrobial Resistance. History and development of chemotherapy. Classification, mode of action, production, and assay of antibiotics. Antimicrobial agents against bacteria, viruses, fungi, and protozoa. Antibiotic resistance, multiple antibiotic resistance (MAR), mechanisms of drug resistance, antimicrobial susceptibility testing, and rational antibiotic policy.

Unit III: Clinical Microbiology and Infectious Diseases. Principles of prevention, diagnosis, treatment, and control of infectious diseases. Healthcare-associated infections (HAIs), hospital infection control measures, antimicrobial stewardship, and clinical applications of microorganisms in health and disease management.

Unit IV: Immunodiagnostics and Serological Techniques. Antigen-antibody interactions. Principles and applications of immunological techniques including ELISA, immunofluorescence, rapid diagnostic tests, polyclonal and monoclonal antibodies in clinical diagnosis and disease monitoring.

Unit V: Molecular Diagnostics in Clinical Microbiology. Polymerase Chain Reaction (PCR) and its variants in microbial diagnosis. Restriction Fragment Length Polymorphism (RFLP), SNP genotyping, sequencing technologies, nucleic acid-based detection systems, and molecular epidemiology of infectious diseases.

Unit VI: Advanced Diagnostic Technologies. DNA fingerprinting, forensic microbiology, next-generation sequencing (NGS), metagenomics, biosensors, automation in clinical microbiology laboratories, and recent advances in diagnostic microbiology.

Unit VII: Laboratory Biosafety, Quality Control and Emerging Trends. Laboratory biosafety and biosecurity practices. Biomedical waste management, quality assurance and quality control in diagnostic laboratories. Emerging infectious diseases, translational microbiology, and recent advances in medical and diagnostic microbiology.

Practical Components

Demonstration and practice of microbiology laboratory safety procedures.
Biosafety cabinet operation and aseptic techniques.
Biomedical waste segregation and disposal.
Collection, transport, and processing of clinical specimens.
Isolation and identification of clinically important bacteria.
Antibiotic susceptibility testing (Kirby–Bauer method).
Determination of Multiple Antibiotic Resistance (MAR) index.
ELISA and other immunodiagnostic techniques.
Quality control procedures in diagnostic microbiology laboratories.

Text Books

1. Medical Microbiology.Patrick R. Murray, Ken S. Rosenthal and Michael A. Pfaller. Elsevier.
2. Jawetz, Melnick and Adelberg's Medical Microbiology.Karen C. Carroll, Stephen A. Morse, Timothy A. Mietzner, Steve Miller and Barbara Detrick. McGraw-Hill Education.
3. Diagnostic Microbiology and Infectious Disease.Richard L. Hodinka, Stephen A. Young and Benjamin A. Pinsky. ASM Press.
4. Clinical Microbiology Made Ridiculously Simple.Mark Gladwin and Bill Trattler. MedMaster Publications.
5. Molecular Microbiology: Diagnostic Principles and Practice.David H. Persing, Fred C. Tenover, James Versalovic, Yi-Wei Tang and Thomas F. Smith. ASM Press.

Semester4

Project Work

Course Outcome (CO):

Students go for an intensive project of 6 months in various laboratories and research institutes to get hands on experience on various techniques and also learn to use various sophisticated instruments used in research. They get a flavor of research which motivates them to pursue their doctoral program.They also join microbiological R&D industries.

MCB2PCOR14M

Project Work1 Attendance

MCB2PCOR15M

Project Work2 External Evaluation

MCB2PCOR16M

Project Work3 Write up

MCB2PCOR17M

Project Work4 Presentation

MCB2PCOR18M

Project Work5 Question answer

Grand viva

MCB2PCOR19P

Course outcome (CO):

1.To demonstrate a comprehensive knowledge of core subjects studied during the program.

2.Communicate scientific knowledge confidently and clearly through oral presentation and discussion.

3.Defend and justify answers using logical reasoning and subject understanding