J.J. College of Arts and SCIENCE (Autonomous),

Sivapuram Post, Pudukkottai – 622 422

Syllabus – P.G.

(2022-2023 onwards)

P.G. and Research Department of Microbiology

Programme Outcome (PO) – M.Sc.

At the End of the Programme, Post Graduates will have

PO-1: Adequate domain knowledge and critical thinking to enrich it further by self-study.

PO-2: Developed discipline specific skills in reasoning, analysis and communication.

PO-3: Acquired an aptitude for research in mono-disciplinary and multi-disciplinary areas.

PO-4: Become employable in specific areas involving expertise.

PO-5: Developed a keen sense of professional and social ethics.

ProgrammeSpecific Outcome (PSO) – M.Sc.

At the end of the Programme the student will be able to

PSO-1: Understand and apply knowledge in the field of Microbiology.

PSO-2: Design, perform experiments and acquire skills in the specialized areas of Microbiology

PSO-3: Understand the need and impact of microbiological solutions in environment and societal context keeping in view the need for sustainable solution.

PSO-4: Take up the research projects, review literatures and solve the research-oriented problems.

PSO-5: Foster for higher studies, R & D activities and professional career in emerging trends in Microbiology.

ProgrammeEducational Objectives (PEO) – M.Sc.

- To give learners a broader and deeper perspective on their chosen core areas
- To promote application-oriented learning through Elective Courses
- To initiate learners in Research Work
- To develop Library and Reference skills through Assignments and Term Papers
- To promote oratorical and rhetorical skills through participation in seminars, conferences, public viva and debates
- To prepare learners for competitive examinations like NET, SLET, TRB and Civil Services
- To cultivate leadership quality through training in event management

ADVANCED MICROBIOLOGY

Course Code: P1R2MBCC1	**Credit:** 5
Category: Core Course	**Hrs/Week:** 06, **Total Inst.Hrs:** 72
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To know the modern classification system of Microorganism
- To become familiar with structure and function of cellular components
- To get knowledge about Fungi nutritional strategies.
- To learn Algae and protozoans structure and classification.
- To prepare the student to involve in various research fields by learning culture collection and preservation methods

Unit I: Classification of Microorganism 15hrs

Taxonomy, Definition and systematics, Nomenclatural rules and identification of microbes in the living world classification systems – Haeckel's three kingdoms, Whittaker's five kingdoms approach, Carl Woese Third domain system. Numerical Taxonomy: Major characteristics used in taxonomy – Classical and Molecular methods. Outline classification of Bergey's manual of systematic bacteriology (2011-2013).

Unit II: Ultra Structure of Bacteria 15hrs

Structure and composition of cell walls Gram negative, Gram positive bacteria, Halophiles. L-forms and Archaebacteria, capsule type's composition and function.Cell membranes in eubacteria, archaebacteria and cyanobacteria – membrane functions, periplasmicspace.Structure and function of flagella, cilia and pili, intracellular components, gas vesicles, chlorosomes, carboxysomes, magnetosomes and phycobilisomes. Reserve food materials – polyhydroxybutyrate, polyphosphates, cyanophycin and sulphur inclusions. Nuclear material – bacterial chromosomes and bacterial plasmids.

Unit III: Fungi 14hrs

Cell wall – chemical composition and functions, membranes and their functions, nutritional strategies of fungi. Structure and life cycle of fungi – Ascomycetes (*Aspergillus*), Deuteromycetes (*Candia*), Zygomycetes (*Mucor*), Basidomyces (*Agaricus*). Economic importance of fungi.

Unit IV: Algae and protozoans 14 hrs

Structure of algal cells – classification – reproduction and characteristics of Chlorophyta (Green algae), Chrysophyta (Golden Brown and Yellow), Green algae, Diatoms, Euglenophyta (Euglenoids).Rhodophyta (Red algae), Cyanophyta, Xanthophyta – General characteristics and classifications of Protozoans. Economic importance of algae.

Unit V: Culture Collection and Preservation **14 hrs**

Culture collection methods-aerobic and anaerobic culture collection and basic identification methods. Preservation methods of microbes for storage and microscopy studies, culture collections centers – ATCC and MTCC. Physical, chemical methods for controlling microorganisms.A note on fossil microorganism. Microbes in extreme environment.

Text Books:

1. PelczarJr,M.J.Chan, E.C.S. and Kreig,N.R. (1993). Microbiology, Mc,GrawHill.Inc, New York (All units covered).
2. Prescott,L.M. Harley,J.P. and Klein, D.A.(2003). Microbiology (5th edition) McGraw Hill, New York (All units covered).
3. Madigan,M.T. Martinko,J.M and Parker,J..Brock, T.D.(1997). Biology of Microorganism (8th edition). Prentice Hall International lnc, London (All units covered).
4. GeetaSumbali and Merhrotra R.S. (2009).Principles of Microbiology.Tata McGraw Hill Education private Limited.

Reference Books:

5. SambamurtyA.V.S.S (2005).Text Book of Algae .I.K.InternationalPvt Ltd.
6. Alexopoulus, C.J. and Mims,C.W.(1993). Introductory Mycology (3th edition). Wiley Eastern Ltd, New Delhi.
7. Elizabeth Moore- Landecker.(1996). Fundamentals of the fungi.(4th edition). Prentice Hall International, lnc London.
8. Holt,J.S.Kreig, N.R. Sneath, P.H.A and Williams,S.T. Bergey's Manual of Determinative Bacteriology (9th edition),Williams and Wilkins., Baltimore.
9. John Webster (1993). Introduction to Fungi (2th edition). Cambridge University Press, Cambridge.
10. Salle, A.J.(1996). Fundamental principles of Bacteriology, (7th edition).Tata McGraw-Hill publishing company Ltd, NewDelhi.

Course Outcomes:

After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Classify microorganisms	K2
CO2	Describe Ultra structure of Bacteria	K2
CO3	Explain the life cycle of fungi	K3
CO4	Find the structure of Algae and Protozoa	K5
CO5	Interpret culture collection and preservation	K2

Title of the Course: General Microbiology						**Course Code:** P1R2MBCC1					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	2	3	3	3	2.9
CO2	3	3	1	3	3	3	2	2	3	3	2.6
CO3	3	2	2	1	1	3	2	2	3	3	2.2
CO4	3	2	2	1	1	3	2	2	3	3	2.2
CO5	3	3	3	3	3	3	3	2	3	3	2.8
	Mean Overall Score										**2.54**
	Result										**High**

BIOCHEMISTRY

Course Code: P1R2MBCC2	**Credit:** 5
Category: Core Course	**Hrs/Week:** 06, **Total Inst.Hrs:** 72
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To have a detailed knowledge about the structure and function of carbohydrates
- To know the properties of Aminoacids.
- To understand the importance of fatty acids
- To become familiar with nucleic acids
- To be aware of vitamins

Unit – I

Carbohydrates: 14 hrs

Classification, structure, occurrence and biological functions of monosaccharides, disaccharides and polysaccharides. Carbohydrate metabolism - Glycolysis, Gluconeogenesis, Citric acid cycle, Glyoxylate cycle, HMP shunt pathway: energetcis and regulation.

Unit – II Amino acids: 15 hrs

Nomenclature and classification, structure, and biological functions - Titration curve - isoelectric point. Metabolism: deamination, transamination, decarboxylation, desulphuration, degradation and biosynthesis of individual amino acids, transglutaminase cycle and urea cycle and regulation. Proteins: Classification, structure, peptide bond, properties and biological functions of proteins. Elucidation of proteins structure: determination of primary and secondary structure of protein – alpha helix, beta sheet, beta turns, Ramachandran Plot. Super secondary structures - helix-loop-helix. Tertiary and quaternary structures. Factors responsible for protein folding of amino acids. Amino acid sequencing techniques and Chemical synthesis of polypeptides, salting in and salting out of proteins.

Unit – III:Fatty Acids 15 hrs

Structure, classification, properties and biological functions of saturated and unsaturated fatty acids. Structure and biological functions of phospholipids, sphingolipids, glycolipids. Steroids – structure and functions of cholesterol, bile acids and bile salts. Amphipathic lipids - membranes, micelles, emulsions and liposomes. Lipogenesis: biosynthesis of fatty acid, triglycerides, phospholipids, and cholesterol. Regulation of triacylglycerol, phospholipids and cholesterol biosynthesis. Oxidation of lipids. Role of carnitine cycle in the regulation of β-oxidation. Ketogenesis and its control. Lipoprotein metabolism - exogenous and endogenous pathways.

Unit – IV: Nucleic acids 14hrs

Structure of purine and pyrimidines, Composition of RNA, DNA, PNA (Peptide nucleic acid) features of DNA doubles helix. Denaturation and annealing of DNA, structure and different types of RNA and DNA. Biosynthesis of Nucleotides – synthesis of purine and pyrimidines – De nova, salvage and its regulations.

Unit – V: Vitamins **14 hrs**

Vitamins - Definition, nomenclature, structure and biochemical properties and biological availability. Synthesis, storage, metabolism, sources, biochemical functions, deficiency diseases, daily requirements of water soluble and fat soluble Vitamins.

References:

1. Sathyanarayana,U ,Charapani,C.(2010).Biochemistry. Books and allied (P) Ltd
2. Deb,A.C., (1989). Fundamentals of Biochemistry (3rd Edition). New central agency.
3. Jain, J.L., (2005). Fundamentals of Biochemistry (6th Edition), S.Chand Publications
4. Ashokan .P. (2006) Enzymes .Chinna Publications
5. Freifelder, D. (1996) Molecular Biology, II Edition, Narosa Publishing House, New Delhi.
6. Mohan P. Arora.(2004).Biomolecules.1st Edition. Himalaya Publication House
7. David E. Metzler. And Carol M. Metzler (2001). Biochemistry-The chemical reactions of living cells- Vol1&2.(2nd edition).Harcourt/Academic press, Newyork.
8. DonaldVoet and Judith G. Voet (1995). Biochemistry – Second Edition. John Willey and Sons, Inc.
9. Leninger,A.L., Nelson, D.L., Cox, M.M., (1993). Principles of Biochemisry,(2nd Edition).CBS Publishers,
10.Geofferey, L and Zubay (1998). Biochemsitry. (Fourth Edition) Wm. C. Brown Publishers.
11.Stryer, L. (1995). Biochemistry. 4th Ed. W.H. Freeman and Company, New York

Course Outcomes:

After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Describe the Carbohydrates structure and functions	K1
CO2	Explain the properties of Amino acids	K2
CO3	Illustrate the classification of Fatty acids	K3
CO4	Infer the types of Nucleic acids	K4
CO5	Summarize the Vitamins and its deficiency	K5

Title of the Course: General Microbiology						**Course Code:**P1R2MBCC1					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	2	3	3	3	2.9
CO2	3	3	1	3	3	3	2	2	3	3	2.6
CO3	3	2	2	1	1	3	2	2	3	3	2.2
CO4	3	2	2	1	1	3	2	2	3	3	2.2
CO5	3	3	3	3	3	3	3	2	3	3	2.8
									Mean Overall Score		**2.54**
									Result		**High**

MICROBIAL PHYSIOLOGY

Course Code: P1R2MBCC3	**Credit:** 5
Category: Core Course	**Hrs/Week:** 06, **Total Inst.Hrs:** 72
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To understand of the basic functions of a cell
- To know the dynamics of microbial growth
- To be familiar with microbial pigments
- To be aware of how physiology is applicable in industries
- To learn about the thermodynamics

Unit I - Cell Structure and Function **14hrs**

Structural formation of cellular components - Biosynthesis of peptidoglycan - outer membrane, Teichoic acid – Exopolysaccharides; cytoplasmic membrane, S-layer, cell inclusions. Transport mechanisms – active, passive, facilitated diffusions – uni, sym, antiports. Iron uptake - Pinocytosis and Phagocytosis.

Unit II - Microbial Growth **15hrs**

Factors affecting microbial growth – pH, temperature, substrate and osmotic condition. Survival at extreme environments – starvation – adaptative mechanisms in thermophilic, alkalophilic, osmophilic and psychrophilic.Bioluminescence - mechanism – advantages. Transport Carriers, Signal molecules for Biomolecular transport. Physiology in Microbial Bioflim growth and Development. Dioxy growth.

Unit III – Energetics and Microbial Pigments **15hrs**

Microbial pigments - Autotrophs - cyanobacteria - photosynthetic bacteria and green algae – heterotrophs – bacteria, fungi, mixotrophs. Brief account of photosynthetic and accessory pigments – chlorophyll – fluorescences, phosphoroscenses - bacteriochlorophyll – rhodopsin – carotenoids – phycobiliproteins;

Unit IV - Spore Physiology **14 hrs**

Spore Physiology: Types, endospores and other persistent forms, Classification of endospore forming bacteria, spore formation, Initiation process of sporulation. Genes with reference to *Bacillus subtilis*. Other persistent forms: Cyst, Exospores and Myxospores.

Unit V – Metabolism

Metabloism of Hydrogen, Methane and Nitrogen. Respiratory metabolism- EmbtenMeyar Hoff pathways –Enter Doudroff pathway- Glyoxalate pathway-Krebs cycle- oxidative and substrate level phosphorylation- reverse TCA cycle- gluconeogenesis- Fermentation of carbohydrates- homo and heterolactic fermentations.

Text Books:

1. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2003). Microbiology.(5th edition).McGraw-Hill company, New York

2. Moat, A.G., Foster, J.W. and Spector, M. P (2002). Microbial Physiology (4th Edition). John Wiley & Sons, New York

3. Hans G. Schlegel (1995) General Microbiology, Seventh edition, Cambridge University Press

Reference Books:

4. S.Sundarajan (2003). Microbial Physiology, 1st edition, Annol Publications.

5. Pelczar, Jr, M.J.Chan, E.C.S and Kreig, N.R. (1993). Microbiology, Mc.GrawHill.Inc, New York.

6. Caldwell, D.R. (1995). Microbial Physiology and metabolism, Wm. C. Brown, Publishers, USA

7. Salle,A.J. (1996). Fundamental principles of Bacteriology (7th edition).Tata McGraw-Hill publishing company limited, NewDelhi.

8. White, D. (1995). The physiology and biochemistry of Prokaryotes, Oxford University, Press, Oxford, New York.

9. Rabert Poole, K. (2007) Advances in Microbial Physiology, Volume 53 Elsevier Science & Technology

Course Outcomes:
After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Describe the cell structure and function	K2
CO2	Analyze the microbial growth	K4
CO3	Interpret photosynthetic pigments	K2
CO4	Classify endospore forming Bacteria	K2
CO5	Explain metabolism of carbohydrates	K4

Title of the Course: Microbial Physiology						**Course Code:** P1R2MBCC3					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	2	2	3	1	1	2	3	2.3
CO2	3	3	3	2	2	3	3	3	3	3	2.8
CO3	3	2	2	2	2	3	2	2	3	3	2.4
CO4	3	3	2	2	2	3	3	3	3	3	2.7
CO5	3	2	2	2	2	3	3	3	3	3	2.6
									Mean Overall Score		**2.56**
									Result		**High**

PRACTICAL I

ADVANCED MICROBIOLOGY, BIOCHEMISTRY & MICROBIAL PHYSIOLOGY

Paper code: P1R2MBCC4P

Course Objectives:

- To learn the methods of sterilization
- To become familiar with microscopic observations
- To understand the pure culture techniques
- To gain knowledge on staining methods
- To know the biochemical test

1. Principles and methods of sterilization.
2. Direct microscopic observations of bacterial and fungal species – cocci, rods, chains, fungal spores, mycelium, yeast budding.
3. Preparation of Media: Nutrient broth, Nutrient agar, plates, slants, soft agar.
4. Isolation Techniques: Spread plate, Pour plate methods
5. Pure Culture Techniques: Streak plate and Stab culture techniques
6. Measurement of microbes – Micrometry and Dry weight.
7. Motility of bacteria – Hanging drop method
8. Enumeration of bacterial / yeast cells-viable count (Plate count) Total count (Haemocytometer count).
9. Isolation and purification of Cyanobacteria, Actinobacteria, Fungi.
10. Staining methods: Simple, Acid fast, Gram staining, Spore, Capsule,
11. Preparation of Buffer; (Tris, phosphate, acetate buffer).
12. Preparation of standard graph for the following and estimating the concentration in a Microbial sample (i) Glucose – Anthrone method (ii) Bovine Serum Albumin - Lowry's method and Nucleic acid – DNA (diphenylamine method), RNA (Orcinol method).
13. Separation of aminoacids by paper chromatography and identification of aminoacid.
14. Separation of proteins by SDS – PAGE.
15. Bacterial growth curve – Turbidity method Effect of pH, Temperature and Salinity on Mircobial Growth
16. Biochemical tests:
    a. IMViC Test
    b. Urease
    c. Catalase
    d. Oxidase
    e. TSI

f. Hydrogen sulphide

g. Nitrate reduction test

h. Starch, Casein, Gelatin and Lipid hydrolysis tests

References:

1.Wilson, K. and Walker, J. (2000). Practical Biochemistry, 5th Edition, Cambridge University Press.

2. Cappuccino and James, G (1996) Microbiology a laboratory manual, Addison Wesley Publishing Company Inc. 4th edition, England, California.

3. David R. Brooke. Bergey's Manual of Systematic Bacteriology (Vol. I), Eastern Halz, Springer Publication.

4. Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (1994) Methods of General and Molecular Bacteriology, Ed. American Society for Microbiology, Washington D.C.

5. James T. Stanley, Marvin P. Bryant. Bergey's Manual of Systematic Bacteriology (Vol.II), Nobert Fleming Springer Publishers.

6. Wilson K. Walker (1995). Practical Biochemistry, Principles and Techniques, Cambridge University Press.

7. Gerhardt, P., Murray, R.G., Crood, W.A. and Kreig, N.R. (1994) Methods for general and molecular bacteriology, ASM, Washington D.C.

8. Jeanne Dejkstra, Ces.P.de Jager (1998) Practical plant virology, Springer Verlag, Lab Manual, Berlin, Heidel Berg, New York.

9. Miller, J.H. (1992) A short course in bacterial genetics, Cold Spring Harbor.

Course Outcomes:

After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Define the methods of sterilization	K1
CO2	Illustrate the microscopic observations	K2
CO3	Apply the pure culture techniques	K3
CO4	Examine the staining methods	K4
CO5	Estimate the biochemical test	K5

Title of the Course: Practical - I						**Course Code:** P1R2MBCC4P					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	3	3	3	3	3.0
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	3	3	3	3	3	3	3	3	3.0
	Mean Overall Score										**3.0**
	Result										**High**

IMMUNOLOGY & IMMUNOTECHNOLOGY

Course Code: P2R2MBCC5	**Credit:** 5
Category: Core Course	**Hrs/Week:** 05, **Total Inst.Hrs: 60**
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To understand of the basic functions of Immune system
- To know the properties antigens and antibodies
- To understand the structure and functions of immune cells
- To familiarize with the knowledge of Immunity to infections
- To develop skills in immunotechniques

Unit I: Immune System **12 hrs**

Milestones in immunology - evolution of immunology. Immunity- Innate and Adaptive, phagocytosis. Immunity to specific infection,. Primary lymphoid organs - Secondary lymphoid organs - Hematopoiesis , immuno reactive cells - T & B lymphocytes, macrophages, granulocyte and NK cells. Nutrition on Host Immunity and Immune Activation mechanism.

Unit II: Antigen and Antibody Molecules **12 hrs**

Antigen types and its properties, Antigen engineering for better immunogenicity - Use for vaccine development- immunization schedule, whole cell vaccines, recombinant vaccines, DNA vaccines, synthetic peptide, multivalent subunit and anti-idiotype vaccines. Antibody structure and function, Classification of immunoglobulins, Antibody engineering – Monoclonal Antibody production - Hybridoma Technology. Antibody for diagnosis, Antibody for therapy.

Unit III: MHC, Cytokines and Complements **12 hrs**

Major Histocompatibility - Genetic organization of H2 and HLA complexes. Class I and class II MHC molecules, structure and function. Antigen processing and presentation by MHC molecules. Cytokine structure and their receptors - Cytokine therapy, Complements – membrane attack complex – classical and alternate pathway. Transplantation

Unit IV: Cancer Immunity **12 hrs**

Definition. Tumor Antigen - Specific and Associated antigens. Immunoediting, Tumor evasion Mechanisms – Tumor microenvironment, Immunomodulation methods. Chemotherapy. Host immune response against Bacterial and Viral infections.

Unit V: Immunotechnology and its applications **12 hrs**

Precipitation, Agglutination and Radiology in immunotechniqes, Enzyme-Linked immunosorbent assay (ELISA), Western blotting, immunofluorescence, Flowcytometry and immunoelectron microscopy. Infectious diseases - immune system in AIDS, transplantation immunology, cancer and the immune system.

Refernces:

1. Ivan Roitt. Jonathan Brostoff and David Male. (2007). Immunology(7th edition).Elsevier science Ltd., New York

2. Janis Kuby (1994). Immunology. (2nd edition). W.H. Freeman and company,New York.
3. N.V.Shastri (2005). Principles of Immunology.(5th Edition).Himalaya Publishing House, Mumbai.
4. I.Kannan (2007). Immunology. MJP Publishers.
5. S.C.Rastogi (2008). Elements of Immunology. CBS publishers, New Delhi.
6. Lydyard, Whelan and Fanger (2002), Instant notes in Immunology, Bios scientific publishers.
7. Charles A. Janeway,Jr. Paul Travers. Mark Walport and Donald Capra,J.(1999). Immunobiology-The immune system in health and disease.(4th edition).Current Biology Publications, London.
8. Richard A.,.Goldsby Thomas J. Kindt and Barbera A. Osborne. (2002). Kuby Immunology.(5th edition).W.H. Freeman and company, New York.
9. Abul K. Abbas. Andrew H. Lichtman and Jordan S.Pober.(1994). Cellular and Molecular Immunology.(2nd edition).W.B. Saunders company, Philadelphia.
10. Ian.R.Tizard (2004). Immunology – An introduction.4th Edition.
11. Joshi & Osama (1998). Immunology (Serology, Hematology), Agro Botanica.

Course Outcomes:

After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Define immunity and its types	K1
CO2	Explain Vaccines and its preparation	K2
CO3	Simplify the MHC molecules	K4
CO4	Determine the B and T cells	K5
CO5	Discuss the Immunotechniques	K6

Title of the Course: Immunology & Immunotechnology						**Course Code:** P2R2MBCC5					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	3	2	3	2	3	3	3	2.7
CO2	3	3	2	3	2	3	3	3	3	3	2.8
CO3	3	3	2	3	2	3	3	3	3	3	2.8
CO4	3	3	2	3	2	3	3	3	3	3	2.8
CO5	3	3	2	3	2	3	3	3	3	3	2.8
									Mean Overall Score		**2.78**
									Result		**High**

CLINICAL MICROBIOLOGY

Course Code: P2R2MBCC6	**Credit:** 5
Category: Core Course	**Hrs/Week:** 05, **Total Inst.Hrs: 60**
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To learn the types of bacterial infections
- To understand the pathogenicity of bacterial diseases
- To become familiar with diagnostic methods
- To get knowledge on cultivation methods of virus
- To be aware of viral infections

Unit I – Introduction **12 hrs**

Infections - sources of infections, Types of infections - methods of infections - Definitions - epidemic, pandemic, endemic, Acute, Chronic, systemic and opportunistic diseases. Virulence factors of microorganisms causing human infections - Carriers and Types. Normal flora of human.

Unit- II – Respiratory Tract Infections **12 hrs**

Characteristics, Symptoms, Pathogenesis, Epidemiology, Diagnosis, Prevention and Control of Upper Respiratory Tract Infections - Pneumonia, Rheumatoid, Diphtheria, Common Cold, Influenza, Tuberculosis and COVID-19. Lung Cancer.

Unit III – Gastrointestinal Infections **12 hrs**

Characteristics, Symptoms, Pathogenesis, Epidemiology, Diagnosis, Prevention and Control of Gastrointestinal Infections – Enteric Fever, Cholera, Salmonellosis, Shigellosis, Hepatitis, Mumps and Stomach flu. Gastric cancer.

Unit IV – Neurological Disorders **12 hrs**

Characteristics, Symptoms, Pathogenesis, Epidemiology, Diagnosis, Prevention and Control of Neurological disorders - Encephalitis, Gonorrhea, Botulism, Listeriosis, Leprosy, Tetanus, Rabies and Polio.

Unit V – Urogenital, Cardiac and Reproductive Infections **12 hrs**

Cystitis, Pyelonephritis, Endocarditis, Genital infection, AIDS, Syphillis, Candidiasis, Small Pox, Measles, Psoriasis, Pityriasis and Athlete's Foot. Gynecologic Cancer.

Text books:

1. Chakraborty P (2003). A Text book of Microbiology. Second edition, Published by New Central Agency (P) Ltd., Kolkata.
2. Ananthanarayan R and JayaramPaniker CK (2005). Text Book of Microbiology. Seventh edition, Orient Longman Limited, Hyderabad.

3. SatishGupte (2005). The Short Textbook of Medical Microbiology.Eighth edition, Jaypee Brothers, Medical publishers (P) Ltd., New Delhi.

Reference Books:

4. Baron EJ, Peterson LR and Finegold SM (1994). Bailey and Scotts diagnostic microbiology. 9th edition, Mosby publications.
5. Rajan S (2009). Medical Microbiology. First edition, MJP Publishers, Chennai.
6. Rajesh Bhatia and RatanLallchhpujani (2004). Essentials of Medical Microbiology. Third edition, Jaypee Brothers, Medical Publishers (P) Ltd., New Delhi.
7. Sundararaj, T (2005). Microbiology Laboratory Manual, Perungudi, Chennai-96.
8. Jawetz, Melnick, &Adelberg's. (2013). Medical Microbiology. 26th Edition. McGraw-Hill.
9. Saravanan P (2006) Virology. First edition, MJP Publishers, A Unit of Tamil Nadu Book House, Chennai.
10. Morag C and Timbury MC. (1994). Medical Virology. Tenth edition, Churchill Livingstone, London.
11. Dimmok NJ, Primrose SB (1994). Introduction to modern virology Fourth edition, Blackwell scientific company publications.
12. Patrie R Murray. (1990). Medical Microbiology. Mosby Publications.
13. Luria SE, Darnell JE, Baltimore D and Compare A (1978). General virology. Third edition, John Wiley and Sons, New York.

Course Outcomes:

After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Explain the types of bacterial infections	K1
CO2	Relate the pathogenicity of bacterial diseases	K2
CO3	Apply the Biochemical laboratory diagnostic methods	K3
CO4	Describe the cultivation methods of virus	K4
CO5	Elaborate the types of viral infections	K6

Title of the Course: Clinical Microbiology						**Course Code:** P2R2MBCC6					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	1	3	3	3	2.7
CO2	3	3	3	3	2	3	3	3	3	3	2.9
CO3	3	3	3	3	2	3	3	3	3	3	2.9
CO4	3	3	3	3	2	3	3	3	3	3	2.9
CO5	3	3	3	3	2	3	2	3	3	3	2.9
										Mean Overall Score	**2.86**
										Result	**High**

FOOD AND DAIRY MICROBIOLOGY

Course Code: P2R2MBCC7	**Credit:** 5
Category: Discipline Specific Elective	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- Identify factors essential for the growth of microorganisms
- Relate the requirements for bacterial growth to the definition of potentially hazardous food
- Fermentation is the controlled action of selected microbes to alter the texture of foods
- Discuss the types of illness associated with food poisoning
- List the types of food preservations

Unit I: Introduction **12 hrs**

Importance of food and dairy microbiology- Types of microorganisms in Food Spoilage - source of contamination- Factors influencing microbial growth in food - extrinsic and intrinsic factors - pH, temperature, moisture, and oxygen reduction potential.

Unit II: Food Fermentations **12 hrs**

Methods of fermentations and organisms used - Cheese, bread, wine, beer. Fermented vegetables - Cabbage, cucumber, olives. Food and enzymes from microorganisms - single cell protein. Production of amylase and protease.

Unit III: Contamination, Spoilage and Preservation **12 hrs**

Cereals and cereals products, sugar and sugar products, vegetables and fruits, meat and meat products - fish and other sea foods, egg and poultry - dairy and fermentative products (ice cream, yoghurt, kefir, kumiss and acidophilus milk), cheese production and its types.

Unit IV: Food Borne Diseases **12 hrs**

Intoxication and food poisoning - *Staphylococcus*, *Clostridium*,*Escherichia coli* and *Salmonella* infections, Hepatitis, Amoebiosis and Mycotoxins. Bacterial and fungal exo- and endotoxins.

Unit V: Principles and Methods of Food Preservation **12 hrs**

Methods of preservations- Physical and chemical methods, food sanitations. Milk preservation methods - pasteurization. Good manufacturing practices (GMP) - hazard analysis, critical control points and personnel hygiene. Food sanitation in food manufacture and in the retail trade; Food control agencies and its regulations.

References

1. Frazier and Westhoff, DC. (2014). Food Microbiology. 5th Edition. TATA McGraw Hill Publishing Company LTD., New Delhi
2. Adams, M.R and Moss, MO. (1995). Food Microbiology. The Royal Society of Chemistry, Cambridge
3. Banwart GJ. (2004). Basic food microbiology, Chapman & Hall, New York.
4. Sivasankar B. (2005). Food Processing and Preservation. Prentice-Hall of India Pvt.Ltd.
6. John Garbutt (1997). Essential of Food Microbiology. Arnold Publications, London.
7. Andrews AT, Varley J. (1994). Biochemistry of milk products. Royal Society of Chemistry.
8. Robinson RK. (1990). The microbiology of milk. Elsevier Applied Science, London.
9. Ramanathan N. (2009).A Textbook of Food Microbiology, OM Sakthipathipagam

Course Outcomes

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Observe the importance of Food and Dairy Microbiology	K1
CO2	Describe the Food Fermentation Process	K6
CO3	Explain the Food contamination, spoilage and preservation	K4
CO4	Find the food borne disease	K5
CO5	Classify the different methods of Preservations	K4

Title of the Course: Food and Dairy Microbiology						**Course Code:** P2R2MBCC7					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	3	2	3	1	3	3	3	2.6
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	2	3	3	3	3	3	3	3	3	2.9
CO5	3	3	3	3	3	3	3	3	3	3	3.0
										Mean Overall Score	**2.9**
										Result	**High**

MICROBIAL BIOTECHNOLOGY

Course Code: P2R2MBCC8	**Credit:** 5
Category: Core Course	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Employability	**Marks:** CIA: 25+ Ext: 75 = 100

Objectives: The Course aims

- Tobeawareof microbialproductionofenzymes
- Tofamiliarizewiththeknowledgeof microbialproducts likeSCP
- Toknowthe eco-friendlyalternatives usingmicrobes
- Tounderstandtransgenic models
- Tounderstandtherecyclingandreuseofwastes

UnitI: Enzyme Technology 12hrs

Biotechnology – Definition – History – Scope. Microbialproduction of enzymes-Protease-Pectinase- Lipase. Industrial application of microbial enzymes- Therapeutic- Manipulative-Analytical uses.Immobilization of enzymes and its application. Ribozymes-Abzymes-Synzymes.

UnitII: Microbial Products 12hrs

Biotechnological potential of microalgae – Food – Feed - Colourant – Fuel – Pharmaceutically valuable compounds. SCP(BacteriaandYeast).Mushroomcultivation.Healthcare products-Insulin-Somatotrophin- Somatostatin- Interferon- Blood clotting factor VII- Vaccines. Productionof IAA-Giberellin-Auxin

UnitIII: Biofuel, Biosensors and Biochips 12 hrs

Definitions- Bioethanol production-application.Biodisel production-application. Biogas production-application. BioHydrogen production - application. Biosensors – Types -Application. Biochips – Types - Application.

UnitIV: Transgenic Plants and Animals 12 hrs

Development of Transgenic plants and animals – Resistant toHherbicide – Insects, Pest and other Pathogens – bacteria –virus and fungus.Transgenicrice, Edible vaccine, bioplastic. Transgenic animals – ethical implications on transgenic animals

UnitV:Bioremediation 12 hrs

Microbes involved in biodegradation **–** Microbial degradation of phenolics – In Situ and Ex situ – metals –sewage nutrients (phosphateandnitrate) – hydrocarbons – xenobiotic compounds, bioaugmentation – bioaccumulation – bio - magnification. Microbial leaching of ores – oil extraction. Microbial deterioration of materials, paper, leather, wood, paint, textiles, paint, metal corrosion. Biocorrosion of metals (Iron, Copper).

Text Books

1. Singh,B.D.(2006).Biotechnology.KalyaniPublication.
2. Dubey,R.C.(2017).TextbookofBiotechnology.Chandandcompany(P)Ltd

3. Trevan,M.D,Boffey,S.CouldingK.H.,Stanburry.P.(1990).Biotechnologytheba sicprinciples-TataMcGrawHill edition.
4. Sathyanarayana,U(2008).Biotechnology. Booksandallied(P)Ltd

Reference Books:

5. PradiptaKumar,Mohapatra(2006).TextBookofEnvironmentalBiotechnology.I. KInternational.
6. Das,H.K.,(2007).TextBook of Biotechnology. 3rdEdition.WileyIndia(P)Ltd
7. Ramwat,K.G.,ShailyGoyal(2009).ComprehensiveBiotechnology.Chandandco mpany(P)Ltd
8. WiliamJ,Thieman,Michael,A.,Palladino(2009).IntroductiontoBiotechnology. DorlingKindersley(India) PrivateLimited
9. Philose,P.M.(2006).ATextBookofBiotechnology.DominantPublishersandDist ributors.
10. Ramdass,P.,Meerarani,S(2002).TextbookofAnimalBiotechnology.Libraryofc ongrescataloguingin Publishingin Data.

Course Outcomes:
Aftercompletion of thiscourse,studentswouldbeableto

S.No	Course outcome	Knowledge level
CO1	Classify the microbialproductionofenzymes	K2
CO2	Explain the pharmaceutical value of SCP and Mushroom	K3
CO3	Analysis Biochips and biosensors	K4
CO4	Develop transgenic plants and animals	K6
CO5	Describe the microbial degradation and bio deterioration	K2

Title of the Course: Microbial Biotechnology						**Course Code:** P2R2MBCC8					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	3	2	3	2	3	3	3	2.7
CO2	3	2	3	3	2	3	3	3	3	3	2.8
CO3	3	3	3	3	2	3	2	3	3	3	2.8
CO4	3	3	3	3	2	3	3	3	3	3	2.9
CO5	3	3	3	3	2	3	2	3	3	3	2.8
									Mean Overall Score		**2.8**
									Result		**High**

PRACTICAL II
IMMUNOLOGY & IMMUNOTECHNOLOGY, CLINICAL MICROBIOLOGY, FOOD AND DAIRY MICROBIOLOGY
Paper code: P2R2MBCC9P

Course Objectives:

- To know the collection of venous blood
- To learn the immunoelectrophoresis
- To analyze the blood grouping
- To gain knowledge on isolation of pathogens
- To become familiar in antibiotic susceptibility test

1. Collection of venous blood and separation of serum/plasma
2. Double immunodiffusion – Ouchterlony's method
3. Counter immuno electrophoresis
4. Immunolectrophoresis – Graber and Williams technique
5. Blood grouping
6. Latex agglutination test – ASO, RF
7. WIDAL test: Tube and slide agglutination technique
8. Enzyme Linked Immunosorbent Assay (ELISA)
9. Handling of Laboratory animals and raising antibodies
10. Collection and transport of clinical specimens for microbiological examinations
11. Isolation and identification of upper respiratory tract bacterial pathogen – *Streptococcus pyogens/ Klebsiellapneumoniae*
12. Isolation and identification of lower respiratory tract bacterial pathogen – *Pseudomonas aeuroginosa/ Klebsiella pneumonia/S. pneumonia.*
13. Isolation and identification of gastrointestinal bacterial infection – *Salmonella / Shigella /Vibrio*
14. Isolation and identification of urinary tract infection (UTI) – *E. coli &Klebsiellapnemoniae*
15. Isolation and identification of bacteria from the cases Typhoid fever – *Salmonella typhi, S. paratyphi*A& B
16. Isolation of fungal skin pathogens – Trichophytons, Microsporum. Dermatophytes&*Candida*
17. Demonstration of intestinal parasites (trophozoites / cysts / ova) – Saline and iodine wet mount.
18. Antibiotic susceptibility test – Disc diffusion method (Kirby - Bauer)
19. Determination of MIC
20. Immobilization Technique – Sodium Alginate Method

References:

1. Atlas Ronald.M. Bartha and Richard (1987). Microbial Ecology 2nd edition. Benjamin/Cummings Publishing company

2. Dirk, J.Elasas, V, Trevors, J.T., Wellington, E.M.H. (1970). Modern soil microbiology, Marcel Dekker INC, New York.

3. EcEldowney, S, Hardman D.J, Waite, S. (1993). Pollution Ecology and Biotreatment – Longman Scientific Publishers

4. Mitchel, R. (1992). Environmental Microbiology. Wiley-John Wiley and Sons. Inc Publications New York.

5. Clescri, L.S., Greenberg, A.E and Eaton, A.D. (1998). Standard Methods for examination of water and waste water, 20th edition, American Public Health Association.

Course Outcomes:
Aftercompletion of thiscourse,studentswouldbeableto

S.No	Course outcome	Knowledge level
CO1	Experiment with the collection of venous blood	K3
CO2	Explain the immunoelectrophoresis	K2
CO3	Analyze the blood grouping	K4
CO4	Examine the isolation of pathogens	K4
CO5	Estimate the antibiotic susceptibility test	K5

Title of the Course: Practical - II						**Course Code:** P2R2MBCC9P					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	3	3	3	3	3.0
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	3	3	3	3	3	3	3	3	3.0
									Mean Overall Score		**3.0**
									Result		**High**

MOLECULAR BIOLOGY & MICROBIAL GENETICS

Course Code: P3R2MBCC10	**Credit:** 5
Category: Core Course	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To understand of the basic concepts of genetics
- To get knowledge on bacterial genetics
- To familiarize with the viral genetics
- To examine the transcription and translation process
- To define the regulation of gene expression

Unit I – Gene and Mutation **12 hrs**

Mutations – spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions. Mutagens - Physical and Chemical mutagens. Outlines of DNA damage and repair rmechanisms.Genetic recombination in bacteria – Conjugation, Transformation and Transduction.

Unit II: Plasmid and Cloning Vectors **12 hrs**

Plasmid features and biology - structural and functional organization, plasmid replication and copy number - stringent and relaxed plasmids, incompatibility of plasmid maintenance. Construction of an ideal vector, co-integrate vectors. Salient features of cloning vectors. Types of cloning vectors: plasmids, cosmids, phasmids, shuttle vectors, BAC, YAC, bacteriophage and other viral vectors.

Unit III: Viral Genetics **12 hrs**

Viral Genetics: General characteristics of viral genome, T4 virulent Phage: Structure- life cycle. Lambda temperate phage: Structure - Lytic and lysogenic cycle, lysogenic repression. Genetic mapping of viruses, Pox viral genetics. Antigenic shift and drift. Site specific recombination (lambda and P1) Techniques for the study of bacteriophages.

Unit IV: Transcription and Translation **12 hrs**

Transcription – initiation, elongation – termination. Synthesis of mRNA in prokaryotes and eukaryotes. Synthesis of rRNA and tRNA. RNA processing – capping and polyadenylation. Genetic code, Translation – initiation, elongation and termination. Signal sequences and protein transport. RNA splicing – SA RNA, MA RNA.

Unit V: Regulation of Gene expression **12 hrs**

.Operon concept, co-ordinated control of structural genes, stringent response, catabolite repression, instability of bacterial RNA, positive regulation in E.coli (Arabinose operon) and negative regulation in E.coli (Lac operon), inducers and repressors, regulation by attenuation by trp operon.

Text Books:

1. David Frifelder, (2012).Microbial Genetics, Narosa Publishing House,New Delhi.
2. Old RS and Primrose,S.B..Principles of gene Manipulation, 5th edition.Black Well Scientific Publication.London.
3. Nancy Trun& Jasmine Trampy (2004). Fundamental of Bacterial Genetics (2004). 1st edition. Blackwell publishing company.

Reference Books:

4. C.B.Powar (2003). Gene Regulation.1st edition. Himalaya publication.
5. S.Sambamurthy (2007). Molecular Genetics. Jones and Bartlett Publishers.
6. Darnell.J. 1995.Molecular Cell Biology, Scientific American Books, USA.
7. Weaver.R.F., Philip.P.W.1989, Genetics, WMC Brown Publishing, USA.
8. Lodish H., Baltimore D., Berk ,A., Zipsary S.L., Matsudaira P., Darnell J.(1995).Molecular Cell Biology .Scientific American Books.
9. Antony J F., Griffiths, Gilbert WM., Wewontin R C., Miller J H., (2000(Modern GeneticAnalysis, Integrating Genes and Genomes, 2ndedition, W H
10. Gardner E.J., Simmons M J., SnustadD.P. (1991).Principles of Genetics .John Wiley and Sons.
11. Lewin B. (2008).GenesVIII 8thedition.Oxford University. Pratice Hall publications.
12. Watson JD,HopkinsNH,RobertsJW,SteitzJA,Weiner AM .(2004).Molecular Biology of the Gene , 5thedition.Benjamin /Cummings Publishing Company.

Daniel L.Harti and W.Jones (2001). Genetics. 5th edition. Jones & Bartlett publications.

Course Outcomes:

After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Define the genetic concepts	K1
CO2	Determine the Viral genetics	K5
CO3	Interpret the gene regulation	K5
CO4	Explain the transcription and translation process	K5
CO5	Elaborate gene expression	K6

Title of the Course: Microbial Genetics & Molecular Biology						**Course Code:** P3R2MBCC10					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	1	3	3	3	2.7
CO2	3	3	3	3	2	3	1	3	3	3	2.7
CO3	3	3	3	3	2	3	3	3	3	3	2.9
CO4	3	3	3	3	2	3	2	3	3	3	2.9
CO5	3	3	3	3	2	3	2	3	3	3	2.8
										Mean Overall Score	**2.8**
										Result	**High**

RECOMBINANT DNA TECHNOLOGY

Course Code: P3R2MBCC11	**Credit:** 5
Category: Core Course	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To define the rDNA technology
- To become familiar with vector Biology
- To get knowledge on molecular markers
- To know about gene manipulation
- To acquire knowledge on gene silencing

Unit I: Basic Techniques in rDNA Technology 12 Hrs

DNA Isolation, Amplification, Genetic Transformation, Recombinanat Selections. Designing of Primer and Probe. Restriction analysis: Types of restriction enzymes. Restriction endonucleases and Properties.

Unit II: Vector Biology 12 Hrs

Construction – pMal, GST, pET based vectors (Baculovirus and Pichia), Product Purification system – His – Tag, GST – Tag, MBP – Tag. Intein based vectors: Inclusion bodies: Methodologies to reduce formation of inclusion bodies, Mammalian expression and replicating vectors.

Unit III: Molecular markers and DNA mapping 12 Hrs

DNA and PCR based markers: RFLP, RAPD, AFLP, EST, SSCP, VNTR, Multilocus probes, Microsatellites, Minisatellites, STMS, DAF, AP-PCR. DNA Mapping: Physical and Molecular Mapping.Hybridization Techniques – Southern, Northern and Western

Unit IV: Gene Manipulation and Protein DNA interaction 12 Hrs

Insertion of foreign DNA into Host cells – Transformation, Electroporation, Transfection. Construction of Libraries – Isolation of mRNA, total RNA, Reverse Transcriptase and cDNA Synthesis. cDNA and Genomic Libraries. Construction of Microarrays. Electrophoretic mobility shift assay. DNA Foot Printing.

Unit V: Gene Silencing 12 Hrs

Gene silencing techniques: siRNA Technology, Micro RNA. Construction of siRNA vectors. Principles and application of gene silencing – Gene knock out and Gene therapy. Transgenics – Gene replacement, Gene targeting. Introduction to genome editing – CRISPR – CAS9 System.

Text Books:

1. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, II nd edition, Cold spring harbor laboratory press, New York.

2. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995
3. Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu , D. Kim and L.J. Cseke, CRC Press Florida 1995

Reference Books:

4. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Berger and A. R. Kimmel, Academic Press Inc, San Diego, 1996
5. Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel, Academic Press Inc, San Diego, 1990
6. DNA Science: A First Course in Recombinant Technology, D. A. Mickloss and G. A Freyer, Cold Spring Harbor Laboratory Press, New York, 1990
7. Molecular Biotechnology, 2nd Ed. S. B. Primrose, Blackwell Scientific publishers, Oxford, 1994
8. Milestones in Biotechnology, Classic Papers on Genetic Engineering, J. A. Davis and W. S. Reznikoff, Butterworth-Heinemann Boston 1992
9. Route Maps in Gene Technology, M. R. Walker, and R. Rapley, Blakwell Science, Oxford, 1997
10. Genetic Engineering : An Introduction to Gene Analysis and Exploitation in Eukaryotes, S. M. Kingsman, Blackwell Scientific Publications, Oxford, 1998
11. An Introduction to Genetic Engineering, 3rd Edition. Desmond S. T. Nicholl, Cambridge University press, 2008.
12. Gene Cloning and Manipulation, 2nd Ed. Cristopher Howe, Cambridge University Press, 2007.

Course Outcomes:

After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Define the rDNA Technology	K1
CO2	Determine the Vector Biology	K5
CO3	Explain the molecular markers	K5
CO4	Determine the gene manipulation	K6
CO5	Elaborate gene silencing	K6

Title of the Course: Recombinant DNA Technology						**Course Code:** P3R2MBCC11					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	3	2	3	1	3	3	3	2.6
CO2	3	2	3	3	2	3	2	2	3	3	2.6
CO3	3	2	3	3	2	3	1	3	3	3	2.6
CO4	3	3	3	3	2	3	1	3	3	3	2.7
CO5	3	3	3	3	2	3	3	3	3	3	2.9
	Mean Overall Score										**2.68**
	Result										**High**

ENVIRONMENT AND AGRICULTURAL MICROBIOLOGY

Course Code: P3R2MBCC12	**Credit:** 5
Category: Core Course	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To know about the various types of interactions among group of organisms and role of microbes in improving soil fertility.
- To become familiar with some important Indian crop diseases
- To make students aware of the importance of microorganisms, their role in mediating biogeochemical cycles and inculcate the spread of air borne diseases
- To acquire the knowledge of aquatic ecosystem
- To know the solid and liquid waste management

Unit I: Soil Microbiology **12 hrs**

Interactions among soil microorganisms - mutalism - commensalism - amensalism - synergism - parasitism - predation - competition. Microbial interactions between plants - rhizosphere -phyllosphere - mycorrhizae - symbiotic association in root nodules. Biofertilizers - VAM, *Rhizobium*,*Frankia*,*Azospirillum*,*Azotobacter*and *Azolla*.

Unit II: Plant Diseases and its control **12 hrs**

Some bacterial diseases of agricultural crops. Plant diseases, pathogens and symptoms and control measures with reference to paddy, cotton, maize, tomato, citrus, mango, potato. Plant protection -phenolics- phytoalexins and related compounds. Bioinsecticides - viral, bacterial and fungal- a brief note.

Unit III: Biogeochemical Cycles & Air Microbiology **12 hrs**

Soil microbes and fertility of soil. Roles of microbes in biogeochemical cycles - carbon, nitrogen, phosphorus, sulphur. Soil microbes and fertility of soil. Aerobiology - a brief introduction - droplet nuclei - aerosols - air borne transmission of microbes and diseases; assessment of air quality.

Unit IV: Aquatic Microbiology **12 hrs**

Aquatic microbiology - factors that affect microbial growth - temperature - pressure - light - salinity - turbidity - pH - inorganic and organic constituents. Aquatic habitats - freshwater - lakes, ponds and streams; marine habitats - estuaries, deep sea, hydrothermal vents, saltpans, coral reefs and mangroves and their microbial communities; zonation - food chain and food web. Role of microorganisms in the productivity.

Unit V: Waste Treatment **12 hrs**

Types of wastes - characterization of solid and liquid wastes. Treatment of solid wastes - incination composting, vermiform composting, sillage, pyrolysis and saccharification.

Treatment of liquid wastes - primary and secondary treatment; anaerobic (methanogenesis) - aerobic - trickling, activated sludge, oxidation pond.

References

1. Atlas Ronald, M., Bartha, and Richard (2009). Microbial Ecology. 4th Edition Benjamin/Cummings Publishing Company, California.
2. Subba Rao N.S (1995). Soil microorganisms and plant growth. Oxford and IBH publishing co. Pvt. Ltd. New Delhi
3. Joseph, C. Daniel. (1999). Environmental aspect of Microbiology. 2nd Edition, Bright sun publication
4. Rengasawamy G, Bagyaraj, D.J. (2001) Agricultural Microbiology. Prentice Hall of India (P) Ltd
5. Sharma, P.D. (2009). Environmental Microbiology. Narosa Publication
6. Dirk, J. Elasas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, New York, Hong Kong.
8. Mitchel, R. (1992). Environmental Microbiology. Wiley - John Wiley and Sons. New York.
9. Clescri, L.S., Greenberg, A.E. and Eaton, A.D. (1998). Standard Methods for Examination of Water and Waste Water. 20th Edition, American Public Health association.
10. Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (1994). Methods for General and Molecular Bacteriology, ASM Publications, Washington D.C.

Course Outcomes:

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Discuss the importance of soil microbiology	K2
CO2	Describe the Plant diseases and its control mechanisms	K2
CO3	Explain biogeochemical cycles and air microbiology	K3
CO4	Assess the Aquatic microbiology	K5
CO5	Classify the Different waste treatment methods	K2

Title of the Course: Environment & Agricultural Microbiology						**Course Code:** P3R2MBCC12					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	2	3	1	3	3	3	2.4
CO2	3	3	3	2	2	3	2	3	3	3	2.7
CO3	3	2	2	2	2	3	2	3	3	3	2.5
CO4	3	3	3	2	2	3	2	3	3	3	2.7
CO5	3	3	3	3	3	3	3	3	3	3	3.0
	Mean Overall Score										**2.66**
	Result										**High**

BIOPROCESS TECHNOLOGY

Course Code: P3R2MBCC13	**Credit:** 5
Category: Core Course	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- Toknowhow themicrobesareused inindustries
- Tobeawareof thestrainimprovement forindustrial purposes
- Toknowthedifferenttypesoffermentersandtheirfunctions
- Tofamiliarwithlargescaleproductionofimportantproducts
- Tounderstandthepatentrights

Unit I–Industrially Important Microbes and their Development 12 hrs

Screeningmethodsforindustrialmicrobes–detectionandassayoffermentationproducts– classification of fermentation types – strain selection and improvement. Mutation and recombinantDNAtechniquesforstrain development.

Unit II–Fermenter–Types and Function 12 hrs

Fermenters –Basic functions, design andcomponents– asepsis and containment requirements–bodyconstructionandtemperaturecontrol–aerationandagitationsystems– sterilizationoffermenter, air supply, and medium; aseptic inoculation methods– sampling methods, valve systems –abrief ideaon monitoringandcontrol devices andtypesoffermenters. Sensors in fermenter – Automation methods, Heat and Moist transfer, Highthroughput screening.

Unit III–Large Scale Fermentation 12 hrs

Fermentation media – Desired qualities –mediaformulation strategies –economic eans of providing energy, carbon –n itrogen –vitamin and mineral sources – role of buffers, precursors, inhibitors, inducers and antifoams, effect of environment (temperature, pH, high nutrient concentration), types of fermentation. Sterilization, kinetics of thermal death of micro - organisms, batch and continuous sterilization.

Unit IV- Downstream Processing 12hrs

Objectives and criteria - foam separation - precipitation methods - filtration devices – chemical andelectro flocculation andfilter aids- industrial scale centrifugation andcell disruption methods-liquid-liquidextraction-solventrecovery–chromatography-two-phaseaqueousextraction–supercriticalfluidextraction-ultra filtration, drying devices, crystallization and whole broth processing. Effluent Treatment (Solid and Liquid)

Unit V- Industrial Products and Economics 12hrs

Commercial production of penicillin, ethanol, vinegar, vitamin B12, Protease from

microbial sources. GATT and IPR, forms of IPR, IPR in India, WTOACT, Convention on Biodiversity (CBD), Patent Co-operation Treaty (PCT), forms of patents and patentability, process of patenting, Indian and international agencies involved in IPR & patenting, Global scenario of Indian patents and , patenting of biological materials. Fermentation economics.

Text Books:

1. StanburyP.F.A.WhitakerS.J.Hall,(1995)PrinciplesofFermentationTechniques.2nded.
2. PatelA.H.(2016).IndustrialMicrobiology,RajivBeriforMacMillanIndiaLte.,NewDelhi
3. Casida,J.R(2012).IndustrialMicrobiology.Newageinternational(P)Limited.
4. SateeshM.K,(2008).BioethicsandBiosafety.I.K.InternationalPublishinghousePvt.Ltd.

Reference Books:

5. Kalaichelvan,PT.&ArulPandi(2007)BioprocessTechnology.MJPPublishers,Chennai.
6. Demain,A.L.andDavies,J.E.(1999).ManualofIndustrialMicrobiologyandBiotechnology. ASM Press.
7. Glick,B.R.andPasternak,J.J.(1998).MolecularBiotechnology,IIEdition,ASMPress,New York.
8. Tortora,G.J.,Fernke,B.R.andCase,C.L.(2001),Microbiology– AnIntroduction,BenjaminCummings.
9. PrescottC.,Dunn.G.(2002).IndustrialMicrobiology.Agrobios(India).

Course Outcomes:

Aftercompletion of thiscourse,studentswouldbeableto

Sl.No	Course Outcomes	Knowledge Level
CO1	Explain strainimprovement methods	K3
CO2	Find differenttypesof fermenters,functionandtheir applications	K5
CO3	Manipulate the fermentation media formulation	K3
CO4	Develop skill in downstream process	K6
CO5	Describe industrial products and IPR	K2

Title of the Course: Bioprocess Technology						**Course Code:** P3R2MBCC13					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	2	2	3	3	2.8
CO2	3	3	3	3	3	3	2	2	3	3	2.8
CO3	3	3	3	3	3	3	3	2	3	3	2.9
CO4	3	3	3	3	3	3	3	2	3	3	2.9
CO5	3	3	3	3	3	3	3	3	3	3	3.0
									Mean Overall Score		**2.88**
									Result		**High**

PRACTICAL III

MOLECULAR BIOLOGY & MICROBIAL GENETICS, RECOMBINANT DNA TECHNOLOGY, ENVIRONMENT & AGRICULTURAL MICROBIOLOGY AND BIOPROCESS TECHNOLOGY

Code: P3R2MBCC14P

Course Objectives:

- To become familiar with the isolation of antibiotic resistant microbes
- To gain knowledge on transformation and transduction
- To learn characterization of DNA
- To understand the Blotting techniques
- To know the plant diseases

1. Isolation of antibiotic resistant microbes
2. Isolation of Streptomycin resistance mutant by gradient plate technique
3. Transformation (competent cell preparation) and Transduction using P1.
4. Isolation of Auxotrophic mutant
5. Isolation of Genomic DNA from bacteria
6. Isolation of Plasmid DNA from bacteria
7. Characterization of DNA by Agarose gel electrophoresis
8. Restriction digestion and Ligation of DNA
9. Transformation of plasmid DNA
10. Polymerase Chain Reaction
11. Blotting techniques - Southern and Western Blotting
12. Isolation and enumeration of soil microorganisms (fungi, bacteria and actinobacteria).
13. Staining of vesicular Arbuscularmycorrhizae from plant.
14. Isolation and culturing of *Rhizobium* from root nodules.
15. Study of the following diseases:
    a. Tobacco mosaic;
    b. Bacterial blight of paddy;
    c. Downy mildew of bajra;
    d. Powdery mildew of cucurbits;
    e. Head smut of sorghum;
    f. Red rot of sugar cane.
16. Isolation and identification of air-borne bio-particles using Andersen sampler.
17. Determination of DO of polluted/pond water.
18. Determination of BOD of polluted/pond water.
19. Determination of COD of polluted/pond water.
20. Assessment of water quality by MPN technique.
21. Production, quantification and characterization of followings:
    a. Alcohol,
    b. Citric acid,
    c. Amylase,
    d. Lipase,
    e. Protease

References:
1. K.R.Aneja (2010). Experiments in Microbiology, Plant pathology and biotechnology. New Age International Pvt.Ltd.NewDelhi.
2. Atlas Ronald.M. Bartha and Richard (1987). Microbial Ecology 2nd edition. Benjamin/Cummings Publishing company
3. Dirk, J.Elasas, V, Trevors, J.T., Wellington, E.M.H. (1970). Modern soil microbiology, Marcel Dekker INC, New York.
4. EcEldowney, S, Hardman D.J, Waite, S. (1993). Pollution Ecology and Biotreatment – Longman Scientific Publishers
5. Mitchel, R. (1992). Environmental Microbiology. Wiley-John Wiley and Sons. Inc Publications New York.
6. Clescri, L.S., Greenberg, A.E and Eaton, A.D. (1998). Standard Methods for examination of water and waste water, 20th edition, American Public Health Association.

Course Outcomes:

Aftercompletion of thiscourse,studentswouldbeableto

Sl.No	**Course Outcomes**	**Knowledge Level**
CO1	Explain the isolation of antibiotic resistant microbes	K2
CO2	Examine the transformation and transduction	K4
CO3	Define the characterization of DNA	K1
CO4	Determine the Blotting techniques	K5
CO5	Discuss about plant diseases	K6

Title of the Course: Practical - III						**Course Code:** P3R2MBCC14P					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	3	3	3	3	3.0
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	3	3	3	3	3	3	3	3	3.0
									Mean Overall Score		**3.0**
									Result		**High**

PROJECT WORK

Code: P4R2MBPW15

Course Objectives:

- To develop research skills involved execution of microbiological proposal
- To use appropriate microbiological methods and lab equipment
- To be aware about safe Microbiology, using appropriate protective, biosafety and emergency procedures.
- To prepare document and report on experimental protocols, results, and conclusions.
- To develop the skills of preparing and conducting independent research.

Course Outcomes:

Aftercompletion of thiscourse,studentswouldbeableto

S.No.	Course Outcomes	Knowledge Level
CO1	Develop research skills involved execution of microbiological proposal	K6
CO2	Apply appropriate Microbiological methods and Lab Equipment	K3
CO3	Make use of appropriate protective, biosafety, and emergency procedures	K3
CO4	Create document and report on experimental protocols, results and conclusions	K6
CO5	Propose techniques of microbiology in conducting independent research	K6

Title of the Course: Project Work						**Course Code:** P4R2MBPW15					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	3	3	3	3	3.0
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	3	3	3	3	3	3	3	3	3.0
									Mean Overall Score		**3.0**
									Result		**High**

BIOLOGICAL TECHNIQUES

Course Code: P1R2MBDSE1:1	**Credit:** 3
Category: Discipline Specific Elective	**Hrs/Week:** 06, **Total Inst.Hrs:** 72
Nature of the Course: Employability	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives

- To have a detailed knowledge about the instruments
- To understand the importance of instruments in industries
- To develop the instrumentation skills among the students
- To be familiar with the types of Microscope
- To get knowledge on molecular techniques

Unit I: Microscopy and Related Techniques 15hrs

Light Microscopy: Microscopic optics, components of microscopes. Basic principles and types of Bright field, Dark field, Phase contrast. Fluorescence, Polarization and confocal microscopes and their applications. Immunofluorescence – In situ hybridization. Electron Microscopy – Principle, Techniques and applications of Transmission Electron microscope (TEM) and Scanning Electron Microscope (SEM), Atomic Force Microscope (AFM). Photomicrography and Video micrography.

Unit II: Analytical Techniques 15hrs

Spectroscopic methods – UV-Visible, Atomic Absorption and Atomic Emission Spectroscopy. Spectroflurimetry, Luminometry. X- ray spectroscopy. Centrifugation – Principles and types centrifugation. Electroanalytical methods – electrolytic – Potentiometric, conductimetric, coulometric&voltametric analysis. Biosensors. Radioactive Analysis: Principles of radioactivity, GM counter & LS counter.

Unit III: Principles & Applications of Chromatographic Techniques 14 hrs

Principles of chromatography, Thin layer chromatography, Adsorption – Ion exchange and gel permeation – affinity chromotography for separation of compounds GC and HPLC methods.

Unit IV: Electrophoresis Techniques 14 hrs

Electropohoretic techniques – protein – nucleic acid – immuno – two dimensional electrophoresis.Isoelectric focusing, silver staining.Capillary electrophoresis, Native-PAGE.

Unit – V: Molecular Techniques 14 hrs

Polymerase chain reaction – Principle, types and applications. Cloning techniques – vectors, enzymes and strategies. Blotting Techniques (Southern, Northern, western and dot blots).

Text Books:

1. Veerakumari (2015). MJP Publishers.
2. Palaivelu.P(2002) Analytical Biochemistry, MKU University.
3. B.Sivakumar (2005). Bioseperatons - Principles and Techniques.Prentice-Hall of India Pvt.ltd.

Reference Books:

4. P.Asokan (2002). Analytical Biochemistry. Chinna Publications.
5. Dubey, R.C. (2017). Text book of Biotechnology. Chand and company (P)Ltd.
6. P Sambrrok, J. and Ruseell, D.W. (2001) Molecular Cloning – A Laboratory Manual (3rd eidition, Vol. 1,2,3) Cold Spring Laboratory Press, New York. Ress
7. Glick, B.R. and Pasternak, J.J. (1994). Molecular Biotechnology, ASM Press.
8. John G. Webster. (2004). Bioinstrumentation. University of Wisconsin, John Wiley & Sons, Inc.
9. Wilson, K. and Walker.J (2005). Practical Biochemistry Principles and Techniques,6th edition, Cambridge University/
10. Holme.J and Peck.H (1993). Analytical Biochemistry 2nd edition. Longman Scientific and Technical.

Course Outcomes:
After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Examine the Microscopic techniques	K1
CO2	Discuss the Analytical techniques	K2
CO3	Determine the Chromatographic techniques	K3
CO4	Explain the Electrophoresis techniques	K4
CO5	Elaborate the Molecular techniques	K6

Title of the Course: Biological Techniques						**Course Code:** P1R2MBDSE1:1					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	3	2	3	3	2.8
CO2	3	3	3	3	2	3	3	3	3	3	2.9
CO3	3	3	3	3	2	3	3	2	3	3	2.8
CO4	3	3	3	3	2	3	3	3	3	3	2.9
CO5	3	3	3	3	2	3	3	3	3	3	2.9
										Mean Overall Score	**2.86**
										Result	**High**

MOLECULAR TAXONOMY AND PHYLOGENY

Course Code: P1R2MBDSE1:2	**Credit:** 3
Category: Discipline Specific Elective	**Hrs/Week:** 06, **Total Inst.Hrs:** 72
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- Toaware of taxonomical positions of microbes
- To know the sequence analysis
- To understand the sequence analysis
- To get knowledge on rRNA based fingerprinting
- To apply molecular phylogeny in taxonomy

Unit I: Microbial Taxonomy **14 hrs**

Introduction to microbial taxonomy – morphological taxonomy, biochemical taxonomy,and molecular taxonomy. Numerical taxonomy – basic concepts of taxonomy. Positive and negative aspects of each taxonomical methods. Morphological phylogeny.

Unit II: Biochemical & molecular taxonomy **15 hrs**

Chemotaxonomy - fatty acid, protein finger printing, Isozyme typing, pigments & polyamines. Biochemical phylogeny. Molecular taxonomy – G +C content, DNA –DNA hybridization, Plasmid profiles, RFLP, RAPD, STRR & LTRR, REP –PCR, rRNA based DNA finger printing methods

Unit III: rRNA Based Finger Printing **15 hrs**

Types of rRNA – 23S rRNA, 16S rRNA& 5S rRNA. Importance of 16SrRNA inmicrobial identification and taxonomy. Methods of 16S rRNA / rDNA fingerprinting -Isolation of rRNA, RT- PCR, Isolation of DNA, amplification of 16S rDNA using PCR, Cloning, transformation, Blue-white screening, Plasmid isolation, Dot blot/Southern blot hybridization using specific probes sequencing of 16S rDNA using chain-termination method.

Unit IV: Sequence Analysis **14 hrs**

Submission of rDNA sequences in GenBank – Bankit& Sequin guidelines. NCBI, EMBL & DDBJ – retrieving sequences. RNA structure prediction, Restriction enzyme patterns. Ribosomal Database Project - Designing primers & probes. Sequence comparison, alignment and data base searching – Clustal W, FASTA & BLAST. DNA barcoding.

Unit V: Molecular Phylogeny **14 hrs**

Introduction to Molecular phylogeny – tree terminology, software programs for making phylogenetic trees – MEGA, Phylib, RAPDistance. Cladogram, additive trees and ultrametric trees, rooted, unrooted trees and tree shapes.

References:

Text Books:

1. Bioinformatics (Sequence and genome analysis) (2002) 2nd edition by David W.Mount, CBS publication.UK
2. Genomes by T.A.Brown 1stedition,Bios Scientific publication UK.
3. Gene Biotechnology (2nd Edition) by Joghand, S.N. Himalaya Publishing company, India. 4.
4. Concepts of genetics by William Klug, MichealR.Cummings. Pearson Education, Delhi.
5. Genome Mapping and Sequencing by Ian Dunham (Hardcover - Sep 1, 2003).
6. Brendan Wren (Editor), Nick Dorrell (2002) Functional Microbial Genomics (Volume33) (Methods in Microbiology), Academic Press, UK.
7. Sandy B. Primrose Richard M. Twyman (2005) Principles of Genome Analysis and Genomics, Blackwell Publishing, USA.
8. Roderic D. M. Page, Edward C. Holmes (1998). Molecular Evolution: A Phylogenetic Approach. Blackwell publishing, USA.
9. Principles of Genome Analysis: A Guide to Mapping and Sequencing DNA from Different Organisms by S. B. Primrose (Paperback - Jan 1998)

Course Outcomes:

After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Describe the concepts of taxonomy	K2
CO2	Apply the DNA fingerprinting methods	K3
CO3	Compare the types of tRNA	K2
CO4	Take part in Genbank Submission	K4
CO5	Construct Phylogenetic tree	K6

Title of the Course: Molecular Taxonomy and Phylogeny						**Course Code:** P1R2MBDSE1:2					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	3	3	3	1	3	3	3	2.7
CO2	3	3	3	3	3	3	2	2	3	3	2.8
CO3	3	2	3	3	3	3	1	2	3	3	2.6
CO4	3	3	3	3	3	3	3	2	3	3	2.9
CO5	3	3	3	3	3	3	3	2	3	3	2.9
									Mean Overall Score		**2.78**
									Result		**High**

MICROBIAL NANOTECHNOLOGY

Course Code: P2R2MBDSE2:1	**Credit:** 3
Category: Discipline Specific Elective	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To understand introduction about history of nanotechnology and its development.
- To learn the Synthesis of nanoparticles and its vast applications.
- To get knowledge about Nanoparticle Size analyzer.
- To acquire knowledge on nanoparticles advantages and disadvantages.
- To know nanoparticle used in drug delivery system.

Unit – I **12 hrs**

History of nanotechnology, concept and future prospects – application in Life Sciences. Terminologies – nanotechnology, microbial nanotechnology, nanomedicine, nanowires, quantum Dots, nanocomposite, nanoparticles. Present status and future prospects of microbial nanotechnology.

Unit – II **12 hrs**

Molecular nanotechnology-nanomachines and collagen.Uses of nanoparticles- cancer therapy and manipulation of cell and biomolecules.Types of nanoparticles- physical, chemical and biological.Microbial synthesis of nanoparticles- mechanism.

Unit – III **12 hrs**

Nanoparticles-types and functions Physical and chemical properties of nanoparticles. carbon nanotubes - Characterization of nanoparticles using UV-Vis, FTIR spectroscopy, Electron Microscopy – HRTEM, SEM, AFM, EDS, XRD and nano particle size analyzer.

Unit – IV **12 hrs**

Advantages of nanoparticles: drug targeting, protein detection, MRI, development of green chemistry – commercial viability of nanoparticles. Disadvantages – health risk associated with nanoparticles, inadequate knowledge on nanoparticles research.

Unit – V **12 hrs**

Drug delivery-protein and nanoparticle mediated. Uses of nanoparticles in MRI, DNA and protein microarrays.Nanotechnology in health sectors.Toxicology in nanoparticles-Dosimetry.

References:

1. David SG. (2004). Bionanotechnology, Lessons from nature, John Wiley & Sons Inc. publication

2. Parthasarathy BK. (2007). Introduction to Nanotechnology, Isha Publication.

3. Elisabeth P and Aravind P. (2007). Bionanotechnology.Morgan& Claypool Publishers.4. Bernd R. (2006). Microbial Bionanotechnology: -. Horizon Scientific Press.

5. David ER and Joseph DB. (2009). Bionanotechnology: Global Prospects. CRC Press.
6. Ehud G. (2013). Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology, World Scientific Publishers.
7. Silva GA and Parpura V. (2011). Nanotechnology for Biology and Medicine: At the building block level, Springer Science.
8. Ibrahim K, Khalid S and Idrees K. (2017). Nanoparticles: Properties, applications and toxicities. Arabian Journal of Chemistry.
9.Yadav.R.K. (2007).Nanotechnology.Manglam Publishers.
10. https://www.igi-global.com/chapter/microbial-nanotechnology/165227

Course Outcomes:
After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Describe history of nanotechnology	K2
CO2	Explain physical and chemical properties of nanoparticles	K4
CO3	Analyze different nanoparticle size	K4
CO4	Discuss advantages and disadvantages of nanoparticles	K2
CO5	Interpret nanotechnology in health sectors	K2

Title of the Course: Microbial Nanotechnology						**Course Code:** P2R2MBDSE2:1					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	1	1	1	1	3	1	1	3	3	1.8
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	2	3	3	3	2.9
CO4	3	2	2	2	2	3	2	3	3	3	2.5
CO5	3	2	3	2	3	3	3	3	3	3	2.8
										Mean Overall Score	**2.6**
										Result	**High**

BIOETHICS, BIOSAFETY & IPR

Course Code: P2R2MBDSE2:2	**Credit:** 3
Category: Discipline Specific Elective	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To define the concepts of Bioethics.
- To learn the biosafety and lab associated infections
- To get knowledge on assessment of biosafety
- To become familiar with quality control.
- To be aware of Intellectual Property Rights.

Unit - I: Bioethics

Legalty, morality and ethics, the principles of bioethics, autonomy, human rights, beneficience, privacy justice equalit .

Unit - II: Biosafety

Concept and issues, rational and subjective perceptions of risks and benefits – relationship between risk hazard, exposure, and safe gaurds – biosafety concerns at the level of individuals, institutions, society, region, country and the world – Lab associated infections.

Unit - III: Biosafety Assessment

Biosafety assessment in biotechnology – biosafety during industrial production of GMOs – microbes, plants and animals. Planned introduction of genetically modified organisms and pharmaceutical products fromGMOs such as drug-vaccines – biomolecules. Biosafety guidelines in India.

Unit - IV: Quality control

Quality control in food process technology – WHO standards – Quality control in dairy products, drugs and beverages – Quality control for potable water.

Unit V: IPR

GATT and IPR, forms of IPR, IPR in India, WTO Act, Convention on Biodiversity (CBD), Patent Co-operation Treaty (PCT), forms of patents and patentability, process of patenting, Indian and international agencies involved in IPR & patenting, Global scenario of patents and India's position, patenting of biological material, GLP, GMP.

Unit VI: Latest Learning (for Continuous Internal Assessment only) Latest developments related to the course during the Semester

References:

1. Ignacimuthu. S (2009).Bioethics. Narosa Publishinghouse
2. Singh B. D (2006).Biotechnology.KalyaniPublication.

3. Shaleesha .A (2008).Bioethics. Wisdom Biotechnology
4. Sateesh M.K, (2008).Bioethics and Biosafety .I.K.International Publishing house (P) Ltd
5. Sathyanarayana, U (2008).Biotechnology.Books and allied (P) Ltd
6. Frederic H. Erbisch, Karim M. Maredia (2004). Intellectual Property Rights in Agricultural Biotechnology, CABI Publisher.
7. Mittal D.P. (1999). Indian Patents Law. Taxmann Allied Services (p) Ltd.
8. Christian Lenk, Nils Hoppe, Roberto Andorno (2007). Ethics and Law of Intellectual Property: Current Problems in Politics, Science and Technology, Ashgate Publisher (p) Ltd.
9. Felix Thiele, Richard E. Ashcroft (2005). Bioethics in a Small World. Springer.
10. John Bryant (2002) Bioethics for Scientists. John Wiley and Sons Publisher.

Course Outcome

After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Explain the bioethics	K5
CO2	Apply the biosafety measures	K3
CO3	Summarize the biosafety assessment	K2
CO4	Analyse the food and Dairy products	K4
CO5	Understand the importance of IPR	K5

Title of the Course: Bioethics, Biosafety & IPR						**Course Code:** P2R2MBDSE2:2					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	3	2	3	3	2.9
CO2	3	3	3	3	3	3	3	2	3	3	2.9
CO3	3	3	3	3	3	3	3	2	3	3	2.9
CO4	3	3	3	3	3	3	3	2	3	3	2.9
CO5	3	3	3	3	3	3	3	2	3	3	2.9
										Mean Overall Score	**2.9**
										Result	**High**

MEDICAL LAB TECHNOLOGY

Course Code: P2R2MBDSE2:2	**Credit:** 3
Category: Discipline Specific Elective	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Entrepreneurship	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To learn about the Blood system and their functions.
- To get Knowledge on Cardiovascular system.
- Clear ideas about diagnostic pathology and laboratory safety.
- To become aware of laboratory safety measures
- To create knowledge on Clinical Biochemistry

Unit-I Anatomy **12 hrs**

Terminology and general plan of the body, Body parts and Areas, Terms of location and position, Body cavities and their membranes, Planes and sections. Tissues – Types, Musculoskeletal system, Respiratory system, Digestive system

Unit-II Physiology **12hrs**

Cell physiology, Blood composition, function, cellular component & their function, Lymphatic system-composition & function. Cardiovascular system general arrange, Respiratory system, Gasterointestinal physiology.

Unit-III Diagnostic Pathology **12hrs**

Basic definitions and familiarization with the common terms used in pathology, Causes and mechanisms of cell injury, reversible and irreversible injury, Introduction of hyperplasia, hypoplasia, hypertrophy, atrophy, metaplasia, necrosis and apoptosis.

Unit-IV Laboratory Safety **12hrs**

Specimen collection and processing of blood, urine & CSF, separation of serum and plasma, deproteinization of sample, Handling of specimens for testing, preservation of specimen, transport of specimen, factors affecting the clinical results, effect of storage onsample.

Unit-V Clinical Biochemistry **12hrs**

Physical, chemical and microscopic examination of urine, qualitative test of urine for reducing sugars, protein, ketone bodies, bile salt, bile pigments, urobilinogen, occult blood, uric acid, urea and creatinine, quantitative estimation of 24 hrs urine for protein and their clinical significance.

References:

Mukkerjee K.L. (1999).Medical laboratory Technology. Vol I, II, III.TataMcGrawHill Publications.

Course Outcomes:

After completion of this course work students would be able to

S.No	Course outcome	Knowledge level
CO1	Define the anatomy of human body	K1
CO2	Summarize the Physiology	K2
CO3	Experiment with diagnostic pathology	K3
CO4	Apply the Laboratory safety methods	K3
CO5	Estimate the tests in Biochemistry	K6

Title of the Course: Medical Lab Technology						**Course Code:** P2R2MBDSE2:2					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	3	3	3	3	3.0
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	3	3	3	3	3	3	3	3	3.0
										Mean Overall Score	**3.0**
										Result	**High**

BIOSTATISTICS AND BIOINFORMATICS

Course Code: P3R2MBDSE3:2	**Credit:** 3
Category: Discipline Specific Elective	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To develop skills of the students in the area of probability and statistics
- To know about the various reliability methods
- To provide basic idea of bioinformatics databases and application for the students
- To get knowledge on biological databases
- To predict the protein structure

Unit I: Averages and Measures of dispersion **12 hrs**

Introduction to Bio statistics – Definitions, applications of Bio-Statistics – Role of Bio-Statistics. Measures of Central tendency: Arithmetic Mean, Median and Mode. Measures of dispersion: Standard deviation and Coefficient of Variation (Related Problems, direct methods only).

Unit II: Inferential statistics **12 hrs**

Null hypothesis, alternative hypothesis, level of significance (Basic Definitions) Testing of hypothesis: One sample and two samples mean – F-test – ANOVA: one way and two way classification, Chi – square goodness of fit and independent attributes (Related problems).

Unit-III Introduction to Computers **12 hrs**

Basics of Computers-servers, workstations .Operating systems-Unix, Linux, WWW, Search Engine, Finding research articles- PUBMED.

Unit-IV Biological database **12 hrs**

Protein sequence database – PIR, SWISS-PROT, Gene sequence database-Gene bank, DDBJ and EMBL. Structure database – SCOP, CATH and PBD, Specialized databases.

Unit –V Sequence Alignment and Prediction **12 hrs**

BLAST, FASTA. Pairwise sequence and Multiple sequence alignment.Secondary Prediction-Primary structure PROTPARAM, Secondary Structure-SOPMA and Tertiary Structure,Protein Modeling –RASMOL,SWISS-PDB viewers, phylogenetic analysis.

References:

Text Books:

1. AroraMatham (2004^{ed}).Biostatistics.Himalaya Publication.
2. Jasra P.K. and Gur Deep raj – First edition (2000) Krishna PrakashamPvt.Ltd.

3. Bioinformatics (Sequence and genome analysis) (2002) 2nd edition by David W.Mount, CBS publication.UK.
4. Genomes by T.A.Brown 1stedition, Bios Scientific publication UK.
5. Gene Biotechnology (2nd Edition) byJoghand, S.N. Himalaya Publishing company, India.
6. Concepts of genetics by William Klug, MichealR.Cummings.Pearson Education, Delhi.
7. Genome Mapping and Sequencing by Ian Dunham (Hardcover - Sep 1, 2003).
8. Brendan Wren (Editor), Nick Dorrell (2002) Functional Microbial Genomics (Volume33) (Methods in Microbiology), Academic Press, UK.
9. Sandy B. Primrose Richard M. Twyman (2005) Principles of Genome Analysis and Genomics, Blackwell Publishing, USA.
10. Roderic D. M. Page, Edward C. Holmes (1998). Molecular Evolution: A Phylogenetic Approach. Blackwell publishing, USA.
11. Principles of Genome Analysis: A Guide to Mapping and Sequencing DNA from Different Organisms by S. B. Primrose (Paperback - Jan 1998).

Course Outcomes:
After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Apply statistical measures which are used to analyse the data	K3
CO2	Prepare reports to conclude the findings in data analysis	K6
CO3	Define the concepts of sequence analysis and the prediction of structure	K1
CO4	Discuss the software and its application in research field	K5
CO5	Predict the evolutionary distance between organisms or species	K6

Title of the Course: Biostatistics and Bioinformatics						**Course Code:** P3R2MBDSE3:2					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	3	2	3	3	2.9
CO2	3	3	3	3	3	3	3	2	3	3	2.9
CO3	3	3	3	3	3	3	3	2	3	3	2.9
CO4	3	3	3	3	3	3	3	2	3	3	2.9
CO5	3	3	3	3	3	3	3	2	3	3	2.9
										Mean Overall Score	**2.9**
										Result	**High**

RESEARCH METHODOLOGY

Course Objectives:

- To define the design of a research
- To become aware of reports writing
- To get knowledge on ethics
- To be familiar with laboratory practices
- To handle different types of centrifuges

Unit 1:

Research – Definition – Literature Collection – Literature Citation – Experimental designs - Major search engines - Major Websites, book and scientific information - Identification, Selection and formulation of research problem – Research questions

Unit 2:

Research Report – Components of a Research Report – Authors and Addresses – Abstract – Synopsis – Key words – Introduction – Materials and Methods – Results – Discussion – Acknowledgements – Summary and Conclusions – Appendixes – References - Title – Tables – Figures – Formatting and Typing.

Unit 3:

Biological research - Institutional Ethical committee – Animal ethical committee – Use of laboratory animals in research - Laboratory animal management

Unit 4:

General Laboratory Procedures – pH, Buffers, Electrodes and Biosensors – Estimation of Carbohydrates(Bradford Method) – Protein(Lowry Method) – Lipid (Soxlet Method) – Nucleic Acid (Spectrophotometry) – Techniques for Sample Preparation.

Unit 5:

Centrifugation – Principles and Instrumentation - Low-Speed centrifuges – High Speed Centrifuges – Ultracentrifuges. Applications of Centrifugation: Preparative Techniques – Analytical Centrifugation (Differential and Density gradient)

Text Books

• Dr. N. Gurumani, Research Methodology: For Biological Sciences, 2006, MJP Publishers.

• Upadhyay, Upadhyay and Nath, Biophysical Chemistry Principles and Techniques, Himalaya Publications, 1997. Reference Books

• Y. K. Singh and R. B. Bajpai, Research Methodology Data Presentation, 2008, APH Publishing Corporation, New Delhi.

• Rodney Boyer, Modern Experimental Biochemistry (3rd Edition) 2000. Addison Wesley Longman, Inc.

• Wilson and Walker, A Biologists guide to Principles and Techniques of Practical Biochemistry (5th Edition) 2000 Cambridge University Press.

• David Freifelder, Physical Biochemistry, (2nd Edition) 1982, W. H. Freeman and Company, New York.

Course Outcomes:
After completion of this course, students would be able to

Si.No	Course Outcomes	Knowledge Level
CO1	Explain about research	K1
CO2	Describe the research reports	K2
CO3	Discuss about the committee	K6
CO4	Apply the laboratory procedures	K3
CO5	Determine the centrifugation process	K6

Title of the Course: Research Methodology						**Course Code:**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	3	3	3	3	3	3	3	2.9
CO2	3	2	3	3	3	3	3	3	3	3	2.9
CO3	3	2	3	3	3	3	3	3	3	3	2.9
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	3	3	3	3	3	3	3	3	3.0
									Mean Overall Score		**2.94**
									Result		**High**