

M.Sc. MICROBIOLOGY

SEM	COURSE CODE	COURSE	COURSE TITLE	HRS/ WEEK	CRED IT	MARKS		Total Marks
						Internal	External	
I	20PMB1CC1	Core I	General Microbiology	6	5	25	75	100
	20PMB1CC2	Core II	Microbial Cell Physiology	6	5	25	75	100
	20PMB1CC3	Core III	Chemistry of Biomolecules	6	4	25	75	100
	20PMB1CC4P	Core IV	General Microbiology, Microbial Cell Physiology and Chemistry of Biomolecules	6	4	25	75	100
	20PMB1DE1	DSE -I#		6	4	25	75	100
TOTAL				30	22	125	375	500
II	20PMB2CC5	Core V	Microbial Genetics and Molecular Biology	6	5	25	75	100
	20PMB2CC6	Core VI	Genetic Engineering	6	5	25	75	100
	20PMB2CC7	Core VII	Environmental and Agricultural Microbiology	6	4	25	75	100
	20PMB2CC8P	Core VIII	Microbial Genetics and Molecular biology, Genetic Engineering, Environmental and Agricultural Microbiology Practical	6	4	25	75	100
	20PMB2DE2	DSE -II#		6	4	25	75	100
TOTAL				30	22	125	375	500
III	20PMB3CC9	Core IX	Medical Microbiology	6	5	25	75	100
	20PMB3CC10	Core X	Immunology and Immunotechnology	6	5	25	75	100
	20PMB3CC11	Core XI	Bioenergetics and Enzymology	6	4	25	75	100
	20PMB3CC12P	Core XII	Medical Microbiology, Immunology and Immunotechnology, Bioenergetics and Enzymology Practical	6	4	25	75	100
	20PMB3DE3	DSE-III#		6	4	25	75	100
	20PMB3EC1	Extra Credit I	Online Course (MOOC)	-	1*	-	-	-
TOTAL				30	22	125	475	500
IV	20PMB4CC13	Core XIII	Fermentation Technology	6	5	25	75	100
	20PMB4CC14	Core XIV	Food and dairy Microbiology	6	5	25	75	100
	20PMB 4CC15	Core XV	Bioinformatics and Biostatistics	6	5	25	75	100
	20PMB4PW	Project Work	Project	12	8	-	200	200
	20PMB4EC2	Online Course (Compulsory)		-	1	-	-	-
	20PCNOC	Extra Credit-II	Microbiology for career Examinations	-	5*	-	100*	100*
TOTAL				30	24	75	525	500
GRAND TOTAL				120	90	450	1750	2000

*Not considered for Grand total and CGPA

Discipline Specific Electives

Semester	Subject code	Course Title
I	20PMB1DE1A 20PMB1DE1B	Virology Microbial Diversity
II	20PMB2DE2A 20PMB2DE2B	Microbial Ecology Bioremediation and Waste Management
III	20PMB3DE3A 20PMB3DE3B	Bioinstrumentation and Bioethics Endocrinology

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External marks
I	20PMB1CC1	Core – I	GENERAL MICROBIOLOGY	6	5	100	25	75

Course Outcomes

At the end of the course, students will be able to

1. Examine the characteristics and applications of microbial adaptations in planet.
2. Identify the group and proper name of organisms through standardized system.
3. Explain the evolutionary history, classification and distinguished features of bacteria.
4. Summarize the characteristics, structures and life cycle of fungi.
5. Acquire the relevant knowledge about the structure, life cycle and characteristics of microalgae.

UNIT I

18 hours

Microbial Planet: Main themes of Microbiology- Impact of microbes on earth-Microbial involvement in energy and nutrient flow -Application using microorganism: versatile chemical changes, #impact on infectious human disease#.

UNIT II:

18 hours

Microbial Taxonomy: Organizing, classifying and naming the microorganism. Levels of classification- system of presenting a universal tree of life. #Basic concept of numerical taxonomy#. Criteria used in bacterial identification: Classical and Molecular characteristics. Microbial kingdom concept. Classification system of prokaryotes by Bergey's manual of systematic bacteriology (9th edition).

UNIT III

18 hours

Bacterial profiles: General characteristics, Structure and Reproduction of Eubacteria, Archaeobacteria, #Mycoplasma#, Actinomycetes, Rickettsiae, Chlamydias, Spirochaete and Cyanobacteria.

UNIT IV

18 hours

Fungal profiles: History, general characteristics, habit, habitats and mode of nutrition. Classification of Fungi by Alexopoulos (1979). Heterokaryon- Dimorphic fungi and imperfect fungi. Morphology, structure and life cycle of *Aspergillus niger* and #*Saccharomyces cerevisiae*#.

UNIT V

18 hours

Microalgae: Classification of algae based on Fritsch system- General characteristics of microalgae – Habit, Habitat, Biological and Economic importance of microalgae- Morphology, structure, life cycle of *Chlorella* and #*Dunaliella*#.

Self-study portion.

Text Books:

T.B-1 J. Michael, J. R. Pelczar, E. C. S. Chan and N. R. Kreig, Microbiology, 5th edition, McGraw Hill. Inc, New York, 1993.

T.B-2 S. S. Purohit and A. K. Saluja, H. N. Kakrani, Pharmaceutical Microbiology, Mrs.Sarwathi purohit for student edition, India, 2006.

T.B-3 K. S. Bilgrami and R. K. Sinha, Essentials of Microbiology, 1st edition, SK Jain for CBS publishers and distributors, 2005.

T.B-4 P. S. Bisen Kavitha Verma, Hand book of Microbiology, 2004.

UNIT I	Chapter I	T.B-1
UNIT II	Chapter III & V	T.B-2
	Chapter V	T.B-3
UNIT III	Chapter XXIII	T.B-4
UNIT IV	Chapter XVII	T.B-1
UNIT V	Chapter XVIII	T.B-1

Books for Reference:

1. J.G. Holt, N.R. Kreig, P.H.A. Sneath, and S.T. Williams, Bergey's Manual of Systematic Bacteriology, 9th edition, Williams and Wilkins, Baltimore, 1994.
2. L. M. Prescott, J. P. Harley and D. AKlein, Microbiology, 7th edition, Mc Grow Hill, 2007.
3. M.T. Madigan, J.M. Martinko and J.Parker, Brock Biology of microorganisms, 11th edition, Pearson Education international, USA, 2006.
4. G. J. Tortora, B.R Funke and C. L. Case, Microbiology an Introduction, 8th edition, LPE-Pearson Education, Inc, 2005.

Web Source

1. <https://nptel.ac.in/courses/102103015/>
2. <https://courses.lumenlearning.com/suny-biology2xmaster/chapter/ecology-of-fungi/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper					Hours	Credits		
I	20PMB1CC1		GENERAL MICROBIOLOGY					6	5		
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓		✓	✓		✓		✓	
CO2	✓	✓			✓	✓	✓			✓	
CO3	✓		✓	✓	✓	✓		✓	✓	✓	
CO4	✓		✓	✓	✓	✓		✓	✓	✓	
CO5	✓		✓	✓	✓	✓		✓	✓	✓	
Number of Matches= 36, Relationship : High											

Prepared by:

1. Dr.M.Mohamed Mahroop Raja

Checked by:

1. Dr.N.Reehana
2. Dr.A.Khaleel Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External marks
I	20PMB1CC2	Core – II	MICROBIAL CELL PHYSIOLOGY	6	5	100	25	75

Course Outcomes

At the end of the course, students will be able to

1. Describe the synthesis of bacterial cell wall and its transport mechanism.
2. Observe the specific growth rate of microbes under different physicochemical conditions.
3. Determine the distribution, classification and applications of archaeobacteria.
4. Acquire knowledge on photosynthesis and its pigments produced by microorganism
5. Identify the catabolic and anabolic reactions occurring in the organism.

UNIT I

18 hours

Cell structure and function: Bacterial cell wall - Biosynthesis of peptidoglycan - outer membrane, teichoic acid – Exopolysaccharides; #cytoplasmic membrane, pili, fimbriae, S-layer#. Nutrient Transport mechanisms- uniport, symport and antiports- active, passive, facilitated diffusions and group translocation- Siderophore in Iron transport. Electron carriers – artificial electron donors – inhibitors – uncouplers – energy bond – phosphorylation.

UNIT II

18 hours

Microbial Growth: Microbial Nutrition- autotroph, phototroph, heterotroph, organotroph, lithotrophs and Winogradsky column. Phases of growth curve – measurement of growth – calculations of growth rate – generation time. Diauxic growth, Synchronous growth – induction of synchronous growth, synchrony index and Continuous growth. #Factors affecting microbial growth#- Cell division- mechanisms involved in formation of Z-ring.

UNIT III

18 hours

Archaeobacteria: Characteristics, cell wall, properties, distribution, abundance and ecological niche. Thermophiles: Classification, hyperthermophilic habitats and ecological aspects. Extremely Thermophilic Archaeobacteria, Thermophily, commercial aspects of thermophiles. #Applications of thermozymes#. Methanogens: Classification, Habitats, applications.

UNIT IV

18 hours

Microbial Photosynthesis: Carbon assimilation- oxygenic and anoxygenic photosynthesis. Photosynthetic and accessory pigments. Fluorescences and phosphorescences. #bacteriochlorophyll#, rhodopsin, carotenoids, phycobiliproteins, Pulcherrimin, indigoidin, vioalacin. Defensive role of pigments. Bioluminescence mechanism and applications.

UNIT V

18 hours

Microbial Catabolism and Anabolism- Fermentation and Respiration-EMP pathway-Pasture effect, ED pathway, Glyoxalate pathway, Krebs cycle. Anabolism- Gluconeogenesis and #reverse TCA cycle#. Microbial growth on C1 Compounds (Cyanide, Methane, Methanol, methylated amines and carbon monoxide).

Self-study portion.

Text Books:

T.B-1 M. L. Gupta and M. L. Jangir, Cell biology: Fundamentals and Applications, Agrobios, India, 2010.

T.B-2 H. G. Schlegel, General Microbiology, 7th edition, Cambridge university press, 2004.

T.B-3 Stuart Hogg, Essential Microbiology, John Wiley and sons Ltd, 2005.

T.B-4 D. L. Nelson and M. M. Cox, Lehninger: Principles of Biochemistry, 4th edition, W. H. Freeman and company, 2005.

T.B-5 L. M. Prescott, J. P. Harley and D. AKlein, Microbiology, 7th edition, Mc Grow Hill, 2007.

UNIT I	Chapter III	T.B-2
UNIT II	Chapter V	T.B-3
UNIT III	Chapter XXIV, XXV	T.B-1
UNIT IV	Chapter XIX	T.B-4
UNIT V	Chapter VIII	T.B-5

Books for Reference:

1. D.R.Caldwell, Microbial Physiology and Metabolism, W.M.C.Brown Publishers, 2nd edition, LPE-Pearson Education, Inc, 1995.
2. J.L.Ingraham and C.A.Ingraham, Introduction to Microbiology, 3rd edition, Thomson Brooks/cole publication, 2004.
3. G.Gottychalk, Bacterial Metabolism, 2nd edition, Springer- Verlag, Berlin Hissar, Agricultural University, Prentice Hall of India Pvt Ltd, Delhi, 1986.
4. H.W. Doelle, Bacterial Metabolism, 2nd edition, Academic press, Elsevier Publication, New Delhi, India, 2005.

Web Source

1. <https://nptel.ac.in/courses/102103015/>
2. <https://courses.lumenlearning.com/microbiology/chapter/introduction-to-microbialmetabolism/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
I	20PMB1CC2	MICROBIAL CELL PHYSIOLOGY					6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓		✓	✓	✓	✓		✓	✓	✓	
CO3	✓	✓				✓	✓				
CO4	✓		✓	✓	✓	✓		✓	✓	✓	
CO5	✓			✓	✓	✓			✓	✓	
Number of Matches= 34, Relationship : Moderate											

Prepared by:

1. Dr.M.Mohamed Mahroop Raja

Checked by:

1. Dr.N.Reehana

2. Dr.A.Khaleel Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
I	20PMB1CC3	Core – III	CHEMISTRY OF BIOMOLECULES	6	4	100	25	75

Course Outcomes

At the end of the course, students will be able to

1. Acquire knowledge on living organism and its physico chemical regulation.
2. Explain the role of carbohydrates and proteins, their chemical alterations and maintenance in living cells.
3. Explain the types, structure, property, and biosynthesis regulation of lipids and nucleic acids.
4. Describe the chemical nature of hormones and vitamins in the cell.
5. Identify the types of molecules that act in cell signaling pathway.

UNIT I

18 hours

Basics of Biochemistry: The chemical unity of diverse living organisms, composition of living matter. Macromolecules and their monomeric subunits. Structure of atoms. Principles and types of chemical bonding. Structure and properties of water, Acids and bases. Bond strength and interaction between biomolecules.# Basic concept on pH, pKa value and buffer#.

UNIT II

18 hours

Carbohydrates and Proteins: Classification, structure and reactions of monosaccharides and disaccharides. Structure and conformation of polysaccharides - Cellulose, #Amylose and Chitin#. **Protein-** properties of aminoacids. Classification of proteins. Structure of Protein- primary, secondary, tertiary and quaternary structure.

UNIT III

18 hours

Lipids and Nucleic acids: Biological importance and classification of lipids. Properties and types of fats and fatty acid - β -oxidation. #Biosynthesis of cholesterol#. **Nucleic acid** biosynthesis and degradation (de novo and salvage path way).

UNIT IV

18 hours

Vitamins and Hormones: Definition, structure, properties and classification of vitamins- fat soluble vitamins-vitamin A, D, E and K; water soluble vitamins B12, B2, B6 group and vitamin-C. Microbial assay of vitamins and amino acids. Coenzyme activity of vitamins. Protein and peptide hormones – auxin, #gibberellins# and cytokinins.

UNIT V

18 hours

Bio signaling: Molecular mechanism of signal transduction-gated ion channel, cell surface receptor and hormones. Signaling through G protein coupled receptor and second messengers. Protein kinase in signal transduction. Regulation of signaling pathways and #programmed cell death#.

Self-study portion.

Text Books:

T.B-1 U. Satyanarayana and U. Chakrapani, Biochemistry, 3rd edition, Arunabha Sen Publisher, 2016.

T.B-2 Eric E. Conn, Paul K. Stumpf, George Bruening and Roy H. Doi, Outlines of Biochemistry, 5th edition, Wiley India Publisher, 2006.

T.B-3 Ajoy Paul, Text book of cell and molecular biology, 4th edition, Arunabha Sen Publisher, 2015.

UNIT I	Chapter I-III	T.B-1
UNIT II	Chapter II & IV	T.B-1
UNIT III	Chapter III,XIX	T.B-1,2
UNIT IV	Chapter VII	T.B-1
UNIT V	Chapter XV	T.B-3

Books for Reference:

1. J. M. Berg, J. L. Tymoczko and L. Stryer, Biochemistry, 5th Edition, W.H. Freeman, New York., 2005.
2. W. B. Wood, J. H. Wilson, R. M. Benbow and L. E. Hood, Biochemistry: A problems approach, 2nd Edition, Benjamin/Cummins Publishing Company., 1981.
3. D. Voet and J. G. Voet, Biochemistry, 4th Edition, Wiley & Sons., 2011.
4. A. L Lehninger, D. L Nelson, M. M Cox, Principles of Biochemistry, CBS Publishers., 1993.

Web Source

1. <https://nptel.ac.in/courses/102103015/>
2. <https://www.ncbi.nlm.nih.gov/books/NBK9924/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
I	20PMB1CC3		CHEMISTRY OF BIOMOLECULES			6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓		✓	✓		✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓
CO3	✓	✓		✓	✓	✓	✓		✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5		✓		✓			✓		✓	
Number of Matches= 36, Relationship : High										

Prepared by:

1. Dr.H.Vajiha Banu

Checked by:

1. Dr.N.Reehana

2. Dr.A.Khaleel Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
I	20PMB1CC4P	Core – IV	GENERAL MICROBIOLOGY, MICROBIAL CELL PHYSIOLOGY AND CHEMISTRY OF BIOMOLECULES – PRACTICAL	6	4	100	20	80

Course Outcomes

At the end of the course, students will be able to

1. Examine the principles and methodologies for isolation and characterization of microorganisms.
2. Acquire knowledge about microorganism and its biochemical regulation.
3. Compare the factors affecting bacterial growth.
4. Report the reproducible data from biochemical experiments.
5. Apply the principles governing the structure of macromolecules and their participation in chemical reaction.

List of Practicals

GENERAL MICROBIOLOGY

1. Enumeration of Bacteria and Fungi- Viable plate count.
2. Pure culture techniques- Streak plate method
3. Measurement of size of microbes - micrometry method.
4. Motility determination - Hanging drop method and stab method
5. Staining methods- Gram staining, Acid fast, Endospore, PHB, and Capsule staining.
6. Lactophenol cotton blue staining method

MICROBIAL CELL PHYSIOLOGY

7. Measurement of growth curve- Direct and indirect methods.
8. Effect of pH and Temperature on microbial growth.
9. Effect of high salt concentration on microbial growth.
10. Biochemical tests: IMVIC, Catalase, Oxidase, TSI test, Gelatin, casein, starch Hydrolysis, and Urease test.

CHEMISTRY OF BIOMOLECULES

11. Acid base Titration and PKa determination
12. Estimation of total sugar
13. Separation of amino acid by paper chromatography
14. Extraction and Estimation of Total protein – Lowery *et al* method

Practical manuals

1. K.R. Aneja, Experiments in Microbiology, Plant pathology and Biochemistry, 4th edition, New age International publishers, India, 2003.
2. Cappuccino and G. James, Microbiology a laboratory manual, 4th edition, Addison Wesley Publishing Company Inc. California, 1996.
3. K.Wilson and Walker, Practical Biochemistry, Principles and Techniques, Cambridge University Press, 1995.
4. J. Jayaraman, Laboratory Manual in Biochemistry, 2nd edition, Newage publication, 2011.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
I	20PMB1CC4P	GENERAL MICROBIOLOGY, MICROBIAL CELL PHYSIOLOGY AND CHEMISTRY OF BIOMOLECULES – PRACTICAL					6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3			✓	✓	✓			✓	✓	✓	
CO4	✓		✓		✓	✓		✓		✓	
CO5	✓		✓	✓	✓	✓		✓	✓	✓	
Number of Matches= 36, Relationship : High											

Prepared by:

1. Dr.M.Mohamed Mahroop Raja

Checked by:

1. Dr.N.Reehana

2. Dr.A.Khaleel Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
I	20PMB1DE1A	DSE – I	VIROLOGY	6	4	100	25	75

Course Outcomes

At the end of the course, students will be able to

- 1.Explain the concepts studied in virus discovery, taxonomy, properties and structure, classification and replication strategies.
2. Introspect the knowledge on virus infecting plants and its economic importance.
3. Acquire knowledge on human and animal viruses.
4. Describe the structure and characteristics of various bacteriophages.
5. Demonstrate the different types of virus cultivation methods and biosafety.

UNIT I

18 hours

General Virology: History of viruses, Virus taxonomy, nomenclature and classification. properties of viruses; morphology and ultrastructure; capsids and capsomers arrangements; types of envelops and their composition, #viral genome#, introduction to replication strategies. Virus related agents (viroids, virusoids and prions).

UNIT II

18 hours

Plant viruses: Characteristics- Tobamovirus group (TMV); Tymovirus group (Circular mosaic virus); #Tomato spotted wilt virus#, potato virus X, cauliflower mosaic virus, effects of these viruses on plants and various histological and physiological changes induced due to viral infection. Transmission of plant viruses with vectors insects, nematodes, fungi and without vectors (contact, seed and pollens).

UNIT III

18 hours

Human and animal viruses: Characteristics- Adenovirus, Pox virus (DNS containing), Picornavirus, Rota virus, Retrovirus, Corona viruses (RNA containing). Mechanism of virus adsorption and entry into host cell including genome replication and mRNA production by animal viruses, mechanism of RNA synthesis, mechanism of DNA synthesis, transcription mechanism and post transcriptional processing, #translation of viral proteins#, assembly, exit and maturation of progeny virions. Oncogenic viruses.

UNIT IV

18 hours

Bacteriophages: Morphology, ultra structure and classification of phages. #one step growth curve and burst size#. life cycle pattern of bacteriophages: T- even phages; Structure of Cyanophages, Mycophages. General principles of phage- bacterium interaction and growth cycle studies of RNA and DNA phages, Phage genetics- Lambda phage.

UNIT V

18 hours

Cultivation of viruses: Growth of viruses in embryonated egg, in experimental animals and in cell cultures-primary, secondary, Diploid and continuous cell culture. Susceptible cell lines. Assay of viruses: physical and chemical methods of assay, (protein, nucleic acid, radioactivity tracers, electron microscopy. Infectivity assay of animal virus (plaque method, pock counting, end point method) and #infectivity assay of plant viruses#. Biosafety and containment facility in virology lab.

Self-study portion.

Text Books:

T.B-1 S. J. Flint, L. W. Enquest, V. R. Rancaniello and A. M. Skalka, Principles of Microbiology, 3rd edition, American Society for Microbiology, 2009.

T.B-2 J. Michael, J. R. Pelczar, E. C. S. Chan and N. R. Kreig, Microbiology, 5th edition, McGraw Hill. Inc, New York, 1993.

T.B-3 P. Saravanan, Virology, MJP Publishers, 2006.

T.B-4 Apoorva Karanth, Plant virology, Dominant publishers and distributors, New Delhi, 2008.

UNIT I	Chapter I &IV	T.B-1
UNIT II	Chapter X, XIII & XIV	T.B-4
	Chapter III	T.B-3
UNIT III	Chapter IV	T.B-3
	Chapter V to VII, IX	T.B-1
UNIT IV	Chapter II	T.B-3
	Chapter XX	T.B-2
UNIT V	Chapter II	T.B-1

Books for Reference:

1. S.J. Flint, L.W. Enquist, R. Krung, V.R. Racaniello and A.M. Skalka, Principles of Virology, ASM press, Washington, 2000.
2. Geeta Sumbali and R.S. Mehrotra, Principles of Microbiology, 1st edition, Tata McGraw Hill Pvt ltd, New Delhi, 2009.
3. H.F. Conrat, P.C. Kimball and J.A. Levy, Virology, 2nd edition, Prentice Hall, New Jersey, 1988.
4. J.A. Cann, Principles of Molecular virology, 3rd edition, Academic press, California, 2001.

Web Source

1. <https://courses.lumenlearning.com/boundless-biology/chapter/viral-evolution-morphology-and-classification/>

2. <https://www.khanacademy.org/science/biology/biology-of-viruses/virus-biology/a/bacteriophages>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
I	20PMB1DE1A		VIROLOGY			6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓		✓	✓		✓	
CO2	✓	✓			✓	✓	✓			✓
CO3	✓	✓		✓		✓	✓		✓	
CO4	✓				✓	✓				✓
CO5	✓	✓	✓	✓		✓	✓	✓	✓	
Number of Matches= 30, Relationship : Moderate										

Prepared by:

1. Dr.H.Vajiha Banu

Checked by:

1. Dr.N.Reehana

2. Dr.A.Khaleel Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
I	20PMB1DE1B	DSE – I	MICROBIAL DIVERSITY	6	4	100	25	75

Course Outcomes

At the end of the course, students will be able to

1. Describe the history and development of evolutionary relationships.
2. Report the evidence of biodiversity and its energy production.
3. Explore the different adaptations of microbes in stressful environment.
4. Acquire basic idea on marine diversity.
5. Analyze marine microbial association and its products applications.

UNIT I

18 hours

Origin and evolution of life - Theories of evolution; evidences for evolution; sources of variations (mutation, recombination, genetic drift, migration, natural selection); concept of species; #Specification and isolation (geographical and reproductive)#; origin of species.

UNIT II

18 hours

Biodiversity: Distribution, Abundance and Ecological niche. #Biodiversity indices- alpha, beta and gamma diversity#. Life detection methods: Evidence of metabolism (Gulliver), Evidence of photosynthesis (autotrophic and heterotrophic), ATP production, Phosphate uptake and Sulphur uptake.

UNIT III

18 hours

Extremophiles: Definition, characteristics, classification and applications of Alkalophiles, Acidophiles, Halophiles, Barophiles, Extremophiles – adaptations & significance on bacteria-oxygen toxicity, pH,#osmotic pressure and heat shock# etc.

UNIT IV

18 hours

Marine Diversity: Marine environment- properties of seawater, chemical and physical factors- Ecology of coastal, shallow and deep sea microorganism- significance of marine microflora. #Diversity of microorganism in the mangroves and coral environments#.

UNIT V

18 hours

Microbial endosymbionts: Epiphytes- coral- microbial association, sponge- microbial association. Marine microbial products- Carrageenan, agar-agar, sea weed fertilizers, polysaccharide - biosurfactants - enzyme - antibiotics and antitumour agents.

Self-study portion.

Text Books:

T.B-1 L.M. Prescott, P. John Harley and A. Donald Klein, Microbiology, 7th edition, Mc Grow Hill, USA, 2007.

T.B-2 Manoj Tiwari, Kapil Khulbe and Archana Tiwari, Environmental studies, 1st edition, I.K. International, 2007.

T.B-3 P.S.Bisen and Kavitha Verma, Hand book of Microbiology, CBS Publishing, 1994.

T.B-4 David Freifelder, Molecular biology, Library of congress cataloging in publication data, 2007.

T.B-5 D.M.Vasudevan, Biotechnology application, 1st edition, Jaypee Brothers Medical Publishers (p) Ltd, 2008.

UNIT I	Chapter VIII	T.B-1
UNIT II	Chapter IV	T.B-2
UNIT III	Chapter VII	T.B-3
UNIT IV	Chapter XXVI	T.B-4
UNIT V	Chapter VIII	T.B-5

Books for Reference:

1. R.Y. Stainer, J.L. Ingraham, H.H. Wheolis and P.R. Painter, The Microbial world, 5th edition, Prentice Hall, 1986.
2. M.T. Madigan, J.M. Martinko and J. Parker, Brock Biology of microorganisms, 11th edition, Pearson Education international, USA, 2006.
3. P. M. Gault and H. J. Marler, Handbook on Cyanobacteria: Biochemistry, Biotechnology and Applications (Bacteriology Research Developments), Nova Science Publishers, 2009.

Web Source

1. <https://www.khanacademy.org/science/biology/her/evolution-and-natural-selection/a/lines-of-evidence-for-evolution>
2. <https://www.khanacademy.org/science/biology/her/evolution-and-natural-selection/a/lines-of-evidence-for-evolution>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
I	20PMB1DE1B	MICROBIAL DIVERSITY					6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓				✓	✓				
CO2	✓			✓	✓	✓			✓	✓	
CO3	✓			✓	✓	✓			✓	✓	
CO4	✓		✓	✓	✓	✓		✓	✓	✓	
CO5	✓			✓	✓	✓			✓	✓	
Number of Matches= 30, Relationship : Moderate											

Prepared by:

1. Dr.M.Mohamed Mahroop Raja

Checked by:

1. Dr.N.Reehana
2. Dr.A.Khaleel Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
II	20PMB2CC5	Core – V	MICROBIAL GENETICS AND MOLECULAR BIOLOGY	6	5	100	25	75

Course Outcomes

At the end of the course, students will be able to

1. Describe the knowledge on nucleic acids.
2. Explain the system of DNA replication and DNA repair.
3. Analyze the principle of gene transfer mechanism and its regulations.
4. Acquire knowledge on mutation and its effect.
5. Demonstrate the molecular aspects of gene regulation.

UNIT I

18 hours

Nucleic Acids: Genome organization of Prokaryotes and Eukaryotes. Structural aspects of Nucleic acid- the double helical model- various forms of DNA and RNA, hyperchromicity- Nucleic acid as a genetic material- Griffith, Blender jar experiment, Avery experiment, RNA as a genetic material, Beadle and Tatum experiment. Genetic code- general features, wobble hypothesis, #Code is triplet – Molecular evidence#.

UNIT II

18 hours

Maintenance of Genetic Information: DNA replication- basic rules, Semi conservative model- Meselson and Stahl experiment, replication of circular DNA molecule, Discontinuous replication, Bi directional replication, Rolling circle mechanism. DNA damage and repair mechanism- Photo reactivation- Mismatch Repair- #Nucleotide Excision Repair#. Recombination repair- SOS repair.

UNIT III

18 hours

Gene transfer mechanisms: Horizontal gene transfer. Transformation process and regulation. Transduction- general and specialized- Lederberg and Zinder experiment. Conjugation- F⁺, F, Hfr and F', triparental mating, self transmissible and mobilizable plasmids and pili. Transposable elements and #reteroposons types and applications#.

UNIT IV

18 hours

Mutation: Mutation and mutagenesis- Definition and types- Spontaneous mutation and induced mutation- substitution, Insertions, Deletions and frameshifts. Mutagenesis- physical and chemical- UV, alkylators, Base analogs, intercalating agents and mutator genes. Detection, isolation, characterization of mutant and their uses. #Ames test for mutagenicity#.

UNIT V

18 hours

Molecular aspect of gene expression: Regulation of gene and gene expression in prokaryotes and eukaryotes- Transcription and translation. Gene rearrangement by RNA splicing. Catalytic RNA. Gene regulation in prokaryotes: Operon concept- #Lac #and Trp operon.

Self-study portion.

Text Books:

T.B-1 W. H. Elliott and D. C. Elliott, Biochemistry and Molecular Biology, John Wiley & Sons Ltd, 1993.

T.B-2 David Freifelder, Molecular Biology, 2nd edition, Narosa Publication, 1990.

T.B-3 George M. Malacinski, Essentials of Molecular Biology, 4th edition, Jones and Bartlett publishers, 1992.

T.B-4 P. J. Bottiono, The Science of Genetics, 6th edition, Macmillan publishing company, 1989.

UNIT I	Chapter VI	T.B-3
	Chapter IX	T.B-4
UNIT II	Chapter XXIII	T.B-1
	Chapter IX	T.B-2
UNIT III	Chapter VII,IX	T.B-3
	Chapter XXI	T.B-2
UNIT IV	Chapter X,XIII	T.B-4
UNIT V	Chapter XXIV	T.B-1
	Chapter X	T.B-2

Books for Reference:

1. B. Lewin, Genes VII, Oxford University press, 2000.
2. J.D Watson, T.A. Baker, S.P. Bell and Alexander Gann. Molecular Biology of the Gene, 5th edition, Benjamin Cummings, Publishing Company Inc, New York, 2004.
3. P. Steller and D.E. Bianchi, Cell and molecular biology, 3rd edition, Wiley publication, India, 2009.
4. T.A. Brown, Essential Molecular Biology - A Practical approach, Oxford University Press, Oxford, 1991.

Web Source

1.[https://bio.libretexts.org/Bookshelves/Biochemistry/Book%3A_Biochemistry_Free_For_All_\(Ahern%2C_Rajagopal%2C_and_Tan\)/2%3A_Structure_and_Function/2.6%3A_Structure_and_Function_-_Nucleic_Acids](https://bio.libretexts.org/Bookshelves/Biochemistry/Book%3A_Biochemistry_Free_For_All_(Ahern%2C_Rajagopal%2C_and_Tan)/2%3A_Structure_and_Function/2.6%3A_Structure_and_Function_-_Nucleic_Acids)

2.<https://www.khanacademy.org/science/biology/gene-regulation/gene-regulation-inbacteria/a/the-lac-operon>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
II	20PMB2CC5		MICROBIAL GENETICS AND MOLECULAR BIOLOGY			6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓		✓	✓		✓	
CO2	✓			✓		✓			✓	
CO3	✓	✓		✓	✓	✓	✓		✓	✓
CO4	✓	✓	✓		✓	✓	✓	✓		✓
CO5	✓			✓	✓	✓			✓	✓
Number of Matches= 32, Relationship : Moderate										

Prepared by:
1. Dr.N.Reehana

Checked by:
1. Dr.M.Mohamed Mahroop Raja
2. Dr.A.Khaleel Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
II	20PMB2CC6	Core – VI	GENETIC ENGINEERING	6	5	100	25	75

Course Outcomes

At the end of the course, students will be able to

1. Acquire knowledge on basic properties and classification of vector.
2. Examine the mode of action of various enzymes used in genetic engineering.
3. Explain the concept of cloning strategies and techniques.
4. Apply the rDNA by using advanced techniques.
5. Conclude the applications of rDNA technology and its safety guidelines.

UNIT I

18 hours

Vector Biology: Vectors- properties and classification. Plasmid: types and properties. Structure and application of bacterial plasmids: ColE1, pBR322 and pUC19. Bacteriophages vectors - M13 vector and Lambda phage vector. Phagemids, Cosmids. Artificial chromosomes. #Viral vectors used in gene therapy#.

UNIT II

18 hours

Enzymes in genetic engineering: Restriction enzymes (Type, classification, nomenclature and application). Role of Ligases, Alkaline phosphatase, #Polynucleotide kinase, Terminal nucleotidyl transferase,# DNA Polymerases, Taq DNA polymerases, RNase, Reverse transcriptase in rDNA technology.

UNIT III

18 hours

Cloning strategies: Gene Library construction- shotgun cloning and cDNA cloning. Cloning in *Saccharomyces cerevisiae* and other fungi. Screening of recombinants: Insertional inactivation, Blue white selection, positive selection, colony and plaque hybridization. Gene transfer in Bacteria- Electroporation, CaPO₄ mediated, DEAE, #liposomes# and DMSO.

UNIT IV

18 hours

PCR methods: Molecular probes production, labeling and applications. Sequencing by chemical and enzymatic method. Next generation sequencing. Blotting techniques- Southern, Northern and Western blotting. Analyzing DNA- principle of PCR. Types of PCR: inverse PCR, RT PCR, Nested PCR and colony PCR. #DNA Microarray analysis#. DNA finger printing- RFLP and RAPD.

UNIT V

18 hours

rDNA Application: Introduction to Gene therapy (*in vivo* & *ex vivo*), Antisense therapy. GMO's, BT cotton, production of Insulin, human growth hormone. New vaccine technology- Vaccine clinical trials- DNA vaccines- Recombinant Hepatitis vaccine, synthetic peptide vaccines and multivalent subunit vaccines. #Safety guidelines of r-DNA research#.

##Self-study portion.

Text Books:

T.B-1 Sandhya Mitra, Genetic Engineering, Rajiv Beri Macmillan India Ltd, 1996.

T.B-2 Sathyanarayanan, Biochemistry, 3rd edition, Arunabha sen Pvt. Ltd, 2016.

UNIT I	Chapter VI	T.B-1
UNIT II	Chapter 2.7	T.B-1
UNIT III	Chapter 2.1,2.7,2.8	T.B-1
UNIT IV	Chapter VIII	T.B-2
UNIT V	Chapter 2.16, 2.18, 2.9	T.B-1

Books for Reference:

1. S.T. Desmond and Nicholl, An Introduction to genetic Engineering Cambridge University Press,1994.
2. S.C.H. Sussman, F.H. Coflms, Skimmer and D.E. Stewartful, The release of genetically engineered microorganisms, Academic Press, London, 1988.
3. J.D Watson, T.A. Baker, S.P. Bell, and Alexander Gann. Molecular Biology of the Gene, 5th edition, Benjanun/cummngs Publishing Company Inc, New York, 2004.
4. C. Lenk, N. Hoppe and R. Andorno, Ethics and law of intellectual property: Current problems in politics, Science and technology, Ashgate publisher Pvt. Ltd. 2007.

Web Source

1.https://www.abmgood.com/marketing/knowledge_base/next_generation_sequencing_introduction.php

2. <https://courses.lumenlearning.com/boundless-biology/chapter/biotechnology/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
II	20PMB2CC6	GENETIC ENGINEERING					6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓		✓	✓	
CO2	✓	✓		✓		✓	✓		✓		
CO3		✓	✓	✓	✓		✓	✓	✓	✓	
CO4		✓	✓	✓	✓		✓	✓	✓	✓	
CO5		✓	✓	✓	✓		✓	✓	✓	✓	
Number of Matches= 38, Relationship : High											

Prepared by:
1. Dr.N.Reehana

Checked by:
1. Dr.M.Mohamed Mahroop Raja
2. Dr.A.Khaleel Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
II	20PMB2CC7	Core – VII	ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY	6	4	100	25	75

Course Outcomes

At the end of the course, students will be able to

1. Identify the role of microbes and nutrient cycles prevailing in environment.
2. Apply the acquired knowledge on recycling of solid and liquid waste.
3. Acquire the basic idea of biodegradation and its applications.
4. Describe the mechanism of nitrogen fixation and nif gene regulation.
5. Design the production and applications of bioinoculants and biopesticides.

UNIT I

18 hours

Soil Microbiology: Soil profile and Soil Microbiology- Structure, Types, Physical and Chemical properties. Weathering and Humus formation, Soil pollution. Soil microbes- Types and Microbial interaction. Biogeochemical cycles and their sedimentary- Carbon, nitrogen, oxygen, hydrogen, phosphorous, #sulfur and iron#.

UNIT II

18 hours

Recycling of Liquid and Solid wastes: Characterisation and types of liquid waste management and treatment- Primary, Secondary treatment and Tertiary treatment. Characterization and types of solid waste-solid waste management and treatment- Silage, Pyrolysis and saccharification. #Composting and Biogas process and production#. Bioconversion of solid waste and utilization as fertilizer.

UNIT III

18 hours

Environmental Applications: Deterioration of paper, leather, woods, textiles and pharmaceutical products. Bioremediation, Biomagnification and Bioaccumulation. Bio degradation of complex polymers - cellulose, hemicelluloses, and lignin. Microbial leaching-copper and uranium. Xenobiotics degradation- Heavy metals, Radionuclides, #Recalcitrants and Halogenated compounds#. Application of GIS and RS techniques in environmental monitoring.

UNIT IV

18 hours

Diazotrophs: Ecology of diazotrophs. Biological fixation of nitrogen, Nitrogen fixation sites, symbiotic and nonsymbiotic nitrogen fixation. Mechanism of biological nitrogen fixation. Nitrogenase enzyme complex - azoferredoxin and molybdo ferredoxin. Physiological electron donors and mechanism of nitrogen reduction, #regulation of nitrogenase enzyme#. Nif genes and its regulation. Role of hydrogenase enzyme in nitrogen fixation.

UNIT V

18 hours

Bioinoculants: Biofertilizers: Characteristics, Production and application of Rhizobium, Azotobacter, Azospirillum, Phosphate solubilizing and mobilizing bacteria #Blue green algae#, Azolla and Mycorrhizae. Formulation of biofertilizer. Biopesticides- types, mechanism and application of Bacterial, Fungal and Viral insecticides.

##Self-study portion.

Text Books:**T.B-1** K.Vijaya Ramesh, Environmental Microbiology, MJP Publishers, 2004.**T.B-2** P.Rajendran, Microbial Bioremediation, MJP Publishers, 2006.**UNIT I** Chapter V **T.B-2****UNIT II** Chapter V **T.B-2****UNIT III** Chapter VI **T.B-1****UNIT IV** Chapter III,V **T.B-1****UNIT V** Chapter VII **T.B-2****Books for Reference:**

1. C.F. Forster, Biotechnology and Wastewater Treatment, Cambridge University Press, Cambridge, 1985.
2. W.D. Grant and P.L. Long, Environmental Microbiology, Blackie Glasgow, London, 1981.
3. N.F.Gray, Biology of waste water Treatment, Oxford University Press Oxford, 1989.
4. M.K. Rai, Handbook of Microbial biofertilizers, Food Products Press, New York, 2005.
5. M. Gareth, Evans and J.C. Furlong, Environmental Biotechnology Theory and Application, John Wiley and sons Ltd, 2003.

Web Source1.<http://www.futuredirections.org.au/publication/living-soils-role-microorganisms-soil-health/>2. <https://courses.lumenlearning.com/trident-boundless-microbiology/chapter/microbial-bioremediation/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
II	20PMB2CC7	ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY					6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓		✓	
CO3		✓	✓	✓	✓		✓	✓	✓	✓	
CO4	✓	✓	✓			✓	✓	✓			
CO5	✓	✓	✓		✓	✓	✓	✓		✓	
Number of Matches= 38, Relationship : High											

Prepared by:

1. Dr.H.Vajiha Banu

Checked by:

1. Dr.M.Mohamed Mahroop Raja

2. Dr.A.Khaleel Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
II	20PMB2CC8P	Core – VIII	MICROBIAL GENETICS AND MOLECULAR BIOLOGY, GENETIC ENGINEERING, ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY - PRACTICAL	6	4	100	20	80

Course Outcomes

At the end of the course, students will be able to

1. Examine the isolation and characterization of plasmid and chromosomal DNA.
2. Demonstrate the principle and characterization of SDS PAGE.
3. Analyze the amplification of DNA by PCR.
4. Compare the estimation of BOD and COD in polluted water.
5. Identify the indicator organism and cellulase producing microorganism.

List of Practicals

MICROBIAL GENETICS AND MOLECULAR BIOLOGY, GENETIC ENGINEERING

1. Scoring of mutants through physical agents.
2. Isolation and Characterization of chromosomal DNA.
3. Isolation and Characterization of plasmid DNA.
4. Restriction digestion of DNA
5. Principle and separation of protein gel electrophoresis (SDS PAGE).
6. Isolation of Protoplast and Spheroplast.
7. DNA amplification- PCR analysis.

ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

1. Determination of BOD of polluted / pond water.
2. Determination of COD of polluted / pond water.
3. Assessment of water quality by MPN technique.
4. Isolation of cellulase producing microbes from soil.
5. Algae as indicators of water pollution.

Practical manual

1. T.A. Brown, Essential Molecular Biology - A Practical approach, Oxford University Press, Oxford, 1991.
2. K.R. Aneja, Experiments in Microbiology, Plant pathology and Biochemistry, 4th edition, New age International publishers, India, 2003.
3. Cappuccino and G. James, Microbiology a laboratory manual, 4th edition, Addison Wesley Publishing Company Inc. California, 1996.
4. J. Jayaraman, Laboratory Manual in Biochemistry, 2nd edition, New age publication, 2011
5. R.M. Atlas and R. Bortha, Microbial Ecology Fundamentals and Application, 4th edition, LPE Pearson Education, Inc, 2005.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
II	20PMB2CC8	MICROBIAL GENETICS AND MOLECULAR BIOLOGY, GENETIC ENGINEERING, ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY PRACTICAL					6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3			✓	✓	✓			✓	✓	✓	
CO4	✓		✓		✓	✓		✓		✓	
CO5	✓		✓	✓	✓	✓		✓	✓	✓	
Number of Matches= 36, Relationship : High											

Prepared by:
1. Dr.N.Reehana

Checked by:
1. Dr.M.Mohamed Mahroop Raja
2. Dr.A.Khaleel Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
II	20PMB2DE2A	DSE – II	MICROBIAL ECOLOGY	6	4	100	25	75

Course Outcomes

At the end of the course, students will be able to

1. Describe the distribution and association of microorganisms in microbial environment.
2. Acquire the knowledge of aerobic atmosphere, air sampling devices and airborne diseases.
3. Analyze the various techniques used to treat aquatic microbes.
4. Demonstrate the microbiological examination of water and indicator organism.
5. Acquire the knowledge of genetic population and genetic variation of microbial ecology.

UNIT I

18 hours

Microbial environment: Distribution and communities of microbial environment- Factors influencing the microbial density in soil- zymogenous and autochthonous flora in soil- Microbial associations- symbiotic proto cooperation, Ammensalism, Commensalism, Syntropism, Parasitism and Predation with suitable examples. Methods of studying microbial ecosystem. #Biological equilibrium#. Meaning of succession: Tolerance and inhibition patterns of succession, theories of succession.

UNIT II

18 hours

Aero Microbiology: Stratification of atmosphere. Microbial contamination of air- Sources of contamination-Biological indicators of air pollution. Droplet and Droplet Nuclei. Enumeration of bacteria from air, air sampling devices. Significance of air microflora, Outline of airborne diseases (Bacterial - Whooping cough, Diphtheria, Pneumonia; Fungal- Aspergillosis, Cryptococcosis; Viral- Chickenpox, Influenza, Measles). #Air sanitation#.

UNIT III

18 hours

Aquatic Microbiology: Fresh and marine water zone. Microbial ecology of lakes, ponds, rivers, stream, ground water wetland, Factors affecting the microbial population. Techniques for the study of aquatic microbes. Eutrophication- #factors controlling eutrophication#. Water treatment: preliminary- aeration, sedimentation, coagulation and flocculation. Filtration- rapid and slow sand filters and Microfilters.

UNIT IV

18 hours

Microbiology of potable water: Water quality measures: guideline, methods, identification and validation. Bacteriological techniques for the examination of water- MPN index. Indicators of faecal pollution. Waterborne disease: Enteric bacteria (indicators and pathogens) Opportunistic pathogens: *Legionella*, *Vibrio* and *Staphylococcus*. Viruses: *Polio*, *adenovirus*, and *Rotavirus*. Protozoa: *Giardia*, *Cryptosporidium* and #*Toxoplasma*#. Pathogens source tracking and disinfection.

UNIT V

18 hours

Ecology and Genetics: Genetic structure of population:-Genotype frequency, allele frequencies. Hardy-Weinberg Law: Assumptions, predictions, derivation, extension and natural selection. Measuring genetic variation at protein level, measuring genetic variation at DNA level. #Factors effecting gene frequencies#: Mutation, Random genetic drift, migration, Hardy-Weinberg natural selection, Assortative mating and Inbreeding.

##Self-study portion.

Text Books:

T.B-1 N. S. Subrahmanyam and A. V. S. S. Sambamurthy, Ecology, Narosa Publishing House, 2000.

T.B-2 H. D. Kumar, General Ecology, Vikas Publishing House, 1995.

T.B-3 P. K. Gupta, Genetics, Rastogi publications, 2001.

T.B-4 M. Ahamed, S. K. Basumatary, Applied Microbiology, MJP Publishers, 2006.

UNIT I	Chapter I, XVI	T.B- 1
UNIT II	Chapter XI	T.B- 2
UNIT III	Chapter XXIII	T.B- 2
UNIT IV	Chapter XIV, XXI - XXIII	T.B- 3
UNIT V	Chapter VII	T.B- 4

Books for Reference:

1. G. Reiheimer, Aquatic Microbiology, 4th edition, John Wiley & Sons Inc. 1991.
2. W.D. Grant and P.L. Long, Environmental Microbiology, Blackie Glasgow, London, 1981.
3. R. Campbell, Microbial Ecology, 2nd edition, Blackwell publication, 1983.

Web Source

1. <https://www.onlinebiologynotes.com/microbial-ecology-and-role-of-microorganism-in-ecosystem/>
2. <https://www.studocu.com/en/document/university-of-nevada-reno/intro-to-microbiology/lecture-notes/study-ch-21-microbial-ecology/1063573/view>
3. https://www.soinc.org/sites/default/files/uploaded_files/4_17_microbes_and_ecology.pdf

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits				
II	20PMB2DE2A	MICROBIAL ECOLOGY					6	4				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓			✓	✓	✓			✓	✓		
CO2	✓	✓		✓	✓	✓	✓		✓	✓		
CO3		✓		✓	✓		✓		✓	✓		
CO4		✓	✓	✓	✓		✓	✓	✓	✓		
CO5	✓	✓		✓		✓	✓		✓			
Number of Matches= 34, Relationship : Moderate												

Prepared by:

1. Dr.N.Reehana

Checked by:

1. Dr.M.Mohamed Mahroop Raja
2. Dr.A.Khaleel Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
II	20PMB2DE2B	DSE – II	BIOREMEDIATION AND WASTE MANAGEMENT	6	4	100	25	75

Course Outcomes

At the end of the course, students will be able to

1. Analyse various wastes and associated risks on environment.
2. Apply the knowledge on recycling and disposal of wastes.
3. Examine the types of soil treatment and methods of aerobic bioremediation.
4. Identify the process of anaerobic bioremediation.
5. Assess the methods of radioactive and hazardous wastes.

UNIT I

18 hours

Waste Classification and Quantification: Solid waste management and disposal: Sources and generation of solid waste- characterization, composition and classification. Hazardous waste management: Cyanides, Dioxins, Detergents, Plastics, Nylon and Paper. #Waste minimization approaches – Monitoring and management strategies#.

UNIT II

18 hours

Recycling of Wastes: Types- sources- composition of waste- recycling of waste for Industrial, Agricultural and Domestic Purposes; Recycling of Metals, Reuse, recovery and reduction of paper and plastics; Recycling in Food Manufacturing, Beverages, Apparel, Leather, Paper, Pulp, Chemical and other industries; Fly Ash utilization. #Waste Disposal Methods- composting, incineration, pyrolysis, medical waste disposal strategies#.

UNIT III

18 hours

Aerobic Bioremediation: Bioremediation of surface soils: Fate and transport of contaminants in the Vadose zone- #Biodegradation in soil ecosystems#- Types of soil treatment systems- Bioreactors. Subsurface Aerobic Bioremediation: Selection of bioremediation system- *in situ* Bioremediation- *in situ* Bioventing- *in situ* treatment of Harbour Sediments- *in situ* Lagoon treatment.

UNIT IV

18 hours

Anoxic/Anaerobic Bioremediation: Anoxic/Anaerobic Environment - Potential anaerobic Bioremediation – Anoxic/Anaerobic Processes – Fermentation, Degradation of Polycyclic Aromatic Hydrocarbons (PAH), Heterocyclic Compounds and Cyanide Remediation. Factors affecting bioremediation – Bench Scale and Pilot Scale studies – *in situ* Bioreactor treatment of sediments – #*in situ* Bioremediation of contaminated lagoon sediment#.

UNIT V

18 hours

Radioactive Waste: Sources, half life of radioactive elements, modes of decay. Effects on Plants, Animal and Man. Low and High-level Radioactive Waste Management – Waste Minimization and Treatment. Radiation standards. Legislation, Regulation and Policy - Current Regulations and programs of interest – #Hazardous Waste Management Act#.

##Self-study portion.

Text Books:

- T.B-1 K. Vijaya Ramesh, Environmental Microbiology, MJP Publishers, 2004.
T.B-2 P. Rajendran, Microbial Bioremediation, MJP Publishers, 2006.

UNIT I	Chapter VII	T.B- 2
UNIT II	Chapter V	T.B- 2
UNIT III	Chapter VI	T.B- 2
UNIT IV	Chapter III,V	T.B- 1
UNIT V	Chapter VII	T.B- 1

Books for Reference:

1. M.D. LaGrega, P.L. Buckingham and J.C. Evans, Hazardous Waste Management, IInd edition, McGraw Hill, 2001.
2. T. Leisinger, A.M. Cook, R. Hutter and J. Nuesch , Microbial Degradation of Xenobiotics and Recalcitrant Compounds, Academic Press, London, 1981.

Web Source

1. <http://www.yourarticlelibrary.com/waste-management/solid-waste-management-types-sources-effects-and-methods-of-solid-waste-management/9949>
2. <http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Nuclear-Wastes/Radioactive-Waste-Management/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
II	20PMB2DE2B	BIOREMEDIATION AND WASTE MANAGEMENT					6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓		✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3	✓	✓		✓	✓	✓	✓		✓	✓	
CO4	✓	✓	✓		✓	✓	✓	✓		✓	
CO5		✓		✓			✓		✓		
Number of Matches= 36, Relationship : High											

Prepared by:

1. Dr.M.Mohamed Mahroop Raja

Checked by:

1. Dr.N.Reehana
2. Dr.A.Khaleel Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External marks
III	20PMB3CC9	Core – IX	MEDICAL MICROBIOLOGY	6	5	100	25	75

Course Outcomes

At the end of this course, students will be able to

1. Introspect the knowledge on infectious diseases and its mode of transmission to various stages of infectivity.
2. Identify the study of pathogenic bacteria and its significant factors for causing diseases.
3. Examine the knowledge on medically important fungi and its diagnosis methods.
4. Determine the disease pathogenesis, lab diagnosis, prophylaxis, control of viral diseases.
5. Report the life cycle of protozoan diseases.

UNIT I

18 hours

Pathological patterns of Medical Microbiology: Mile stones in medical Microbiology- Microbial flora of the human body- #Factors responsible for Microbial pathogen# – Host-parasite relationship, Infectious disease process-modes of transmission, factors predisposing to microbial pathogenicity, stages, pathological patterns, virulence, virulence factor, toxin production and infectivity.

UNIT II

18 hours

Bacteriology: Description of the infection, pathogenesis, laboratory diagnosis and prophylaxis of following diseases- Leptospirosis, *H. pyroli*, Pneumonia, Spotted and typhus fever, enteric fever, Meningitis, Diphtheria, Tuberculosis, Leprosy, Tetanus, Cholera infection and Syphilis. #Outline of Bacterial vaccines#.

UNIT III

18 hours

Mycology: Clinical features, laboratory diagnosis and prophylaxis of following infection: Superficial Mycoses: Ring worm, Candidosis and *Pityriasis versicolor*. Subcutaneous mycoses: Mycetoma, Chromoblastomycosis and Sporotrichosis. Systemic mycoses: Coccidioidomycosis, Histoplasmosis, Blastomycosis and Systemic candidosis. #Fungal keratitis and OHS#.

UNIT IV

18 hours

Virology: Description of the viral infections, Vectors, pathogenesis and laboratory diagnosis of following diseases- Reovirus, Hepatitis A, B and C, Haemophilus influenza, Epstein-Bar virus, Papilloma virus, Varicella Zoster virus, Alpha virus, Rubella virus, Retrovirus, SARS and Swine Flu, Dengue, Ebola, Corona and Zika virus. #Anti viral drugs and vaccines#.

UNIT V

18 hours

Parasitology: Description of the infections and sample collection. Life cycle, laboratory diagnosis and the treatment of following diseases- Plasmodium infection, *Wuchereria bancrofti*, *E. histolytica*, Leishmaniasis, Giardiasis, *A. lumbricoides* and #Hook worm#. # #Self-study portion.

Text Books:

T.B-1 D. Greenwood, R. Slack and J. Peutherer, Medical Microbiology, 15th edition, Church Hill Living stone Publication, 2012.

T.B-2 R. Anathanarayanan and C.K. Jayaram Paniker, Text book of Microbiology, 8th edition, University Press,Hyderabad, 2009.

T.B-3 S. Rajan, Medical Microbiology, MJP Publishers, 2017.

UNIT I Chapter I **T.B- 3**

UNIT II Chapter II **T.B- 3**

UNIT III Chapter IV **T.B- 3**

UNIT IV Chapter IV **T.B- 2**

UNIT V Chapter V **T.B- 1**

Books for Reference:

1. S.J. Flint, L.W.Enquist, R. Krung, V.R. Racaniello and A.M. Skalka, Principles of Virology, Molecular Biology, Pathogenesis and control, ASM Press, Washinton, 2000.
2. Jawetz, Melnick and Adelberg's, Medical Microbiology, 22nd edition, McGraw Hill Medical Publication division, 2001.
3. Subhas Chandra Parija. Text book of Medical Parasitology, 2nd edition, 2004.

Web Source

1. <https://www.healthgrades.com/right-care/infections-and-contagious-diseases/bacterial-diseases>
2. www.cdc.gov > fungal > diseases
3. <https://www.healthline.com/health/viral-diseases>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
III	20PMB3CC9		MEDICAL MICROBIOLOGY			6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓	✓		✓	✓	✓
CO2	✓		✓	✓		✓		✓	✓	
CO3	✓		✓	✓		✓		✓	✓	
CO4	✓		✓	✓		✓		✓	✓	
CO5	✓		✓	✓		✓		✓	✓	
Number of Matches= 32, Relationship : Moderate										

Prepared by:

1. Dr.M.Mohamed Mahroop Raja

Checked by:

1. Dr.N.Reehana
2. Dr.J.Sirajudeen

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External marks
III	20PMB3CC10	Core – X	IMMUNOLOGY AND IMMUNOTECHNOLOGY	6	5	100	25	75

Course Outcomes

At the end of this course, students will be able to

1. Acquire the knowledge on immune system and its biological mechanism that prevent diseases.
2. Determine the antigen and antibody reaction and its effect on the organisms.
3. Examine the immune reaction of B-cell, T-cell, cancer cell and autoimmunity
4. Analyze the hypersensitivity reaction with undesirable reactions produced by the normal immune system including allergies.
5. Apply the antigen and antibody interaction by using advance technology to generate large number of identical antibodies that stimulates an immune response.

UNIT I

18 hours

Physiology of Immune system: Properties of Immune system- Innate, adaptive and mucosal immunity. Haematopoiesis-T cell, B cells, NK cells, Monocytes, Macrophages, eosinophils, neutrophils, basophils, mast cell, dendritic cells. Lymphoid organs of immune system. Humoral and cell mediated immunity. Induction of immune response-Cytokines, lymphokines and chemokines.

UNIT II

18 hours

Principle of Antigens and Immunoglobulins: Antigens- properties and types. Haptens, adjuvants, Mitogen (superantigens). T dependent and independent antigens. Antigenic determinants. Immunogens and chemical nature. Immunoglobulins-structure, properties, types and subtypes. Monoclonal antibody: production and their applications. Complement- Classical, Alternate and Membrane attack pathways.

UNIT III

18 hours

Immune cell activation: B- cell activation, Differentiation and receptor. T cell- Generation, Activation, Differentiation and receptors. Clonal selection Theory and process. Tumor immunology. Cancer of the immune system#. Autoimmune disorders and Immunology of infectious diseases – Viral, Bacterial and protozoan and Immunodeficiencies.

UNIT IV

18 hours

Regulation of Immune response: MHC genome-Structure, types and function of HLA antigen. MHC antigen processing. History of organ Transplantation and types. HLA typing methods. Graft rejection mechanism. Graft disease (GVHD) and immunosuppressive drugs. Hypersensitivity reactions and types. Immune tolerance, suppression and Immunotherapy.

UNIT V

18hours

Immunological techniques: Antigen antibody interaction-Affinity, Avidity and epitope mapping. Theories of Ag-Ab interaction. *In vitro* immunological methods-Neutralization-VDRL and RPR test. Types and application of agglutination-Ascoli test, coombs test and widal test, precipitation-SRID, Ouchterlony, Immunoelectrophoresis- CCIE, RIE. Complement fixation direct and indirect, Viral neutralization test, Immunofluorescent antibody technique. ELISA, Radio immunoassays (RIA) and Flow cytometry#.

##Self-study portion.

Text Books:

T.B-1 I.Kannan, Immunology, MJP publications, 2007.

T.B-2 S.C.Rastogi, Elements of Immunology, 3rd edition, CBS Publishers & Distributors Pvt. Ltd, 2006.

UNIT I	Chapter II	T.B-1
UNIT II	Chapter IV	T.B-2
UNIT III	Chapter XIV	T.B-2
UNIT IV	Chapter XVI	T.B-2
UNIT V	Chapter XXV	T.B-1

Books for Reference:

1. I. M. Roit, Essential Immunology, Blackwell Scientific Publications, Oxford, 2017.
2. J. Kubly, Immunology, 4th edition, WH Freeman and Company, New York, 2013.
3. Richard M. Hyde, Immunology, 3rd edition, National Medical series, Williams and Wilkins, Harward Publishing company, 2005.

Web Source

1. <https://nptel.ac.in/courses/102103038/2>
2. <https://www.microbiologybook.org/mobile/m.immuno-4.htm>
3. https://www.amboss.com/us/knowledge/Hypersensitivity_reactions

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
III	20PMB3CC10		IMMUNOLOGY AND IMMUNOTECHNOLOGY			6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓		✓		✓	✓	
CO2	✓		✓	✓	✓	✓		✓	✓	✓
CO3	✓		✓	✓		✓		✓	✓	
CO4	✓		✓	✓		✓		✓	✓	
CO5	✓		✓	✓	✓	✓		✓	✓	✓
Number of Matches= 34, Relationship : Moderate										

Prepared by:

1. Dr.M.Mohamed Mahroop Raja

Checked by:

1. Dr.N.Reehana
2. Dr.J.Sirajudeen

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External marks
III	20PMB3CC11	Core – XI	BIOENERGETICS AND ENZYMOLOGY	6	4	100	25	75

Course Outcomes

At the end of this course, students will be able to

1. Describe the knowledge on energy level.
2. Acquire the knowledge idea about energy transfer and its synthesis.
3. Determine the basic idea of nomenclature, classification and assay of enzymes.
4. Demonstrate the mechanism of enzyme action.
5. Observe the enzyme kinetics and its velocity equations.

UNIT I

18 hours

Energy and Regulation: Introduction to thermodynamics-law of thermodynamics-relation between internal energy & enthalpy, heat capacity, free energy. The concept of Gibbs free Energy, exergonic and endergonic reactions, redox potential. #Spontaneous & non spontaneous reactions#. Gibbs-Helmholtz equation. Application of first and second law of thermodynamics to biological systems.

UNIT II

18 hours

Energy Conversions - Mitochondria: Chemical activity of mitochondria. Sequence of electron carriers and sites of oxidative phosphorylation, ATP generation, #heme and non- heme iron proteins#. Thermodynamic considerations, oxidation - reduction electrodes, standard electrode potential, redox couples, phosphate group transfer potential. Respiratory controls. Theories of oxidative phosphorylation, uncouplers and inhibitors of energy transfer.

UNIT III

18 hours

Enzymes and assay: Introduction to Enzymes- Concept of convergent and divergent evolution of enzymes. Nomenclature and classification of enzymes. #Specificity and active site- Lock & key model, Induced fit model#. Fundamentals of enzyme assay – enzyme Units, coupled kinetic assay, immobilized enzymes. Enzyme localization. Criteria of purity of enzymes. Monomeric and oligomeric enzymes- Monomeric enzymes; serine proteases, zymogen activation, multifunctional enzymes, oligomeric enzymes and multi- enzyme complexes.

UNIT IV

18 hours

Mechanism of Enzymes Action: Theories of mechanisms of enzyme action- Enzyme specificity- Active site- Study of Mechanism of enzyme reaction. Pathway of enzyme catalyzed reactions. Enzyme Kinetics. Mechanism of action of lysozyme, chymotrypsin and ribonuclease. #Enzyme inhibition# and regulation.

UNIT V

18 hours

Enzyme kinetics: Importance of enzyme kinetics, factors affecting rates of enzyme mediated reactions (pH, temperature, substrate concentration, enzyme concentration and reaction time). Derivation of Michaelis - Menton equation and its significance in enzyme kinetic studies. Lineweaver - Burke plot, Haldane-#Briggs relationship#.

Self-study portion.

Text Books:

T.B-1 S. Shanmugam and T. Sathiskumar, Enzyme Technology, International Pvt Ltd, 2009.

T.B-2 L.M. Prescott, J.P. Harley, D.A. Klein, Microbiology, WCB Mc Graw Hill, 2008.

T.B-3 S.M. Bhatt, Enzymology and Enzyme Technology. S. Chand Publication, 2011.

T.B-4 Malcolm Dixon and Edwin Clifford Webb. Enzymes. 3rd Edition Academic Press, New York.

T.B-5 L.Stryer, Biochemistry, 4th edition, W.H. Freeman and company, New York, 2002.

UNIT I	Chapter VI	T.B-1
UNIT II	Chapter X	T.B-2
UNIT III	Chapter III	T.B-3
UNIT IV	Chapter V	T.B-4
UNIT V	Chapter XIV	T.B-5

Books for Reference:

1. Athel Cornish Bowden, Principles of Enzyme Kinetics, Portland press, 2004.
2. M.F. Chaplin and C. Bucke, Enzyme Technology, Cambridge University press, 2007.

Web Source

1. [https://chem.libretexts.org/Bookshelves/Biological_Chemistry/Supplemental_Modules_\(Biological_Chemistry\)/Enzymes/Enzymatic_Kinetics/Enzyme_Assays](https://chem.libretexts.org/Bookshelves/Biological_Chemistry/Supplemental_Modules_(Biological_Chemistry)/Enzymes/Enzymatic_Kinetics/Enzyme_Assays)
2. https://www.inf.ed.ac.uk/teaching/courses/csb/CSB_lecture_enzyme_kinetics.pdf

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
III	20PMB3CC11		BIOENERGETICS AND ENZYMOLOGY			6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓			✓		✓			✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓
CO3	✓	✓		✓	✓	✓	✓		✓	✓
CO4	✓	✓		✓	✓	✓	✓		✓	✓
CO5	✓	✓		✓		✓	✓		✓	
Number of Matches= 34, Relationship : Moderate										

Prepared by:

1. Dr.M.Mohamed Mahroop Raja

Checked by:

1. Dr.N.Reehana
2. Dr.J.Sirajudeen

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External marks
III	20PMB3CC12P	Core – XII	MEDICAL MICROBIOLOGY, IMMUNOLOGY, BIOENERGETICS AND ENZYMOLOGY- PRACTICAL	6	4	100	20	80

Course Outcomes

At the end of this course, students will be able to

1. Observe the isolation and identification of pathogenic bacteria.
2. Determine the drug resistant and sensitive bacteria.
3. Analyze the antigen and antibody interaction.
4. Examine the enzyme assay.
5. Apply the knowledge on enzyme immobilization.

1. Isolation and identification of pathogenic bacteria from – pus and urine
2. Testing sensitivity of bacteria to antibiotics.
3. Assessing Minimum Inhibitory concentration
4. Germ tube test
5. KOH mount for fungal pathogen
6. Haemagglutination slide method- Blood grouping and Rh typing
7. Tube agglutination method-WIDAL test
8. Latex agglutination- ASO test for RA.
9. Double immunodiffusion- identity pattern
10. Purification of Immunoglobulins: Ammonium sulphate precipitaion.
11. Qualitative ELISA-hcG Test demonstration
12. Estimation of Alkaline phosphatase from patient's serum
13. Alkaline protease Enzyme assay
14. Immobilization of enzyme by alginate beads

Practical manual

1. A.Balows, K.L. Hauser Jr, H.D. Isenberg, H.J. Shalomy, Manual of Clinical Microbiology, ASM, Washington, 2007.
2. James G. Cappuccino and N. Sherman, Microbiology: A Laboratory manual, 7th edition, Benjamin cummings publications, 2004.
3. P.Gerhardt, R.G. Murray, W.A. Wood and N.R. Kruz, Methods for General and Molecular Bacteriology, ASM, Washington, 2008.
4. Karen E. Messley, Microbiology Lab manual, 2nd Edition, Benjamin cummings Publisher, 2003.
5. V. Lorian, Antibiotics in laboratory medicine, 3rd edition, Williams and Wilkins, Baltimore, 2011.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
III	20PMB3CC12P	MEDICAL MICROBIOLOGY, IMMUNOLOGY, BIOENERGETICS AND ENZYMOLGY- PRACTICAL					6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓	✓	✓	✓		
CO2	✓	✓	✓	✓		✓	✓	✓	✓		
CO3	✓	✓	✓	✓		✓	✓	✓	✓		
CO4	✓		✓	✓		✓		✓	✓		
CO5			✓	✓				✓	✓		
Number of Matches= 34, Relationship : Moderate											

Prepared by:

1. Dr.M.Mohamed Mahroop Raja

Checked by:

1. Dr.N.Reehana
2. Dr.J.Sirajudeen

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External marks
III	20PMB3DE3 A	DSC – III	BIOINSTRUMENTATION AND BIOETHICS	6	4	100	25	75

Course Outcomes

At the end of this course, students will be able to

1. Acquire the knowledge on analytical techniques.
2. Apply the principles of equipment used in biological and medical field
3. Design the ethical aspects related to the biological research.
4. Introspect the knowledge on biosafety and risk assessment of products.
5. Observe the basic idea about IPR Policy and patent regulations.

UNIT I

18 hours

Cell analysis: Principles and Applications of Light, Phase Contrast, Fluorescence Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Confocal Microscopy. Structural analysis of Biomolecules: UV-Visible, IR, NMR, LASER Raman Spectroscopy, Mass Spectroscopy, #Fluorescence Spectroscopy#.

UNIT II

18 hours

Separation Techniques: Filtration: Methods, filter media, filter aid, ultrafiltration. Industrial filter- dead end filter, cross flow filter, rotary vacuum filter and frame filter. Centrifugation: Principle, methodology and application of Analytical, Differential and Density gradient centrifugation. Chromatographic Techniques -Theory and application of Gel filtration, Ion-exchange, #Gas and HPLC#. Electrophoresis- AGE, PFGE, isoelectric point and focusing, Capillary electrophoresis, mobility shift electrophoresis and Native PAGE, SDS-PAGE and Two dimensional PAGE.

UNIT III

18 hours

Ethics and Bioethics: Perspective of Ethics, Personal vs professional ethics: Moral Reasoning – Ethical theories Deontological, Utilitarianism – Ethical leadership (integrity and ingenuity) - framework for ethical decision making- Michael Macdonald model. #Ethical concerns of biotechnology research and innovation and Bioethics committees#.

UNIT IV

18 hours

Biosafety: GLP - Containment facilities – #Bio safety levels#- Genetically modified organisms and its release - Genetically modified foods. Biological Safety Cabinets, Primary Containment for Biohazards. Biosafety issues in biotechnology – risk assessment and risk management.

UNIT V

18 hours

Patent system – Types, patents, copy rights, trade marks, design rights, geographical indications – importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – #World intellectual property rights organization (WIPO)#.

Self-study portion.

Text Books:

T.B-1 L. Veerakumari, Bioinstrumentation, MJP Publishers, 2006.

T.B-2 N.Gurumani, Research Methodology for Biological Sciences, MJP publishing, Chennai, 2006.

T.B-3 Rajmohan Joshi, Biosafety and Bioethics, Isha Books, New Delhi, 2006.

T.B-4 R.C. Dubey and D.K. Maheshwari, Text book of Biotechnology, S. Chand Publishing, 2014.

UNIT I	Chapter III, XI	T.B-1,2
UNIT II	Chapter V, IX & X	T.B-1
UNIT III	Chapter IV	T.B-3
UNIT IV	Chapter VII	T.B-3
UNIT V	Chapter XXVI	T.B-4

Books for Reference:

1. A.Sasson, Biotechnologies in developing countries present and future, UNESCO publishers, 2003.
2. K. Wilson and J. Walker, Principles and techniques of Practical Biochemistry, 5th edn. Cambridge university press, 2006
3. Tom L. Beauchamp., F. Childress, Principles of biomedical ethics, 8th Edition, Oxford Univerisity Press, 2019.

Web Source

1. <https://static.medicine.iupui.edu/divisions/neph/obrien/workshop2003/Transmitted%20Light%20Microscopy%20Lecture%20-%20Simon%20Atkinson%201.pdf>
2. <http://andrew.gibiansky.com/blog/genetics/technique-primers/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
III	20PMB 3DE3A		BIOINSTRUMENTATION AND BIOETHICS			6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓		✓	✓	✓	✓	
CO2	✓		✓	✓	✓	✓		✓	✓	✓
CO3	✓			✓	✓	✓			✓	✓
CO4		✓		✓	✓		✓		✓	✓
CO5	✓			✓	✓	✓			✓	✓
Number of Matches= 34, Relationship : Moderate										

Prepared by:

1. Dr.M.Mohamed Mahroop Raja

Checked by:

1. Dr.N.Reehana
2. Dr.J.Sirajudeen

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
III	20PMB 3DE3B	DSE – III	ENDOCRINOLOGY	6	4	100	25	75

Course Outcomes

At the end of this course, students will be able to

1. Acquire knowledge on the hormones and mechanism of hormone action.
2. Explain the principles and function of pituitary and thyroid glands.
3. Determine the hormone regulation and metabolism.
4. Describe the knowledge on hormonal control metabolism.
5. Examine the basic idea about reproductive growth and family planning system.

UNIT I

18 hours

Hormones: Definition, Classification, Biosynthesis and circulation in blood. #Mechanism of hormone action#. Mechanism of steroid hormone receptors – Mechanism of action of steroid hormone.

UNIT II

18 hours

Pituitary gland: Morphology, Thyrotropin releasing hormone (TRH), Gonadotropin releasing Hormone, Control of GH Secretion, Dopamine and control of prolactin secretion. Thyroid gland: Biosynthesis of Thyroid hormone, Iodine Trapping, Incorporation of Iodine, Mechanism of thyroid hormone action, #Control of thyroid function#.

Unit III

18 hours

Hormonal regulation of fuel metabolism: Body fuels – #Glucose#, Glycogen, Protein and fat. Overall regulation of blood glucose concentration (Short- term regulation, Long – term regulation).

UNIT IV

18 hours

Hormonal control of pregnancy and lactation : Puberty, Menstrual cycle – Menopause. Types and functions of placenta. Human Chorionic gonadotropin (HCG), Human chorionic Somatomammotropin (HCS), Corticotropin releasing hormone (CRH), Growth and development of mammary glands, #Milk Production#.

UNIT V

18 hours

Reproductive Health: Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; #Demographic terminologies used in family planning#.

##Self-study portion.

Text Books:

T.B-1 M.N Chatterjea and Rana shinde, Text Book of Medical Biochemistry, Jaypee publisher, 2007.

T.B-2 U.Sathyanarayana and U.Chakrapandi, Biochemistry, Elsevier publisher, 2013.

T.B-3 H. Maurice Goodman, Basic Medical Endocrinology, 4th Edition, Academic press, 2009.

T.B-4 Verma S. and Agarwal V.K. Chordate Embryology, S.Chand &Co., New Delhi, 2000.

UNIT I	Chapter XXXIII	T.B-1
UNIT II	Chapter XIX	T.B-2
UNIT III	Chapter XXXVI	T.B-2
UNIT IV	Chapter VII	T.B-3
UNIT V	Chapter XV	T.B-4

Books for Reference:

1. B.I. Balinsky, An Introduction to Embryology, Holt saunders, New York, 2009.

Web Source

1. <https://courses.lumenlearning.com/wm-biology2/chapter/hormonal-regulation-of-metabolism/>
2. <https://www.pearsonhighered.com/assets/samplechapter/0/1/3/4/0134169808>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits				
III	20PMB 3DE3B	ENDOCRINOLOGY					6	4				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓		✓	✓		✓		✓	✓			
CO2	✓		✓	✓		✓		✓	✓			
CO3			✓	✓				✓	✓			
CO4	✓		✓	✓	✓	✓		✓	✓	✓		
CO5	✓			✓	✓	✓			✓	✓		
Number of Matches= 30, Relationship : Moderate												

Prepared by:

1. Dr.N.Reehana

Checked by:

1. Dr.M.Mohamed Mahroop Raja
2. Dr.J.Sirajudeen

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
III	20PMB3EC1	EXTRA CREDIT-I	Online Course (MOOC)	-	1	-	-	-

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
IV	20PMB4CC13	Core – XIII	FERMENTATION TECHNOLOGY	6	5	100	25	75

Course Outcomes

At the end of this course, students will be able to

1. Acquire the knowledge on industrial fermentation processes and its scope.
2. Design the framework to establish a Bioreactor set up and Integrate upstream and Downstream processing after upscale execution.
3. Introspect the knowledge on media component preparation and formulation.
4. Determine the raw material and process of primary metabolites.
5. Analyze the product formation of secondary metabolites.

UNIT I

18 hours

General concept of industrial microbiology- History and scope of industrial microbiology. Isolation and screening of industrially important microorganism. Strain improvement. Types of industrial fermentation processes: Batch continuous, surface, submerged and #solid state fermentation#.

UNIT II

18 hours

Upstream and Downstream Processes – Bioreactor- hyper performance bioreactors, industrial bioreactors, fermentor types-mass and energy transfer in bioreactor, rheology, mass transfer and liquid mixing. Performance of standard bioreactors- temperature control-aeration and agitation system, sterilization, oxygen transfer. #Anaerobic fermentor -sampling methods#. Classification of fermentor-stirred aerated fermentor, tower fermentor, airlift fermentor and bubble cap fermentor. Downstream processing – precipitation – filtration, centrifugation, cell disruption and drying.

UNIT III

18 hours

Industrial Fermentation Process- Media components and formulation, crude media components, antifoam agents, precursors, inducer and inhibitors and buffering agents. Sterilization of media and raw materials. Maintenance of sterility at critical points during fermentation.# Inoculum preparation#.

UNIT IV

18 hours

Industrial production of primary metabolites - Raw material, organism and process involved in the alcohol production -Production of organic acids – Vinegar, Lactic acid, citric acid- Alcoholic beverages- Beer and #Wine production#.

UNIT V

18 hours

Industrial production of secondary metabolites- Production of antibiotics- Penicillin and Streptomycin, amino acid – L- Glutamic acid and L- Lysine. Enzymes– Amylase, Pectinase and Protease. Vitamins – Cyanocobalamine and #Riboflavin#.

##Self-study portion.

Text Books:

T.B-1 L.E. Casida, Industrial Microbiology, Wiley Eastern Limited, New Delhi, 2007.

T.B-2 L.M. Prescott, J.P. Harley, D.A. Klein, Microbiology, WCB Mc Graw Hill, 2008.

T.B-3 E.M.T.El-Mansi, C.F.A. Bryce, A.L. Demain, A.R. Allman, Fermentation Microbiology and Biotechnology, 2008.

T.B-4 W.Crueger, A.Crueger, Thomas D. Brock. Biotechnology: A Textbook of Industrial Microbiology, 2011.

UNIT I	Chapter I	T.B-2
UNIT II	Chapter II	T.B-3
UNIT III	Chapter III,XIX	T.B-1,2
UNIT IV	Chapter IV	T.B-3
UNIT V	Chapter IV,XVI	T.B-3,4

Books for Reference:

1. S. Baumberg, I.S. Hunter and P.M. Rhodes, Microbial Products- New approaches, Cambridge Univ. Press, 2001.
2. S.C. Prescott, and C.C. Dunn, Industrial Microbiology, Tata McGraw-Hill Publishing Company limited, New Delhi, 2001.
3. B. Sikyta, Methods in Industrial Microbiology, Ellis Horwood Limited, 1993.
4. P.F. Stanbury, A. Whitaker and S.J. Hall, Principles of Fermentation Technology, 7th edition, Elsevier Science limited Aditya Books Private Limited, New Delhi, 2001.

Web Source

1. <http://www.biologydiscussion.com/biotechnology/bioprocess-technology/bioreactors-types-6-types-of-bioreactors-used-in-bioprocess-technology/10090>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits				
IV	20PMB4CC13		FERMENTATION TECHNOLOGY			6	5				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓	✓	✓	✓		
CO2	✓	✓		✓		✓	✓		✓		
CO3		✓	✓	✓			✓	✓	✓		
CO4		✓		✓	✓		✓		✓	✓	
CO5		✓		✓	✓		✓		✓	✓	
Number of Matches= 32, Relationship : Moderate											

Prepared by:

1. Dr.N.Reehana

Checked by:

1. Dr.M.Mohamed Mahroop Raja
2. Dr.J.Sirajudeen

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
IV	20PMB4CC14	Core – XIV	FOOD AND DAIRY MICROBIOLOGY	6	5	100	25	75

Course Outcomes:

At the end of this course, students will be able to

1. Apply the various preservative on the food product.
2. Describe the types of spoilage on the food material.
3. Examine the knowledge on food borne infection and intoxication.
4. Acquire the knowledge of fermented food production.
5. Identify the product nutritive value and its culture preservation.

UNIT I

18 hours

Food Microbiology: Microorganisms important in food microbiology- Molds, yeasts and Bacteria- General characteristics- classification and importance. Principles of food preservation- physical, chemical preservatives and food additives. Factors influencing Microbial growth in food- Extrinsic and #Intrinsic factors#.

UNIT II

18 hours

Food deterioration: Contamination and spoilage of Cereals, sugar products, vegetables, fruits, meat and meat products, milk and milk products- fish and fish products- #spoilage of canned foods#. Detection of spoilage and characterization.

UNIT III

18 hours

Food-borne pathogens: Bacterial and non bacterial- with examples of infective and toxic types- *Brucella*, *Bacillus*, *Clostridium*, *Salmonella*, *Escherichia*, *Shigella*, *Staphylococcus*, *Vibrio*, *Yersinia*, *Camphylobacter*, #Nematodes, Protozoa, algae, fungi and viruses#.

UNIT IV

18 hours

Industrial Food fermentations: Starter cultures and their biochemical activities, production and preservation of the following fermented foods- Soy sauce fermentation by Moulds - Fermented vegetables – #Sauerkraut# - Fermented Meat – Sausages -Production and application of SCP and Baker's products in food industry.

UNIT V

18 hours

Dairy Microbiology: Probiotics and Prebiotics use of *Lactobacilli*, #homo and heterolactic fermentations# and their therapeutic and nutritional value. Microbiology of fermented milk products -acidophilus milk, yoghurt and cheese. Preservation methods- periodic transfer, mineral oil slant, liquid nitrogen, lyophilization and other preservative methods.

##Self-study portion.

Text Books:

T.B-1 W.C. Frazier and D.C. Westhoff, Food microbiology, TATA McGraw Hill Publishing Company Ltd. New Delhi, 2004.

T.B-2 M.R. Adams and M.O. Moss, Food Microbiology, The Royal Society of Chemistry, Cambridge, 2007.

T.B-3 Neelima Rajvaidya, Dilip Kumar Markandey, Industrial applications of Microbiology, APH Publishing Corporation, 2006.

UNIT I	Chapter I-III	T.B-1
UNIT II	Chapter II & V	T.B-1
UNIT III	Chapter XIII-XIX	T.B-1
UNIT IV	Chapter VII	T.B-2
UNIT V	Chapter V	T.B-3

Books for Reference:

1. G.J. Banwart, Basic food microbiology, Chapman & amp; Hall, New York., 2014.
2. J.T. Edward Harth, Apllied Dairy Microbiology, Marcel Deeker Inc. New York., 1998.

Web Source

1. <https://foodsafetyhelpline.com/what-are-the-different-methods-of-food-preservation/>
2. <https://www.fightbac.org/food-poisoning/foodborne-pathogens/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper					Hours	Credits		
IV	20PMB4CC14		FOOD AND DAIRY MICROBIOLOGY					6	5		
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓		✓	✓	
CO2		✓		✓	✓		✓		✓	✓	
CO3	✓		✓	✓		✓		✓	✓		
CO4		✓	✓	✓	✓		✓	✓	✓	✓	
CO5		✓	✓	✓	✓		✓	✓	✓	✓	
Number of Matches= 36, Relationship : High											

Prepared by:

1. Dr.N.Reehana

Checked by:

1. Dr.M.Mohamed Mahroop Raja

2. Dr.J.Sirajudeen

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
IV	20PMB4CC15	Core – XV	BIOINFORMATICS AND BIOSTATISTICS	6	5	100	25	75

Course Outcomes

At the end of this course, students will be able to

1. Describe the basic computer and its mode of operation.
2. Analyze the various sequence alignment with scoring matrix.
3. Acquire the knowledge on phylogenetic and protein structure prediction.
4. Determine the knowledge of basics of Biostatistics, data collection and classification methods.
5. Analyze the concept and methods of Correlation and Regression.

UNIT I

18 hours

Introduction to Bioinformatics - Definition, History, Web servers, computer systems, languages - machine, high level and assembly. Basics of computers –types, servers, operating systems, UNIX, Linux. Internet basics – internet connection, web browsing and URL. #Finding scientific articles – Pubmed#. Biological databases NCBI, EMBL, DDBJ and Protein Data Bank- Swiss- prot, PIR, SCOP and CATH.

UNIT II

18 hours

Sequence Alignments: Pairwise alignment – local, global, dotplot and dynamic programming. Heuristic method- BLAST - blastn, blastp, blastx PSI, PHI and FASTA. Sequence alignment Score – E-Value and P-Value. #Scoring Matrix- BLOSUM, PAM and GAP PENALITY#. Multiple sequence alignment-Progressive, Iterative and block based alignment-Clustalw2.

UNIT III

18 hours

Phylogenetic and Protein analysis: Phylogenetic tree – Phenetics, Cladistics- rooted, unrooted and Bifurcating. Phylogenetic analysis – Neighbor –Joining, Maximum parsimony, minimum likelihood and #UPGMA#. Protein analysis- secondary structure prediction – Chou and Fassman, GOR method. Protein tertiary structure Prediction- protein modeling and Abinitio. Visualization of protein structure- RASMOL and SWISS PDB.

UNIT IV

18 hours

Introduction to Biostatistics: Basic definitions and applications – Population and sample – Variables – Collection and presentation of data – Descriptive statistics - Measures of Central tendency – #Mean# (arithmetic, harmonic and geometric) Median and Mode – Measures of dispersion – range, mean deviation, variance and standard deviation.

UNIT V

18 hours

Measures of Central Tendency: Inferential statistics – Probability and distributions – Poisson, Binomial and Normal distribution – Chi-square test – Hypothesis test - Student's t-test – Correlation and Regression – #ANOVA#.

Self-study portion.

Text Books:

T.B-1 J.Ramsden, Bioinformatics an introduction, Springer Publisher, 2006.

T.B-2 Jin Xiong, Essential Bioinformatics, 1st edition, Cambridge University Press, 2006.

T.B-3 R. Singh and R. Sharma. Bioinformatics: Basics, algorithms and applications, Universities Press, (India) Pvt. Ltd, Hyderabad, India, 2010.

T.B-4 K.L.A.P. Sharma, B.Ravindra reddy, T. Pullaiah, Daya Publishing house, 2013.

UNIT I	Chapter I	T.B-1
UNIT II	Chapter II, IV, XI	T.B-2
UNIT III	Chapter XIII	T.B-2, 3
UNIT IV	Chapter I, IV-VIII	T.B-4
UNIT V	Chapter IX, X	T.B-4

Books for Reference:

1. D. Higgins and W. Taylor. Bioinformatics: Sequence, structure and databanks, Oxford University Press, 2002.
2. P. Banerjee, Introduction to Biostatistics, S. Chand and Company Ltd, 2007.
3. P.N. Arora and P.K. Malhon Biostatistics Himalaya Publishing House, Mumbai, 2008.

Web Source

1. www.bioinformaticssoftwareandtools.co.in.
2. www.bioinformaticsweb.net/datalink.html

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits				
IV	20PMB4CC15	BIOINFORMATICS AND BIOSTATISTICS					6	5				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓			✓	✓	✓			✓	✓		
CO2	✓		✓	✓	✓	✓		✓	✓	✓		
CO3	✓		✓	✓		✓		✓	✓			
CO4	✓			✓	✓	✓			✓	✓		
CO5	✓		✓	✓		✓		✓	✓			
Number of Matches= 32, Relationship : Moderate												

Prepared by:

1. Dr.N.Reehana

Checked by:

1. Dr.M.Mohamed Mahroop Raja
2. Dr.J.Sirajudeen

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
IV	20PMB4PW	PROJECT	PROJECT WORK	12	8	200	50	150

Course Outcomes

At the end of this course, students will be able to

1. Acquired the adequate knowledge on research skills and specialize in their field of interest.
2. Obtained the technical skills in terms of writing the reports and publishing the same reputed Journals.
3. Identify the national research institutes and Industries and if possible to have collaboration with such institutes and industries for their own research work.

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
IV	20PCNOC	Online Course (Compulsory)		-	1	-	-	-

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
IV	20PMB4EC2	Extra Credit - II	MICROBIOLOGY FOR CAREER EXAMINATIONS	-	5	100	-	100