Course Structure &Syllabus Choice Based Credit System (CBCS)

M.Sc Microbiology

Eligibility Criteria: Candidates who have passed a B.Sc degree in science with chemistry/ botany/ zoology/ biochemistry/ microbiology and biotechnology as core/cognate with 50 % aggregate for general students and 45 % for SC/ST/OBC/CAT-1 students in the subjects mentioned above are eligible for M.Sc Degree course in Microbiology.

Course Structure

I SEMSTER

Sl. No	Paper Code	Title of the Paper	Instruction Hours per Week	No. of credits	Duration of the Examination	Marks		
						Internal Assessment	Semester End Exam	Total Marks
1	CPT-1.1	Cell Biology and Microbial Systematics	4	4	3Hrs	20	80	100
2	CPT-1.2	Bacteriology and Virology (Including Techniques)	4	4	3Hrs	20	80	100
3	CPT-1.3	Microbial Biochemistry and Enzymology (Including Instruments)	4	4	3Hrs	20	80	100
4	SPT-1.4A	Mycology and Phycology	4	4	3Hrs	20	80	100
	SPT-1.4B	Protozoology and Parasitology	4	4	3Hrs	20	80	100
5	CPP-1.5	Practical based on CPT-1.1	4	2	3Hrs	10	40	50
6	CPP-1.6	Practical based on CPT-1.2	4	2	3Hrs	10	40	50
7	CPP-1.7	Practical based on CPT-1.3	4	2	3Hrs	10	40	50
8	SPP-1.8A	Practical based on SPT-1.4A	4	2	3Hrs	10	40	50
	SPP-1.8B	Practical based on SPT-1.4B	4	2	3Hrs	10	40	50
		Total	**32**	**24**		**120**	**480**	**600**

Note: CPT: Core paper Theory CPP: Core paper Practical

SPT: Special paper Theory SPP: Special Paper Practical

II SEMSTER

Sl. No	Paper Code	Title of the Paper	Instruction Hours per Week	No. of credits	Duration of the Examination	Marks		
						Internal Assessment	Semester End Exam	Total Marks
1	CPT-2.1	Microbial Physiology and Metabolism	4	4	3Hrs	20	80	100
2	CPT-2.2	Microbial Genetics	4	4	3Hrs	20	80	100
3	SPT-2.3A	Microbial Ecology and Environmental Microbiology	4	4	3Hrs	20	80	100
	SPT-2.3B	Microbial Diversity and Extremophiles	4	4	3Hrs	20	80	100
4	OEPT-2.4	*To be offered by other Departments of the faculty*	4	4	3Hrs	20	80	100
5	CPP-2.5	Practical based on CPT-2.1	4	2	3Hrs	10	40	50
6	CPP-2.6	Practical based on CPT-2.2	4	2	3Hrs	10	40	50
7	SPP-2.7A	Practical based on SPT-2.3A	4	2	3Hrs	10	40	50
	SPP-2.7B	Practical based on SPT-2.3B	4	2	3Hrs	10	40	50
8	OEPP-2.8	*To be offered by other Departments of the faculty*	4	2	3Hrs	10	40	50
		Total	32	24		120	480	600

Note: CPT: Core paper Theory CPP: Core paper Practical

SPT: Special paper Theory SPP: Special Paper Practical

OEPT: Open Elective paper theory OEPP: Open Elective paper Practical

III SEMSTER

Sl. No	Paper Code	Title of the Paper	Instruction Hours per Week	No. of credits	Duration of the Examination	Marks		
						Internal Assessment	Semester End Exam	Total Marks
1	CPT-3.1	Molecular Biology and Genetic Engineering	4	4	3Hrs	20	80	100
2	CPT-3.2	Immunology and Immunotechnology	4	4	3Hrs	20	80	100
3	SPT-3.3A	Agricultural Microbiology and Phytopathology	4	4	3Hrs	20	80	100
	SPT-3.3B	Bioinformatics and Biostatistics	4	4	3Hrs	20	80	100
4	OEPT-3.4	*To be offered by other Departments of the faculty*	4	4	3Hrs	20	80	100
5	CPP-3.5	Practical based on CPT-3.1	4	2	3Hrs	10	40	50
6	CPP-3.6	Practical based on CPT-3.2	4	2	3Hrs	10	40	50
7	SPP-3.7A	Practical based on SPT-3.3A	4	2	3Hrs	10	40	50
	SPP-3.7B	Practical based on SPT-3.3B	4	2	3Hrs	10	40	50
8	OEPP-3.8	*To be offered by other Departments of the faculty*	4	2	3Hrs	10	40	50
		Total	**32**	**24**		**120**	**480**	**600**

Note: CPT: Core paper Theory **CPP: Core paper Practical**
SPT: Special paper Theory **SPP: Special Paper Practical**
OEPT: Open Elective paper theory **OEPP: Open Elective paper Practical**

IV SEMSTER

Sl. No	Paper Code	Title of the Paper	Instruction Hours per Week	No. of credits	Duration of the Examination	Marks		
						Internal Assessment	Semester End Exam	Total Marks
1	CPT-4.1	Industrial Microbiology and Bioprocess Engineering (Including IPR)	4	4	3Hrs	20	80	100
2	CPT-4.2	Medical and Diagnostic Microbiology	4	4	3Hrs	20	80	100
3	SPT-4.3A	Food and Dairy Microbiology	4	4	3Hrs	20	80	100
	SPT-4.3B	Microbial Systems Biology	4	4	3Hrs	20	80	100
4	CPD-4.4	Core paper Dissertation	4	4	3Hrs	20	80	100
5	CPP-4.5	Practical based on CPT-4.1	4	2	3Hrs	10	40	50
6	CPP-4.6	Practical based on CPT-4.2	4	2	3Hrs	10	40	50
7	SPP-4.7A	Practical based on SPT-4.3A	4	2	3Hrs	10	40	50
	SPP-4.7B	Practical based on SPT-4.3B	4	2	3Hrs	10	40	50
8	CPPD-4.8	Practical Based on Core paper Dissertation	4	2	3Hrs	10	40	50
		Total	**32**	**24**		**120**	**480**	**600**

Note: CPT: Core paper Theory **CPP: Core paper Practical**

SPT: Special paper Theory **SPP: Special Paper Practical**

CPD: Core paper Dissertation **OEPP: Core paper Project Practicals**

SYLLABUS

Note: All the CPT/SPT/OEPT courses consists of four units each and each unit should be taught for a maximum of 16 hours.

I-SEMESTER

CPT 1.1 CELL BIOLOGY AND MICROBIAL SYSTEMATICS

Unit I **16 Hrs**

Morphology and ultra-structure of prokaryotic cell

Ultrastructure of prokaryotic cells: Ultrastructure of prokaryotic cells: Structure and functions of cell wall, flagella, cilia, pili, fimbriae, periplasmic space, gas vesicles, chlorosomes, carboxyomes, magnetosomes and phycoblisomes. Capsule structure, composition and properties. Cell wall-chemical composition and characteristics (Gram positive & gram-negative bacteria: lipoproteins, lipopolysaccharides, matrix proteins), function; plasma membrane (fluid mosaic model), function of cell membrane; Mesosomes, cytoplasm, ribosomes, -subunits and chemical composition; molecular chaperons, nucleoids,plasmids- types of plasmids, cytoplasmic inclusions, endospores and Exospores. Morphological types– Archeabacteria.

Unit II **16 Hrs**

Ultra structure and Organization of Eukaryotic Cell

Structural organization of: Cytoskeleton (structural proteins – microfilaments, actins, etc.); nucleus, Mitochondria and chloroplasts and their genetic organization, EndoplasmicReticulum, Golgi apparatus, Protein trafficking; Events in cell cycle, Regulation of cell cycle.

Unit III **16 Hrs**

Membrane Transport (Prokaryotes and Eukaryotes)

The composition and architecture of membranes, Membrane dynamics, Solute transport across membranes: Passive diffusion, active transport using P and F type ATPases, Ion mediated transport, transport of ions across membranes (ion pumps), co-transport, symport, antiport, endocytosis and exocytosis. Biochemical shuttles across mitochondrial membranes, Model membranes; Liposomes.

Unit IV **16 Hrs**

Microbial Systematics

Definition and systematics, nomenclature rules and identification, hierarchical organizationand the position of microbes in the living world classification systems – artificial and phylogenetic– dendogram. Haeckel's three-kingdom classification, Whittaker's five kingdom approach, Three domain classification of Carl Woese. Major characteristics used in taxonomy – morphological, physiological, metabolic, genetic and molecular characteristics, comparison of proteins, nucleic acid hybridization, nucleic acid sequence comparison, DNA and RNA homology, G+C ratio, significance of rRNA in microbial taxonomy, Numerical Taxonomy and Chemotaxonomy.

References:

1. Alberts Bruce (1985) *Molecular Biology of Cell.* Garland Pub.
2. Conn Eric, Stumpf Paul K., Bruuening George, Doi Roy H., (1987) *Outlines of Biochemistry Edition* , John Wieley and Sons, New Delhi.
3. De Robertis E. D. P. and De Robertis E. M. F. (1987), Cellular and Molecular Biology Leaand Febiger, Philadelphia.
4. Schlegel Hans G. (1995) General Microbiology, Edition 7, CUP, Cambridge.

CPT 1.2 BACTERIOLOGY AND VIROLOGY (INCLUDING TECHNIQUES)

Unit I **16 Hrs**

Characteristics and Salient features of major groups of Bacteria

Occurrence, shape and arrangement of bacterial cells, structure of bacterial cell – cell wall (Gram positive or Gram negative), capsule, plasma membrane, cytoplasm, ribosome, nucleoid, mesosomes, plasmids, flagella, pili (fimbriae), inclusion bodies, cell division and endospore formation. Characteristics of major groups of bacteria, Archaebacteria – general characteristics and classification; Eubacteria, Actinomycetes – general characteristics and classification, economic importance. Cyanobacteria – general characteristics and classification – ultra-structure, reproduction and economic importance. Mycoplasma, Rickettsia, Chlamydia, Photosynthetic bacteria and bioluminescent bacteria.

Unit II **16 Hrs**

Bacteriological Techniques

Microscopy: components of microscopes. Basic principles and types of Bright field, Dark field, Phase contrast, Fluorescence microscopes and their applications. Electron Microscopy – Principle, working and applications of Transmission Electron microscope (TEM) and Scanning Electron Microscope (SEM). Isolation and sampling techniques: General isolation and sampling techniques for microorganisms from different sources. Microbial culture media and its types: Microbial growth; growth curve, diauxic growth curve, Measurement of microbial growth-cell number by turbidity and biomass, influence of environmental factors on growth. Staining techniques: Principles, protocols and applications of staining techniques. Simple, differential and structural staining techniques. Sterilization: Detailed process of physical and chemical methods of sterilization. Nutrition: Nutritional requirements, nutritional types of microorganisms, growth factors, creb tree effect, uptake of nutrients by the microbial cell. Microbial culture preservation: Concept, types of microbial culture preservation. Microbial Safety measures: Concept, safety measures in handling microbiological samples and microorganisms.

Unit III **16 Hrs**

General Virology

Brief outline on discovery of viruses, Distinctive properties of viruses; Biological properties of viruses – host range, transmission-vector, non-vector; Physical properties of viruses – morphology, structure. Biochemical characteristics – chemical composition of viruses, proteins, nucleic acids, envelope, enzymes, lipids, carbohydrates, multiplication of viruses. Morphology & ultrastructure- Capsids and their arrangements - types of envelopes and their composition, their types and structures, ICTV nomenclature and classification of viruses. Major characteristics of different virus families- Viroid's and prions, Animal and Plant Viruses, bacteriophages.

Unit IV **16 Hrs**

Virological Techniques

Isolation and cultivation of viruses in embryonated eggs, experimental animals, and cell

cultures- Primary & secondary cell cultures and continues cell cultures. Assay of viruses – Principle, Procedure, merits and demerits. Physical assay- electron microscopy and Biological assay- Plaque Assay, Serological assay- ELISA, RIA, Western blot.

References:

1. Alan J.Cann (1997). Principles of Molecular virology. (2nd edition). Academic press, California.
2. Ann Giudici Fettner (1990). The Science of Viruses. Quill William Marrow, Newyork.
3. Conrat HF, Kimball PC and Levy JA. (1988). Virology. II edition. Prentice, Hall, Englewood Cliff, New Jersey. Dimmock NJ, Primrose SB. (1994) Introduction to Modern Virology IV edition. Blackwell Scientific Publications, Oxford
4. Flint, S.J., Enquist, L.W., Krung, R. Racaniello, VR. And Skalka, A.M. (2000). Principles of Virology, Molecular Biology, pathogenesis and control, ASM Press, Washinton D.C.

CPT 1.3 MICROBIAL BIOCHEMISTRY AND ENZYMOLOGY (INCLUDING INSTRUMENTATION)

Unit 1 **16 Hrs**

Bio molecules

Carbohydrates – General properties, structure, classification and functions. Lipids - Classification, structure, properties and functions. Proteins– Peptide synthesis: chemical and Merrifield synthesis. Primary (peptide conformation, N- and C- terminal, peptide cleavage), Secondary (α-helix, sheet, random coil, Ramachandran plot), Tertiary and Quaternary structures of proteins. Nucleic acids – DNA and RNA.

Unit II **16 Hrs**

Bioenergetics and Electron transport chain

Laws of thermodynamics, Concept of free energy, standard free energy to enthalpy, entropyand equilibrium constant, determination of ΔG for a reaction. Relationship between equilibrium constant and standard free energy change, biological standard state & standardfree energy change in coupled reactions. ATP as universal currency of free energy, Redox potentials. Oxidative phosphorylation: Mitochondria ultrastructure, Energy harnessing cascade from nutrients, Reducing equivalents, Electron transport and its carriers-Complex I, II, III, IV; Mitchell's Hypothesis—experimental verification, Determination of P:O ratio, ATP synthesis by F1-Fo ATP synthase. Bacteriorhodopsin: Photo cycle and significance.

Unit III **16 Hrs**

Enzymology

Introduction to enzymes; nomenclature and classification of enzymes; chemical nature and properties of enzymes, activation energy, factors affecting enzyme activities, active site, allosteric site, coenzymes and co factors. Types of enzyme specificity, units of enzymeactivity. Mechanism of enzyme action-lock and key model, induced fit hypothesis, substrate strain theory, Mechanism of enzyme catalysis - Acid-Base catalysis, Covalent catalysis, Chemical kinetics, Derivation of Michaelis-menton equation, km value and its significance, lineweaver-burk plot, Enzyme inhibition-reversible and irreversible. Regulation of enzyme activity. Allosteric enzymes. Isozymes.

Unit IV **16 Hrs**

Instrumentation

Principles and applications of Chromatography (TLC, Column Chromatography, Ion exchange Chromatography, Affinity Chromatography, Gas Chromatography, HPLC). Electrophoresis: Agarose gel Electrophoresis and SDS-PAGE. Spectroscopy: UV/Visible spectroscopy, Fluorescence spectroscopy, Infrared spectroscopy, NMR, ESR, Radiography: Autoradiography.

References:

1. Zubey, G. L (1996), Biochemistry, 4th edition, Wm. C. Brown publishers.
2. Stanier.R.Y., Ingrahm,J.L., Wheelis, M.L., Painter, R.R,.(1987) General Microbiology,5th edition,The Macmillan press Ltd
3. Conn , Stmpf, P. K., Bruening, G. R. H.(1987) Outlines of Biochemistry, 5th edition, JohnWiley & sons.
4. Gottschalk,G., (1985), Bacterial Metabolism, 2nd edition, Springer Verlag.
5. Nelson, D, Cox, M, (2005), Lehninger Principles of biochemistry,4th edition, W. Freeman and Company.

SPT 1.4 A- MYCOLOGY AND PHYCOLOGY

Unit I **16 Hrs**

Introduction to Mycology

History and development of Mycology, General characteristics, distribution andclassification of Fungi, Ultrastructure of fungal cells, Nutrition in Fungi, Reproduction of Fungi-vegetative, asexual and sexual, Fungal spore and Fruiting bodies, Interaction betweenfungi and other organisms.

Unit II **16 Hrs**

Fungal systematics

Occurrence, structure and Life cycle–Slime molds, Oomycetes, Chytridiomycetes, Zygomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes.

Unit III **16 Hrs**

Introduction to Phycology

History and development of phycology; General characters, distribution and classificationof algae. Reproduction in Algae. Morphology and ultrastructure of Cyanophycean cell. Differences between micro and macro algae. Symbiotic algae: Lichens, coral reef and sea sponges.

Unit IV **16 Hrs**

Economic importance of fungi and algae

Economic importance of fungi-Fungi in Agriculture, medicine, industry. Bioremediation (of wood, paper, textile, leather) in Fungi. Fungi as biocontrol agent. Mycorrhizae: Ecto Mycorrhizae, Endo Mycorrhizae, VAM. Mycotoxins, Quorum sensing in fungi. Economic importance of Algae- Algae in Agriculture, industry and food. Role of Algae in heavy metal removal, algal blooms and toxins. Role of Algae in water purification.

References:

1. Alexopoulos, C.J. and C.W. Mims 1979. Introduction to Mycology (3rd Ed.)Wiley Eastern Ltd.,New Del
2. Charlile M. & Watkinson S.C. The Fungi, Publisher: Academic Press.
3. E.Moore –Landeekeer: Fundamentals of the fungi, Publisher: Prentice Hall.
4. L. Barsanti, Paolo Gualtieri: Algae: anatomy, biochemistry, and biotechnology

5. Ayhan Demirbas, M. Fatih Demirbas: Algae Energy: Algae as a New Source of Biodiesel (2010)
6. Linda E. Graham, James Graham, James M. Graham: Algae (2009)
7. Burnett J.H., Publisher: Edward, Arnold Crane Russak: Fundamentals of Mycology.

SPT 1.4B - PROTOZOOLOGY AND PARASITOLOGY

Unit I **16 Hrs**

Salient features of protozoa

Classification, Reproduction and feeding in Protozoa and economic importance of protozoa.

Unit II **16 Hrs**

Flagellates

Giardia intestinalis, *Trichomonas vaginalis*) Ciliates (*Balantidium coli, Isospora belli, Cryptosporidium parvum*), Trypanosomes, *Leishmania, Plasmodium, Toxoplasma gondii.*

Unit III **16 Hrs**

Trematodes

General Characters, systematics and pathogenecity of Liverfluke (*Fasciolla hepatica*), Intestinal Fluke (*Fasciolopsis buski*), Lung flukes (*Paragonimus westermani*), Blood flukes (Schistosomes), Cestodes (General characters and classifications. Intestinal Tape worms (*Taeniasolium, Dipylidiumcaninum*), Extra- Intestinal Larval Cestodes (*Diphyllobothrium spp. Echinococcus spp*).

Unit IV **16 Hrs**

Nematodes

General Characters & Classifications, Intestinal Nematodes (*Ascaris lumbricoids*, *Trichinella spiralis*, Hook worms), Blood and tissue nematodes (*Wuchereria bancrofti, Dracunculus medinensis*), Partasites of insect origin (Flies & bugs, Fleas and lice) Arachnids (ticks and mites), Crustaceans (Cyclops)

References:

1.Anand N. Shukla and Rajiv Tyagi (2002) Protozoan diseases, Anmol publication New Delhi.
2.Burton J. Bogitsh (1998) Human Parasitology, Academic press. New York.
3.Leslie Collier., Albert Balows and Max Sussman (1998)Topleyamd Wilson's
4.Microbiology and microbial infections: Vol5: Parasitology, Arnoldspubl. NewYork,
5. Rathnaswamy GK (1974) A hand book of medical entomology and elementary parasitology,Publ: S.VishwanathPvt.Ltd.,

II Semester

CPT 2.1 MICROBIAL PHYSIOLOGY AND METABOLISM

Unit I **16 Hrs**

Microbial Nutrition

Classification of organisms based on carbon source, energy source and electron sources. Macro and micronutrients. Microbial photosynthesis: definition, photosynthetic apparatus in prokaryotes, photosynthetic pigment- PS1, PS2. Types of photosynthesis- oxygenic and anoxygenic photosynthesis, Mechanism of photosynthesis: Light dependent reaction- cyclic and noncyclic photophosphorylation, light independent reaction- Calvin cycle.

Unit II **16 Hrs**

Carbohydrate metabolism

Introduction to metabolism- Catabolism, Anabolism. Aerobic and anaerobic pathways: Glycolysis and its regulation, Glycogenesis, gluconeogenesis and its regulations; TCA cycle and its regulations, oxidative phosphorylation. Nitrogen Metabolism- Sources of nitrogen, Nitrogen fixation: Non symbiotic and symbiotic nitrogen fixation.

Unit III **16 Hrs**

Lipid Metabolism

Fatty acid oxidation (β oxidation), energetics of palmitic acid oxidation. Ketone bodies, ketogenesis. Utilization of ketone bodies, overproduction of ketone bodies (ketonemia, ketonuria and ketosis). Biosynthesis of long-chain fatty acids (palmitate). Synthesis of triacylglycerols, biosynthesis and degradation of cholesterol.

Unit IV **16 Hrs**

Fermentation reactions

Definition, physiological significance, types of fermentation, alcohol and lactic acidfermentation, homo and hetero-fermentation pathways, bifidum pathway.

References:

1. Zubey, G. L (1996), Biochemistry, 4th edition, Wm. C. Brown publishers.
2. Stanier.R.Y., Ingrahm,J.L., Wheelis, M.L., Painter, R.R,.(1987) General Microbiology,5thedition, The Macmillan press Ltd
3. Conn , Stmpf, P. K., Bruening, G. R. H.(1987) Outlines of Biochemistry, 5th edition,John Wiley & sons.

4. Gottschalk,G., (1985), Bacterial Metabolism, 2nd edition, Springer Verlag.
5. Nelson, D, Cox, M, (2005), Lehninger Principles of biochemistry,4th edition, W. H.Freemanand Company.

CPT 2.2. MICROBIAL GENETICS

Unit I **16 Hrs**

Principle of genetics.

Mendals Experiments and Principles of inheritance. DNA as genetic material, Experiments of Griffith; Avery, McCleod; Mc Carthy and Harshey Chase. RNA as genetic material- Experiment of Fraenkel and Singer. Structure of nucleic acids- DNA structure and types, RNA types and structure, Extrachromosomal genetic elements – Plasmids and transposons, Ribozymes.

Unit II **16 Hrs**

Replication, Transcription and translation

DNA Replication: Meselson and Stahl Experiment. DNA Replication in prokaryotes and eukaryotes. Transcription in prokaryotes and eukaryotes. RNA processing – nuclear splicing, rRNA and tRNA processing, Translation in prokaryotes and eukaryotes, post-translational modification, Genetic code.

Unit-III **16 Hrs**

Gene transfer

Genetic transfer in bacteria: Transformation, Transduction, and Conjugation, Transposable elements: Transposable elements in prokaryotes – IS, Transposons, Mechanism of Transposition in Prokaryotes, Transposable elements in eukaryote, Retro-transposons and Retroposons.

Unit-IV **16 Hrs**

Mutations

Mutations: Introduction and Types of Gene mutations - Base substitution (Transition and transversion), Frame shift mutation, insertion, deletion, missense, nonsense, reverse, suppressor and lethal mutations). Pleiotropy- definition and examples. Mutagens – Physical (ionizing and non- ionizing radiations) and chemical (Base analogs, Alkylating agents, Acridine dyes, Deaminating agents, Hydroxylating agents, Tobacco carcinogens); Oncogenic Viruses. DNA Repair Mechanism: Excision Mechanism – Nucleotide, Base, Post Replication, DNA Repair mechanism and its types.

References:

1. Snyder L. and Chapness W. Molecular Genetics of Bacteria 2007.
2. Birge EA. 1981. Bacterial and Bacteriophage Genetics. Springer Verlag.
3. Gardner JE, Simmons MJ & Snustad DP. 1991. Principles of Genetics. JohnWiley& Sons.
4. Lewin B.1999. Gene. Vols. VI, IX. John Wiley & Sons.
5. Maloy A &Friedfelder D. 1994.Microbial Genetics.Narosa.
6. Scaife J, Leach D &Galizzi A 1985. Genetics of Bacteria. Academic Press.
7. William Hayes 1981. Genetics of Bacteria.Academic Press.

SPT 2.3 A -MICROBIAL ECOLOGY AND ENVIRONMENTAL MICROBIOLOGY

Unit I **16 Hrs**

Introduction to Microbial Ecology

Evolution of Life on Earth; History and scope of ecology, Concept of autecology, synecology, population, community, biome. Ecological succession. Microorganism in aquatic Environment: major physical and chemical factors (light, temperature, gases, nutrients). Biogeochemical cycles of Carbon, Nitrogen, Phosphorous and Sulphur.

Unit II **16 Hrs**

Aquatic Microbiology

Distribution of microorganisms in Fresh and Marine ecosystems (estuaries, mangroves, deep sea, hydrothermal vents, salt pans, coral reefs). Zonation of water ecosystem. Effect of aquatic microorganisms on ecosystem. Potability of water: Microbial assessment of water. Water purification or water treatment plants.

Unit III **16 Hrs**

Aerobiology

Air Microflora in different layers of atmosphere, Bioaerosol, Assessment of air quality using principles of sedimentation, impaction, impingement, suction and filtration. Air pollutions - types of pollutants, Brief account of transmission of airborne microbes; Microbiology of indoor and outdoor. Allergy: Causes and tests for detection of allergy. Role of microbiology achieving sustainable role.

Unit IV **16 Hrs**

Role of microbes in degradation

Biodegradation of xenobiotic – hydrocarbons, pesticides and plastics. Bio deterioration of wood, pulp and paper. Role of microbes in organic solid waste treatment - sewage and effluent treatment; primary, secondary and tertiary treatment. Bioremediation of soil, air and water: various methods, advantages and disadvantages. Role of microbiology achieving sustainable role.

References:

1. Johri B. N. 2000. Extremophiles. Springer Verlag. New York
2. Maier R. M. Pepper I. L. &Gerba C. P. 2000. Environmental Microbiology. Academic Press.USA.
3. Baker K. H. & Herson D. S. 1994. Bioremediation, Mac Graw Hill Inc. N.Y.
4. Ralph M. A. 1997. Environmental Microbiology. John Wiley and Sons.Inc.
5. Forster C. F. & John D. A. 2000. Environmental Biotechnology, Ellis Horwood Ltd. Publication.

SPT 2.3 B- MICROBIAL DIVERSITY AND EXTREMOPHILES

Unit I **16 Hrs**

Diversity

Bacterial Diversity: Archaebacteria, Photosynthetic Eubacteria, Chemoautotrophic and Methophilic Eubacteria, Gliding Eubacteria, Spirochetes, Rickettsia and Chlamydia, Actinomycetes, Mollicutes, Protists. Viral Diversity: Group I – T2 Bacteriophage, Group II – Banana bunchy top virus, Group III –Reovirus, Group IV- TMV, Group V – Rhabdovirus, GroupVI – HIV, Group VII – Hepatitis virus. Salient features of the following group of fungi: Zygomycota (Rhizopus), Ascomycota (Neurospora), Basidiomycota (Agaricus).

Unit II **16 Hrs**

Microbial interaction

Interactions among microorganisms- mutualisms, comensalism, competition, amensalism, parasitism, predation - Interactions between microbes and plants - rhizosphere, phyllosphere, mycorrhizae. Microbial interactions in animals- Rumen microflora, Intestinal microflora. Biofilms.

Unit III **16 Hrs**

Extremophiles

Isolation, classification and properties of extremophiles: hyperthermophiles, psychrophiles, halophiles, acidophiles, methanogenic extremophiles etc. Adaptation mechanisms of extremophiles.

Unit IV **16 Hrs**

Importance and Conservation of Microbial Diversity

Importance of extremophilic microbial diversity in environment: forest ecosystem, Aquatic ecosystem, soil ecosystem, marine ecosystem, Air microflora. Antibiotics and its importance: Streptomycin, Ampicillin/ Penicillin, Tetracycline.

References:

1. Presscott, L. M., Harley, J. P. and Klein, D. A. 1999. Microbiology. 4th edn. WCB Mc Graw-Hill, New Delhi.
2. Satyanarayana, T. and Johri, B. N. 2005. Microbial Diversity – Current Perspectives and Potential Applications. I K Int. Pvt. Ltd. New Delhi.
3. Horokoshi K and Grant WD. Extremophiles- Microbial Life in Extreme environments. 1998. Wiley Liss Publications.
4. Keller M. and Zengler K. (2004) *Tapping in to Microbial Diversity.* Nature Reviews 2, 141-150.
5. Woese C. (1987), *Bacterial Evolution*. Microbiological

III SEMESTER

CPT 3.1 MOLECULAR BIOLOGY AND GENETIC ENGINEERING

Unit I **16 Hrs**

Genome organization

Gene: gene concept, unit of function, replication, recombination. Fine structure of gene: bar locus, complex loci, rII locus and complementation analysis Gene function: one gene/one enzyme hypothesis, pathways of gene action. Genome organization: Genome organization in prokaryotes and eukaryotes special features of eukaryotic gene structure and organization, genome organization in mitochondria and chloroplast.

Unit II **16 Hrs**

Nucleic acid hybridization

Design and construction of probes, nick translation, chemical synthesis, hybridization,liquid hybridization, solid hybridization, determination of stringency conditions Applications of nucleic acid hybridization. Systems that safeguard DNA – DNA repair mechanisms – Excision repair, photo reactivation, mismatch repair, recombination repair, SOS repair.

Unit III **16 Hrs**

Plasmid vectors

Use of natural plasmids as vectors, artificial plasmid vectors, pBR322, pUC 18/19, Ti-plasmid vectors. Bacteriophage vectors – Insertion vectors, replacement vectors, cosmid vectors, phagemid vectors, shuttle vectors and M13 based vectors. YAC, BAC. Restriction endonucleases – Types, RFLP and RAPD. Genome libraries – construction and screening of genome libraries, chromosome walking, cDNA libraries.

Unit IV **16 Hrs**

Recombinant DNA

Isolation of gene of interest: Construction of recombinant DNA, selection of DNA fragments for cloning, cDNA synthesis, chemical synthesis, gene synthesizers, ligation with RES, homopolymer tailing, blunt end ligation, linkers, monitoring restriction and ligation. Gene transformation techniques- Direct Method-Indirect methods, Screening of recombinant, Applications of rDNA technology. PCR – principles, types and applications, primer design and applications. DNA fingerprinting, applications of rDNA technology. DNA sequencing methodology – Sangers dideoxy method.

References:

1. Molecular biology and Microbial genetics (1994) David Frifielder, Stanely R. Maloy, 2nd edition Jones and Barlett Publishers.
2. Genetics by Peter J Russell (1997) 5th edition Benjamin-Cummings Publishing Company.
3. Molecular Biotechnology (2003) Bernard R. Glick and Jack J.Pasternak., 2nd edition byASM press.
4. Gene Cloning and DNA analysis (2004) T.A.Brown 2nd edition. By ASM press.
5. Application of rDNA Technology (2003). Glick & Pasteneuk.

CPT3.2 IMMUNOLOGY AND IMMUNOTECHNOLOGY

Unit I **16 Hrs**

Immune system and Immune Response

Innate and acquired immunity, structure and functions of immune cells-T cells, B cells, Macrophages, NK cells and dendritic cells, Eosinophils, Neutrophils, Mast cells. Organs of immune system-Primary and secondary lymphoid organs. Primary and secondary immune response, Clonal selection theory.

Unit II **16 Hrs**

Hypersensitivity Reactions

Allergy, Hypersensitivity reactions -types (I, II, III, and IV), symptoms, 19mmune diagnosis. Lymphokines and cytokines: Interleukins and Interferons – Production, biological functions and assay methods. Immunological tolerance.

Unit III **16 Hrs**

Immunization

Vaccines-conventional, peptide vaccines, subunit, DNA vaccines. Toxoids, antisera, edible vaccines, plantibodies, ISCOMs, recombinant antibodies, Immune stimulatory complexes. Common immunization programmes-BCG, small pox, PT, polia, measles, Hepatitis B.

Unit IV **16 Hrs**

Immunological Techniques

Agglutination, precipitation, immune-fluorescence, 19mmune electrophoresis, immunoblotting, ELISA, RIA, Flow cytometry. Production and purification of antibodies, determination of antibody

titre by RID and EID, production of hybridoma. Importance of antigen and MHC class II molecules in T-cell cloning. Antigen specific and alloreactive T-cell cloning -immunologically relevant antigens and T cell subtypes. Applications in vaccine development.

References:

1. Essentials of immunology, Ian&Roit Blackwell scientific publications,2001
2. Fundamentals of immunology-williamc.boyed (wileytoppan), 1998
3. Introduction to immunology-john w.kinball,2000
4. Fundamentals of immunology-ottos.view and others.,2004
5. Immunology: Janis Kuby (2001) second edition W.H.freeman&com
6. Cellular & molecular immunology 3rdedn.abulk.Abbas,Andrewk.Lichtman, Jordans.pober, 1989
7. Immunology and Immunotechnology. RajasekaraPandian M and Senthilkumar B (2007).Panima Publishing Corporation , NewDelhi.
8. Immunology and Immunotechnology. RajasekaraPandian M and Senthilkumar B (2007).Panima Publishing Corporation , NewDelhi.
9. Immunology 6th Edn. Goldsby RA, KindtTJ.Osborne BA, Kuby J (2003WH Freeman &Co.New York.
10. Immunology .4th Edn. Benjamini E, Coico Rand Sunshine G(2000). AJohn Wiley & sons, Inc. Publication.
11. Handbook of Experimental Immunology. Weir DM (1979). Black Well ScientificPublications. Oxford.
12. Microbiology (2006) 5th Edn. Pelczar MJ, Chan ECS and Krieg NR. Microbiology (2006)5th Edn. Tata, McGraw-Hill Publishing Company Ltd.New Delhi.
13. Tizard IR (1995). Immunology 4th Edn. Saunders College Publishing Harcourt Brace College Publishers.
14. Immunology 4th Edn. Talwar GP and Guptha (2004). Vol II .CBS Publications.

SPT 3.3 A - AGRICULTURAL MICROBIOLOGY AND PHYTOPATHOLOGY

Unit I **16 Hrs**

Introduction

Historical development, scope and concept of soil and agricultural microbiology. Soil: Composition of soil and soil profile, physical, chemical and biological properties of soil. Distribution of microorganisms in soil, their importance in maintaining soil fertility, factors affecting soil microflora. Plant microbe interactions: Rhizosphere, rhizoplane, Phyllo sphere and mycorrhizal association. Interaction between microorganisms in soil (positive and negative interaction)

Unit II **16 Hrs**

Biofertilizers and Biopesticides

Screening and selection of potential strains, large scale production of bacterial (Rhizobium, Azotobacter, Azospirillum), blue green algal and fungal fertilizers. Methods of application and evaluation of biofertilizers. Green manure, organic matter, compost & composting, vermi composting. Biopesticides-*B.thuringiensis*, Bacillus papillae, Trichoderma; Transgenic crop plants.

Unit III **16 Hrs**

Plant pathology

Parasitism and Disease Development, Pathogenicity, Disease triangle, Disease cycle/ Infection cycle. Diseases caused by Bacteria-fire blight of apple, potato scab, citrus canker, lethal yellowing of coconut; Fungi-powdery scab of potato, late blight of potato, downy mildews of pearl millet, Fusarium wilt of tomato, blast disease of rice, stem rust of wheat, corn smuts.

Unit IV **16 Hrs**

Plant and Microbes interactions

Plant pathology – Mechanical forces, Microbial enzymes and toxins, Defence Mechanisms of Plant: Disease Pre-existing structural and chemical defences, Induced Structural and biochemical defences. Bioremediation of contaminated soils, Biodeterioration; definition and concept, biodeterioration of woods. Biomagnification: concept and consequences.

References

1. Subba Rao. 2000. Soil Microbiology. 4th Ed. Oxford & IBH
2. Subba Rao. Biofertilizers in Agriculture. Oxford & IBH
3. Subba Rao. Recent Advances in Biological Nitrogen Fixation.Oxford & IBH.
4. Rangaswamy and Bagyraj. Agricultural Microbiology.
5. Alexendra and Bold. 1999. Introduction to Mycology. Academic Press.
6. Sundara Rajan S. Practical Manual of Fungi.Anmol Publication.
7. Saminathan M.S. Biotechnology in Agriculture. McMillan.
8. Steinhaus. 1963. Insect Pathology. Vol I & II. Academic Press, New York.
9. Burges H D & Hussey N W. 1971. Microbial Control of Insect and Mites. Academic Press,New York.
10. Burges H D. 1970-1980. Microbial Control of Pests and Plant Diseases.

SPT3.3B-BIOINFORMATICS AND BIOSTATISTICS

Unit I **16 Hrs**

Introduction to Bioinformatics and Biological Data bases

Definition, History, Scope and application of Bioinformatics. Biological Databases: Primary and Secondary- Concepts, Types, Specialization and Limitations, NCBI, EMBL, PDB, KEGG, Microbial genomic database (MBGD), Data retrieval from various databases. Homology Searching and their Applications. Immunoinformatics: Databases, Epitope, prediction and Vaccinology.

Unit II **16 Hrs**

Sequence Analysis

Similarity searching (FASTA & BLAST), Sequence Alignment: Pair wise alignment and Global alignment. Multiple Sequence Alignment: Dynamic Programing, Progressive methods, Iterative methods, Motif finding. Structural alignment -DALI, SSAP, Combinatorial extension. Phylogenetic analysis. Scoring Matrices: BLOSUM, PAM. Molecular Phylogenetic and Applications. Restriction Mapping –WEB CUTTER & NEB CUTTER, Primer designing: Primer-3.

Unit III **16 Hrs**

Structural Bioinformatics

Introduction to Structural Bioinformatics. Methods to model protein structures-Primary, secondary, Tertiary and Quarternary. Ramachnadran Plot. Protein Modelling –Principle of Homology and comparative modeling. Prediction of protein confirmation from Sequences.

Molecular modeling and Simulation. Drug design: Drug discovery process, Role of Bioinformatics in Drug Design.

Unit-IV **16 Hrs**

Introduction to Biostatistics

Principles of Biostatistics: Scope of statistical Methods in Scientific Studies-Population, sample, variables, parameter, primary and secondary Data, Screening and Representation of data, Frequency distribution, Tabulation, Bardiagram, Histograms, Per diagram and Cumulative frequency curves. Measures of central tendency-Mean, Median, Mode, Quartiles and Percentiles. Measures of Variability- Range, Mean deviation, Analysis of Variances, standard deviation and coefficient of Variation

References

1. Bioinformatics. 1998 by Baxevanis
2. Bioinformatics 2000 by Higgins and Taylor OUP.
3. Nucleic acid Research 2001. Jan. Genome database issue.
4. The Internet and the new Biology: Tools for Genomics and Molecular Research by Peruski, Jr. and Peruske (ASM)1997.
5. Functional Genomics. A Practical Approach Edited by Stephen P Hunt and Rick Liveey (OUP) 2000.
6. DNA microarrays: A practical approach edited by Mark Schena (OUP)
7. Bioinformatics: Sequence and Genome analysis. Edited by David W. Mount. Cold spring Harbor, NY: Cold spring Harbor Laboratory Press 2004,692.
8. Fundamentals of Biostatistics- Bernard Rosner, 8th Edition,
9. Biostatistics - P.S. Sundar Rao and J. Richard 5th edition.
10. Fundamentals of Biostatistics. Fundamentals of Biostatistics authored by Bernard Rosner is a practical approach to understand the methods, techniques, and computation of statistics on human populations.

IV SEMESTER

CPT 4.1 INDUSTRIAL MICROBIOLOGY AND BIOPROCESS ENGINEERING

Unit I **16 Hrs**

Introduction to industrial microbes

Characteristics of Industrially important microbes, Isolation, screening and selection of suitable producer microorganisms from the environment, Culture Collections and preservation of industrially important microorganisms, strain improvement and Use of mutants strains, Genetically Modified Microorganisms (GMM).

Unit II **16 Hrs**

Production of microbial products

Industrial products from microorganisms-Antibiotics: production of penicillin, streptomycin. Interferons, vaccines, hormones, vitamins. Enzymes from microbes: amylase and protease. Organic acids: citric acid, acetic acid, Amino acids: glutamic acid, lysine. Production of alcoholic beverages: bear and wine, biofuels: ethanol, methane, biogas.

Unit III **16 Hrs**

Introduction to bioprocessing

Fermentation: definition, fermentation media, raw material used in media production, antifoaming agents, buffers, downstream processing. Types of fermentation processes- single, batch, continuous, multiple, surface, submerged and solid state. fermenter design, Types of fermenters and its application. immobilization methods.

Unit IV **16 Hrs**

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 materials.

References:

1. Ali Cinar, SJ. Parulekar, et al., (2003) Batch Fermentation: Modeling, Monitoring, and Control. Marcel Dekker
2. Anke, T 1997 Fungal Biotechnology, Chapmen & Hall, London.

3. Arnold D & J E.Davies, Atlas. RM 1999 Manual of Industrial Microbiology & Biotechnology2nd Ed.
4. Berry, D.R. (Ed) 1998 Physiology of Industrial fungi BSP, Oxford University.
5. Crueger&Crueger Biotechnology: A Text Book of Industrial microbiology 2nd edition
6. Casida, Industrial Microbilogy
7. Demain, A.L Biology of Industrial Microorganisms
8. Diliello Methods in Food and Dairy Microbiology
9. Harold B. Reisman 1988 Economic Analysis of Fermentation Processes CRC Pr I Llc
10. Harvey,W., Blanch, S.Clark. 2007 Biochemical Engineering, Marcel Dekker

CPT 4.2 MEDICAL AND DIAGNOSTIC MICROBIOLOGY

Unit I **16 Hrs**

Microbiology and Medicine

Historical development, major milestones and significant contributions in medical microbiology; Germ Theory of disease, Koch postulates, Recent trends. Define Disease, Disorder and Syndrome. Microbial Disease- sources, routes of transmission. Pathogenesis- adhesion, invasion, host cell damage, release of pathogens. Communicable Diseases – Microbial Infections and Diseases. Microbial Pathogenicity – factors responsible for Microbial pathogenicity.

Unit II **16 Hrs**

Sources of Infection

Primary and reservoir spread, Modes, Routes of entry, Zoonotic, epizootic diseases; Epidemiology - epidemic, endemic, sporadic, pandemic nature of diseases, prevention and Control measures, WHO guidelines on epidemiology. Chemotherapeutic agents – antibiotics, (Classification based on chemical structure, mode of action and range of effectiveness), Recent trends – Drug resistance and its consequences, NCCLS(CLSI) guidelines and standards.

Unit III **16 Hrs**

Systematic study of important pathogenic organisms

Enterobacteriaceae (*Salmonella, Shigella, E-coli, klebsiella* etc). *Mycobacterium, Staphylococci, Streptococci, Vibrio cholerae, Treponema, Brucella, Clostridium*. Brief account of *Leptospira, meningococci, Campylobacter. Corynebacterium diphtheriae, Bordetella*, Overview of Important viral diseases – Pox, Herpes, Adenovirus, Papovo, Picarno, myxoviridae, retrovirus, arboviruses, hepatitis viruses and Rabies.

Unit IV **16 Hrs**

Brief account of diseases

Direct and Indirect upper respiratory tract infection, Pyogenic Infections, acute diarrheal diseases, Dysentery – Bacillary and Amoebic, PUO (Pyrexia of unknown origin), tuberculosis, Leprosy, Urinary tract infections, Skin infection /pyogenic infections, Dental Caries/ plaque, Sexually Transmitted diseases and nosocomial infections.

References

1. Topley and Wilson. Principles of bacteriology, Virology and Immunity. Edward Arnold.
2. David Greenwood, Richard C and Slack B. Medical Microbiology. ELBS ChurchillLivingstone.
3. Rajesh Bhatia R. Essentials of Medical Microbiology. Jayjee Brothers.
4. Kenneth jR. Medical Microbiology – Introduction to Infectious Disease. Prentice Hall Int.
5. Joanstokes, Ridewaywren and Sir ashleymiles. Clinica Microbiology. Edward Arnold.
6. Dougias J and Slekh. Medical Bacteriology. Churchill Livingstone.
7. Bailey and Scotts. Diagnositc Microbiology. C.V. Mosry Company
8. Hoghl and Moffet. Clinical Microbiology. JB Lippincott Company.

SPT 4.3 A - FOOD AND DAIRY MICROBIOLOG Y

Unit I **16 Hrs**

Concepts and scope of food microbiology

Food and its constituents: carbohydrates, proteins, fats and oils, vitamins, minerals, fiber and water- properties and significant. Food as substrate for microorganisms. Extrinsic and intrinsic factors influencing microbial growth. Microbes important in food- molds, yeast and bacteria. Microbes as Food.

Unit II **16 Hrs**

General principles of food spoilage and its preservation

Food Spoilage: spoilage of fruits, vegetables, cereals, meat, fish, sea foods, poultry and canned food. causes of spoilage. Detection of food spoilage. Food borne infection and intoxication: Bacterial, fungal, nematode and protozoa. Preservation of foods – General principles, physical methods of food preservation (high temperature, low temperate and drying), chemical methods of food preservation (food additives), biological methods of foodpreservation.

Unit III **16 Hrs**

Dairy Microbiology

Milk – Definition, compositions, food and nutritive value of milk, properties and its constituents, microbiology of milk. Microbial Contamination, preservation and spoilage of milk. Biochemical activities of milk- souring, lactosis, proteolysis. Testing of milk and milk products, and safety system in dairy industries. Prebiotics and Probiotics and their importance. Fermented milk products - cheese, yogurt, ghee, butter milk, kefir and koumiss.

Unit IV **16 Hrs**

Food sanitation

Food safety laws and standards, international – HACCP, ISO 9000 Series, GMP and LP, India – PFAA, FSSAI, FPO, MPO, CSO, the Agmark Standards, bureau of Indian Standard (BIS). Food testing laboratories in India SRI, FRAC.

References:

1. Doyte MP, Loory RB & Thomas JM; Food Microbiology, ASM Pres, Washington DC.
2. Jay JM, Modern; Food Microbiology, Chapman & Hall, New York.
3. Joshi VK & Pandey Ashok; Biotechnolgoy of Food Fermentation, Asiatech Publ. Delhi, India .
4. Frazier WC &Westhof DC; Food Microbiology, 3rd Ed., Tata McGraw H

SPT 4.3 B- MICROBIAL SYSTEMS BIOLOGY

Unit I **16 Hrs**

Genomics

Genome sequencing projects (technology of sequencing and assembly, bioinformatics of genome annotation, current status of genome sequencing projects) Genomic browsers and databases Orthology prediction (comparative genomics) Search for transcription factor binding sites (TFBS), Computational prediction of miRNA target genes De novo prediction ofregulatory motifs, In genome Single nucleotide polymorphisms (SNP) in medical genetics and basic research.

Unit-II **16 Hrs**

Transcriptomics

Experimental techniques: microarrays, EST, SAGE. Microarray data: normalization and analysis. Genevestigator and Onco Mine – browsing microarray-derived gene expression profiles, tissue and stage-of-development-specific patterns of expression, co expression of genes, pre-computed lists of differentially expressed genes.

Unit III **16 Hrs**

Proteomics

Aims, strategies and challenges in proteomics. Proteomics technologies: IEP,2D- electrophoresis, MALDI-TOF mass spectrometry, yeast 2-hybrid system. Protein-protein interactions: experimental and computational methods, databases.

Unit IV **16 Hrs**

Metabolomics

Metabolic pathways resources: KEGG, Biocarta. Nutrigenomics and metabolic health.

References:

1. Bioinformatics: Methods and Applications Genomics, Proteomics and Drug Discovery byRastogi S.C. , Mendiratta Namita , Rastogi Parag.
2. Applying Genomic and Proteomic Microarray Technology in Drug Discovery, SecondEdition by Robert S. Matson
3. Genomics and Proteomics: Functional and Computational Aspects by SándorSuhai

SYLLABUS OF OPEN ELECTIVE COURSES TO BE OFFERED BY THE DEPARTMENT FOR OTHER STUDENTS OF OTHER DEPARTMENTS OF THE FACULTY

OEPT 2.4- The Exciting World of Microbes

Unit I **16 Hrs**

Introduction to Microbiology

Definition, scope and branches of Microbiology. Characteristics of major groups of microbes- General characteristics, classification and economic importance of a) Bacteria b) Fungi c) Actinomycetes d) Cyanobacteria e) Mycoplasma`s f) Viruses.

Unit II **16 Hrs**

Microbiology of Food and Industry

Primary sources of microorganisms in foods. Factors influencing microbial growth in foods - extrinsic and intrinsic. Principles of food preservation - preservation methods -irradiations-drying, heat processing, chilling and freezing, high pressure, modification of atmosphere and chemical preservatives. Nutritional value of fermented foods. SCP and its uses. Contamination, preservation and spoilage of fruits, vegetables, meat and poultry products. Industrially important microorganisms.

Unit III **16 Hrs**

Microbiology of Agriculture and Environment

Distribution of soil microorganisms. Factors influencing the soil microflora- Role of microorganisms in soil fertility. Interactions among microorganisms, mutualisms, commensalism, competition, Ammensalism, parasitism, predation. Interactions between microbes and plants - Rhizosphere, Phyllosphere, mycorrhizae. Microbial interactions in animals-Rumen microbiology - Microbial contribution to food digestion.

Unit IV **16 Hrs**

Microbiology of Health

Concept of Disease, Disorder, Syndrome - Communicable Diseases – Microbial Infections and Diseases. Microbial Pathogenicity – factors responsible for Microbial pathogenicity. Normal flora of human body – factors that influences normal flora, Distribution and occurrence of normal flora (Skin, conjunctiva, nose, nasopharynx, sinuses, mouth, upper respiratory tract, intestinal tract,

urogenital tract). Systematic study of bacterial disease-causing agent: *Salmonella, Mycobacterium, Vibrio cholerae.* Systematic study of fungal disease-causing agent: *Candida, Aspergillus*. Systematic study of Viral disease-causing agent: HIV, Hepatitis andcorona virus. Systematic study of parasitic disease-causing agent: *Plasmodium.*

References:

1. Adams MR and Moss MO. (1995). Food Microbiology, The RoyalSociety of Chemistry, Cambridge.
2. Alexander M. (1977) Introduction to soil microbiology. John Wiley & Sons, Inc., New York. Andrews AT, Varley J. (1994) Biochemistry of milk products. Royal Society of Chemistry.
3. Banwart GJ. (1989), Basic food microbiology, Chapman & Hall, New York. EcEldowney S, Hardman DJ, Waite DJ, Waite S. (1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical.
4. Frazier WC and Westhoff DC. (1988) Food microbiology, TATA McGraw Hill Publishing Company Ltd. New Delhi
5. Balasubramanian D, Bryce CFA, Dharmalingam K, Green J, Jayaraman K. (1996).
6. Concepts in Biotechnology, University Press, India
7. Dubey RC and Maheswari DK (2005). A text book of Microbiology, Revised Multi color Edition S. Chand Publishers, New Delhi.

OEPT 3.4 APPLIED MICROBIOLOGY

Unit I **16 Hrs**

Fundamental principle of Applied Microbiology

Microbial Biodiversity and Sustainable development. Isolation of industrially important microorganisms, preservation and improvement of industrially useful microorganisms. Types of Fermentation and its advantages, Types of fermenters; Airlift, Fluidized bed reactor, Photobioreactors, Stirred tank and Packed bed bioreactors, Downstream processing Methods. GMO and their impact.

Unit II **16 Hrs**

Microbial fuels

History of Biofuels-Global scenario of Biofuel production. Microbial macromolecules as biofuel feedstocks. Alternate sources of energy – methane, hydrogen and biogas production and their significance of commercial production of biofuels. Single cell proteins & single cell oil, MEOR

Unit III **16 Hrs**

Production of commercially important products from Microorganisms

Industrial products from Microorganisms- Antibiotics: Penicillin and Streptomycin, Vaccines, Enzymes: Amylase and Protease, Vitamins, Monoclonal antibodies, Production of Alcoholic Beverages, Mushroom cultivation, Overview of biofertilizers and biopesticides.

Unit IV **16 Hrs**

Microbes in Bioremediation

Bioremediation: Methods and applications. Biodegradable polymers from microorganisms. Biotransformation of Xenobiotics, Methods of Metal Recovery by Microorganisms, Microbial leaching - copper, gold, and Uranium.

References:

1. Adams MR and Moss MO. 1996. Food Microbiology. New Age International (P) Ltd.
2. Cruger W and Crueger A 1995. Biotechnology. Black well Scientific Publications, Oxford.
3. Peppler, HJ and D Pearlman, 2004. Microbial Technology, Vol1 and academic press, New Delhi
4. Demain, AL and Davis JE.2004. Industrial Microbiology and Biotechnology second edition,ASM press Washington, DC. Biochemistry by Geoffrey L. Zubay. Fourth Edition, Addison- Wesley educational publishers Inc.,2008
5. Alexander M. (1977) Introduction to soil microbiology. John Wiley & Sons, Inc., New York.
6. Andrews AT, Varley J. (1994) Biochemistry of milk products. Royal Society of Chemistry.
7. Banwart GJ. (1989), Basic food microbiology, Chapman & Hall, New York.
8. EcEldowney S, Hardman DJ, Waite DJ, Waite S. (1993). Pollution: Ecology and Biotreatment – Longman Scientific Technica

Continuous Internal Assessment for Theory Papers: (Total: 20)

C-1/C 2 Average of two internal tests Marks: 10

C-1A: 2 Seminars (Recent Microbiological advances and Journal Club) Marks: 05

C-2A: Extra activities (Awareness programmes and extension activities etc...) Marks: 05

C -3: SEMESTER END EXAMINATION THEORY (QUESTION PAPER PATTERN)

Max. Marks=80 Time: 03 hours

PART - A

Answer in Brief (Answer any ten) 10 x 2 =20

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

PART – B

Write Short Notes (Answer any four) 4x6=24

1.
2.
3.
4.
5.
6.

PART- C

Essay Type Questions (Answer any three) 3 x 12 = 36

1.
2.
3.
4.
5.

Note: Equal Weightage should be given to all the units while setting thequestion paper

Continuous Internal Assessment Marks Allotment for Practical Papers: (Total: 10)

C-1: Internal Test based on the experiments in the syllabus: 06 Marks

C-2: Submission of Case studies: 04Marks

C -3: SEMESTER END EXAMINATION PRACTICALS (QUESTION PAPER PATTERN)

Max. Marks = 40Time: 03 hours

Major Experiment: 12 Marks

MinorExperiment:06Marks

Spotters (04): 12 Marks

Records: 05 marks

Viva –Voce: 05 marks

CERTIFICATE COURSE

SKILL BASED MICROBIAL VALUE-ADDED COURSE ON MICROBIAL VALUE ADDITION II SEMESTER

Preamble:

1.NAAC Mandatory that skill-based courses for students of all programme.

2. In order to make such courses more industrially relevant and to train students with better skills, the department wishes to offer non credit certificate course in microbial value addition.

Duration: 40 Hrs **Minimum attendance: 30 Hrs**

Topics: Preparation of Biopesticides & Biofertilizers

Methods of Evaluation:

1. Presentation on the Topic
2. Submission of the material and methods
3. Preparation of Biopesticides & Biofertilizers
4. Testing its efficacy
5. Submission of efficacy data
6. Preparing the Mock patent applications
7. Preparation of Manuscript for publications
8. Grades to be awarded on ABMC