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 Semester

S. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						Internal Assessment	Semester End Exam	Total Marks
1	CPT-1.1	**Cell Biology and Microbial Systematics**	4	4	3 Hrs	20	80	100
2	CPT-1.2	**Bacteriology and Virology (including techniques)**	4	4	3 Hrs	20	80	100
3	CPT-1.3	**Microbial Bio-Chemistry and Enzymology (including Instrumentation)**	4	4	3 Hrs	20	80	100
4	SPT-1.4 A	**Mycology and phycology**	4	4	3 Hrs	20	80	100
	SPT-1.4 B	**Protozoology**	4	4	3 Hrs	20	80	100
5	CPP-1.5	**Practical based on CPT 1.1**	4	2	3 Hrs	10	40	50
6	CPP-1.6	**Practical based on CPT 1.2**	4	2	3 Hrs	10	40	50
7	CPP-1.7	**Practical based on CPT 1.3**	4	2	3 Hrs	10	40	50
8	SPP -1.8 A	**Practical based on SPT 1.4 A**	4	2	3 Hrs	10	40	50
	SPP -1.8 B	**Practical based on SPT 1.4 B**	4	2	3 Hrs	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 Semester

S. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						Internal Assessment	Semester End Exam	Total Marks
1	CPT- 2.1	**Microbial physiology and Metabolism**	4	4	3 Hrs	20	80	100
2	CPT- 2.2	**Microbial Genetics**	4	4	3 Hrs	20	80	100
3	SPT- 2.3 A	**Microbial Ecology and Environmental Microbiology**	4	4	3 Hrs	20	80	100
	SPT- 2.3 B	**Microbial Diversity and Extremophiles**	4	4	3 Hrs	20	80	100
4	OEPT – 2.4	***To be offered by other departments of the faculty***	4	4	3 Hrs	20	80	100
5	CPP-2.5	**Practical based on CPT 2.1**	4	2	3 Hrs	10	40	50
6	CPP-2.6	**Practical based on CPT 2.2**	4	2	3 Hrs	10	40	50
7	SPP-2.7 A	**Practical based on SPT 2.3 A**	4	2	3 Hrs	10	40	50
	SPP-2.7 B	**Practical based on SPT 2.3 B**	4	2	3 Hrs	10	40	50
8	OEPP -2.8	***To be offered by other departments of the faculty***	4	2	3 Hrs	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 Semester

S. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						Internal Assessment	Semester End Exam	Total Marks
1	CPT- 3.1	**Mol. Biology and Genetic Engineering**	4	4	3 Hrs	20	80	100
2	CPT- 3.2	**Immunology and immunotechnology**	4	4	3 Hrs	20	80	100
3	SPT- 3.3 A	**Agricultural Microbiology and Phytopathology**	4	4	3 Hrs	20	80	100
	SPT- 3.3 B	**Bioinformatics and Biostatistics**	4	4	3 Hrs	20	80	100
4	OEPT – 3.4	***To be offered by other departments of the faculty***	4	4	3 Hrs	20	80	100
5	CPP-3.5	**Practical based on CPT 3.1**	4	2	3 Hrs	10	40	50
6	CPP-3.6	**Practical based on CPT 3.2**	4	2	3 Hrs	10	40	50
7	SPP-3.7 A	**Practical based on SPT 3.3 A**	4	2	3 Hrs	10	40	50
	SPP-3.7 B	**Practical based on SPT 3.3 B**	4	2	3 Hrs	10	40	50
8	OEPP-3.8	***To be offered by other departments of the faculty***	4	2	3 Hrs	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 Semester

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

Morphology and ultra-structure of prokaryotic cell

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. Reserve food materials – polyhydroxybutyrate, polyphosphate, oil droplets, cyanophycin granules and sulphur inclusions. Cell division, Morphological types – Archeabacteria.

Unit II

Ultra structure and Organization of Eukaryotic Cell

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

Unit III

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

Microbial Systematics

Definition and systematics, nomenclature rules and identification, hierarchical organization and 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. Classification and salient features of bacteria according to Bergey's Manual of Determinative Bacteriology.

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 Lea and Febiger, Philadelphia.

4. Schlegel Hans G. (1995) General Microbiology, Edition 7, CUP, Cambridge.

CPT 1.2 BACTERIOLOGY AND VIROLOGY (INCLUDING TECHNIQUES)

Unit I

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, archaebacteria), capsule, plasma membrane, cytoplasm, ribosome, nucleoid, mesosomes, plasmids, flagella, pili (fimbriae), inclusion bodies, multiplication by cell division and endospore formation. Characteristics of major groups of bacteria, Archaebacteria – general characteristics and classification; Eubacteria, Actinomycetes – general, characteristics and classification, diversity and distribution, economic importance.Cyanobacteria – general characteristics and classification – ultra-structure, reproduction and economic importance. Mycoplasma, Rickettsia, Chlamydia, Photosynthetic bacteria and bioluminescent bacteria.

Unit II

Bacteriological Techniques

Microscopy: Microscopic optics, components of microscopes. Basic principles and types of Bright field, Dark field, Phase contrast. Fluorescence, Polarization and confocal microscopes and their applications. Immunofluorescence – In situ hybridization. Electron Microscopy – Principle, Techniques and applications of Transmission Electron microscope (TEM) and Scanning Electron Microscope (SEM), Atomic Force Microscope (AFM). Isolation and sampling techniques: General isolation and sampling techniques for microorganisms from different sources. Microbial culture

media: Culture media, requirements, types and uses of different microbial culture media. Microbial growth; Concept, growth type, Measurement of microbial growth-cell number, turbidity and biomass, determination of microbial growth curve, Continuous and synchronous culture, balanced and unbalanced growth, influence of environmental factors on growth, dioxy-growth curve, aerobic and anaerobic growth. Staining techniques: Principles, protocols and applications of staining techniques. Simple, differential and vital staining techniques. Sterilization: Principles and applications of different sterilization techniques. Detailed process of physical and chemical methods of sterilization. Nutrition: Nutritional requirements, nutritional types of microorganisms, growth factors, uptake of nutrients by the microbial cell. Microbial culture preservation: Concept, types of microbial culture preservation, type culture collections. Advantages and limitations of culture preservation techniques. Microbial Safety measures: Concept, safety measures in handling microbiological samples and microorganisms.

Unit III

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, sedimentation, electrophoretic mobility, buoyant density; Biochemical characteristics – chemical composition of viruses, proteins, nucleic acids, envelope, enzymes, lipids, carbohydrates, polyamines, cations, Antigenic nature of viruses. Morphology & ultrastructure- Capsids and their arrangements - types of envelopes and their composition-viral genome, their types and structures, nomenclature and classification of viruses-Recent ICTV classification of viruses infecting animals, humans, plants,bacteria, algae, fungi. Major characteristics of different virus families Viroids and prions.Animal and Plant Viruses, bacteriophages.

Unit IV

Virological Techniques

Isolation and cultivation of viruses in embryonated eggs, experimental animals, and cell cultures. Primary & secondary cell cultures and monolayer cell cultures; cell strains, cell lines and transgenic systems.. Assay of viruses – physical and chemical methods (protein, nucleic acid, electron microscopy). Infective assay (plaque method, end point method).

References:

1. Alan J.Cann (1997). Principles of Molecular virology.(2nd edition). Academicpress,California.

2. Ann GiudiciFettner (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.

4. Dimmock NJ, Primrose SB. (1994) Introduction to Modern Virology IV edition.Blackwell Scientific Publications, Oxford

5. Flint, S.J., Enquist, L.W., Krung, R. Racaniello, VR. andSkalka, A.M. (2000). Principlesof Virology, Molecular Biology, pathogenesis and control, ASM Press, Washinton D.C.

CPT 1.3 MICROBIAL BIOCHEMISTRY AND ENZYMOLOGY (INCLUDING INSTRUMENTATION)

Unit I

Biochemistry of Macromolecules

Major Biomolecules: Carbohydrates – Classification, chemistry, properties, and function – mono, di, oligo and polysaccharides.bacterial cell wall polysaccharides. Conjugated polysaccharides– glycoproteins, muriens and lipopolysaccharides. Carbohydrates: Classification, basic chemical structure, monosaccharides, aldoses, and ketoses, cyclic structure of monosaccharides, steroisomerism, anomers and epimers. Sugar derivatives, deoxy sugars, amino sugars, and sugar acids. Proteins and amino acids: Properties of amino acids, structure, confirmation and properties of proteins, metabolism of amino acids, Lipids classification: Bacterial lipids, prostaglandins, structure, function of cholesterol, Major steroids of biological importance.

Nucleic acids: Structure and properties of purines, pyrimidines, nucleosides and nucleotides.

Unit II

Bioenergetics and Electron transport chain

Introduction, Laws of thermodynamics, Gibbs free energy, Relationship of Standard free energy to enthalpy, entropy and equilibrium constant, High energy compounds, ATP as universal currency of free energy, Oxidation-Reduction Reactions, Electromotive force, Half reactions, Redox potentials, Relationship of standard redox potential and standard free energy change.

Components, complexes and functions - Mitochondrial ETC- Prokaryotic ETC - Organotroph – E. Coli - Lithotroph – Nitrosomonas&Nitrobater (Only schematic) - Oxidative phosphorylation: by Chemiosmotic coupling hypothesis. - Structure and mechanism of ATP synthase - Structure of

bacterial ATP synthase, Mitochondrial ATP synthase -Mechanism – Rotational catalysis - Bacteriorhodopsin: Photo cycle and significance.

Unit III

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 enzyme activity.

Strategies of purification of enzymes, criteria of purity, molecular weight determination and characterization of enzymes. Enzyme single and multi-substrate reactions. Ping-pong mechanism, sequential mechanism (ordered and random). 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, rate of reaction, order of reaction, zero order and first order. Derivation of michaelis-menton equation, km value and its significance, lineweaver-burk plot, Enzyme inhibition-reversible and irreversible, competitive, uncompetitive, non-competitive. Regulation of enzyme activity – Covalent modulation, Allosteric regulation, ligand interactions, co-operative interactions, feedback regulation. Isozymes.

Unit IV

Instrumentation

Principles and applications of- Chromatography (TLC, Molecular exclusion, Gel filtration, Ion exchange, Affinity, GC, HPLC). Electrophoresis: Gel Electrophoresis – agarose and acrylamide (native, denaturing and gradient), Isoelectric focusing,PFGE. Centrifugation: Ultra centrifugation, Density gradient centrifugation, Differential centrifugation, Isopycnic centrifugation Spectroscopy: UV/Visible spectroscopy, Circular Dichroism (CD), Optical Rotary Dispersion (ORD), Fluorescence spectroscopy, Infrared spectroscopy, NMR, ESR, FTIR, Radiography: Autoradiography and Liquid, scintillation counting. Mass spectrometry (MALDI, ESI, CID, ICP)

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,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.Freeman and Company.

SPT 1.4 A- MYCOLOGY AND PHYCOLOGY

Unit I

Introduction to fungi

Occurrence and distribution, thallus structure, characteristics, nutrition, classification and reproduction. Introduction of fungi: Occurrence and distribution, somatic structure, hyphal growth, nutrition, heterothallism, sex hormones in fungi, physiological specialization in fungi, fungi and ecosystem; saprophytic parasitic, mutualistic and symbiotic relationship with plants and animals. Classification of fungi. Reproduction in fungi: asexual, sexual and parasexual.

Unit II

Study of the different classes of fungi

Salient features of division and sub division of Myxomycota, mastigomycota, ztgomycota, ascomycotina, basidiomycotina and deuetromycotina. Structure and reproduction of: Dictyostelium, Allomyces, Pilobolus, Claviceps and Fusarium

Unit III

Salient Features of Algae

Distribution, morphology and classification of algae.Isolation from soil and water, algal ecology, media and methods used for cultivating algae.Measurement of algal growth, strain selection and large scale cultivation. Symbiotic algae: Lichens, coral reef and sea sponges. Structure and reproduction of important algae.

Unit IV

Economic importance of algae and fungi

Economic importance of algae as primary producers and commercial products.Uses of algae in heavy metal removal, algal blooms and toxins.Economic importance of Mycorrhiza: ecto-, endo and ect-endo VAM, Fungi as insect symbionts, fungi as biocontrol agents, attack of fungi on other microorganisms, potential application in Agriculture, environment, industry, food. Role of fungi in bio deterioration of wood, paper, textile.Mycotoxins, quorum sensing in fungi.

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. AyhanDemirbas, M. FatihDemirbas: Algae Energy: Algae as a New Source ofBiodiesel (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

Salient features of protozoa

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

Unit II

Flagellates

Giardia intestinalis, *Trichomonasvaginalis*) Ciliates (*Balantidium coli, Isospora belli,Cryptosporidium parvum*), Hemosomatic Protozoa (Free living Amoeba phase, Trypanosomes' monomorphic / Polymorphic, *Leishmania, Plasmodium, Toxoplasma gondii*)

Unit III

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. Echinococcusspp*).

Unit IV

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: Vol 5: Parasitology, Arnolds publ. New York,

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

Microbial Nutrition

Classification of organisms based on carbon source, energy source and electron sources. Macro and micronutrients**.** Microbial Growth: Phases of growth, factors influencing growth, measurement of growth, Continuous and synchronized growth. Microbial photosynthesis: Light energy, photolysis of water, carriers in photosynthesis, photosynthetic pigment, PS1, PS2, cyclic and noncyclic flow, oxygenic and anoxygenic photosynthesis, reduction of carbon dioxide in Calvin cycle. Microbial Stress Responses: Oxidative stress, Thermal stress, Starvation stress, Aerobic to anaerobic transitions. Biofilm and quorum sensing

Unit II

Carbohydrate metabolism

Glycolysis – significance, regulation. Glycogenesis, gluconeogenesis- Significance, regulations; TCA cycle-significance, regulations. Glyoxylate cycle. Amphibolic nature of TCA cycle. HMP shunt. ED Pathway. Phosphoketolase pathway. Metabolism of proteins and amino acids - General as pects of amino acid metabolism. Transamination, deaminaiton, decarboxylation; Urea cycle- regulation. Synthesis and degradation of Glycine, Degradation of phenylanine and Tyrosine, Sulfur containing amino acids- Syntheses and degradation of cysteine.

Unit III

Lipid Metabolism

Fatty acid oxidation (β oxidation), energetics of palmitic acid oxidation. Ketone bodes, ketogenesis, utilization of ketone bodies, overproduction of ketone bodies (ketonemia, ketonuria, ketosis Biosynthesis of long-chain fatty acids (palmitate). Synthesis of triacylglycerols, biosynthesis and degradation of cholesterol. Nucleotide metabolism – Synthesis of IMP, AMP and GMP, Salvage

pathway for purines, degradation of purine nucleotides. Biosynthesis and degradation of pyrimidine nucleotides.

Unit IV

Fermentation reactions

Definition, physiological significance, types of fermentation, alcohol and lactic acid fermentation, 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,5th edition, 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.Freeman and Company.

CPT 2.2 Microbial Genetics

Unit I

Historical Preview of Genetics

Mendelian principles and classical genetics, Genetic concepts, use of microorganisms in genetic studies. Chemical basis of heredity – early concepts of genes – discovery of the chemical basis of heredity - experimental evidences – contributions of Griffith, Avery, Hershey and Chase, Fraenkel – Conrat. Structure of nucleic acids – Structure of DNA and its elucidation, types and different models of DNA, extra-chromosomal DNA. Structure of RNA. Organization of genetic material - Genome organization in viruses, bacteria and eukaryotes. Structure of nucleosome, chromatin and chromosome. concept of phenotype and genotype, monohybrid (law of dominance and segregation), dihybrid(law of independent assortment). Applications of Mendel principles, Chromosomes and Genes: Cell division and Cell Cycle, chromosomal aberrations, karyotype analysis- normal and abnormal karoyotype. Neurospora- Tetrad analysis and linkage detection - 2 point and 3 point crosses, chromatid and chiasma interference, Mitotic recombination in Neurospora and Aspergillus. B) Algal Genetics: Chlamydomonas - unordered tetrad analysis - Recombination and Mapping, Nucleocytoplasmic interactions and gene expression in Acetabularia. Extra nuclear (Cytoplasmic) inheritance. Heterothalism and Parasexuality

Unit II

Perpetuation of genetic information

Replication of DNA, evidence of semi-conservative replication. Mechanism and enzymology of DNA replication. Regulation of DNA replication. Replication of RNA. Co-linearity between genes and proteins - Central dogma, experimental evidences, components of protein synthesis.

Unit III

Transcription and Translation

Biosynthesis of RNA in prokaryotes and eukaryotes, DNA dependent RNA polymerase, initiation, elongation and termination of transcription. Post transcriptional processing - removal of intron transcripts, addition of 5' cap and 3 poly A tail, processing of mRNA, rRNA and tRNA. Reverse transcription. Genetic code and translation – Elucidation and salient features of genetic code, wobble concept, triplet codon usage. Involvement of ribosome in translation, ribosome structure, initiation, elongation and termination of polypeptide chain synthesis, extra ribosomal factors, ribosome cycle, post translation modifications of proteins.

Unit IV

Regulation of gene expression

Enzyme induction and repression, constitutive expression and housekeeping genes, Operon concept, negative and positive regulation, catabolite repression, regulation of lac Operon, trp Operon, arabinose Operon, divergent Operon, attenuator regulation, translational regulation, feedback inhibition. Genetic recombination – in bacteria; transformation, competence, lysogeny, generalized and restricted transduction, conjugation, sexduction, genetic and fine structure mapping. Transposable elements – recombination in bacteria, yeasts, maize and drosophila.

Mutations – Nature and types, mutagenic agents – Physical, Chemical and biological. Phage μ mutagenesis, site directed mutagenesis. Detection of mutation – Ame's test, Mutation in – yeast, neurospora and chlamydomonas.

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

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). Aquatic biota: phytoplankton, zooplankton, benthos, periphyton, macrophytes. Biofilms, Production in lakes, rivers, estuaries and wetlands. Nutrient dynamics in lakes, rivers, estuaries and wetlands.

Unit II

Aquatic Microbiology

Fresh and marine ecosystem (estuaries, mangroves, deep sea, hydrothermal vents, salt pans, coral reefs).Zonation of water ecosystem; upwelling, eutrophication; food chain in aquatic ecosystems. Role of methanotrophs in ecosystem. Potability of water, microbial assessment of water, water purification. Ground water types and their contamination. Biofilm. Waste treatment: Sewage and effluent treatment; Primary, secondary and tertiary treatment, Solid waste treatment. Solid wastes as sources of energy and food.

Unit III

Aerobiology

Airspora in different layers of the atmosphere, bioaerosol, assessment of air quality using air sampler based principles of sedimentation, impaction, impingement, suction and filtration. Brief account of transmission of airborne microbes, indoor and outdoor microbial quality. Allergy: Causes and tests for detection of allergy. Endotoxin in air and its hazards. Molecular methods for air quality assessment. Historical development of space microbiology, Life detection methods a) Evidence of metabolism (Gulliver) b) Evidence of photosynthesis (autotrophic and heterotrophic)

Unit IV

Role of microbes in degradation:

Biodegradation of xenobiotic – hydrocarbons, pesticides and plastics. Biodeterioration of wood, pulp and paper; Biosorption/ bioaccumulation of heavy metal. Bioremediation of soil, air and water: various methods, advantages and disadvantages. Bioleaching of iron, copper, gold and uranium.

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, MacGraw 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

Development of Microbial Communities

Dynamics of community, ecological succession, structure, dispersion, microbial communities in nature and ecosystem models. Quantitative ecology: numbers, biomass, and activities; sample collection(soil, water, sediment, air); detection of microorganisms by phenotypic, lipid profile, and molecular methods; determination of microbial numbers; microbial biomass by biochemical, physiological approaches; measurement of microbial metabolism.

Unit II

Diversity

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

Unit III

Extremophiles

Isolation, classification and properties of extremophiles like- hyperthermophiles, psychrophiles, halophiles, acidophiles, methnogenic extremophiles etc. Adaptation mechanisms of extremophiles,

Unit IV

Importance and Conservation of Microbial Diversity

Importance of extremophilic microbial diversity in environment, pharmaceuticals & human health and industry. Metagenomics and biotechnological applications of extremophiles

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 Methods of Studying Biomolecules

Density gradient sedimentation, zonal centrifugation, electrophoretic separation, agarose, polyacrylaide, pulse field electrophoreses, southern blotting, northern blotting, labeling – radioactive and non-radioactive labeling, isopycnic separation. DNA sequencing direct sequencing, indirect sequencing, Maxam and Gilbert method, Sangers method,

Unit II

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 – photo reactivation, mismatch repair, recombination repair, SOS repair, DNA restriction and modification.

Unit III

Plasmid vectors

Use of natural plasmids as vectors, artificial plasmid vectors, pSC 101, RI, pBR322, pUC 18/19, Ti-plasmid vectors. Bacteriophage vectors – Insertion vectors, replacement vectors, cosmid vectors, phagemid vectors, shuttle vectors and M13 based vectors. Restriction endonucleases – Type, I, II & III, restriction mapping, RFLP and RAPD. Genome libraries – construction and screening of genome libraries, chromosome walking, cDNA libraries.

Unit IV

Recombinant DNA

Isolation of gene of intrest : 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. RNA sequencing, PCR sequencing. 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.

CPT 3.2 IMMUNOLOGY AND IMMUNOTECHNOLOGY

UNIT I

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

Hypersensitivity Reactions

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

UNIT III

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

Immunological Techniques

Agglutination, precipitation, immune-fluorescence, immunoelectrophoresis, immunoblotting, ELISA, RIA, Flow cytometry. Production and purification of antibodies, determination of antibody titre by RID and EID, production of hybridoma. T-cell cloning: Mechanism of antigen recognition by

T and B -lymphocytes, 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, Jordan s.pober, 1989
7. Immunology and Immunotechnology. RajasekaraPandian M and Senthilkumar B (2007). Panima Publishing Corporation , New Delhi.
8. Immunology and Immunotechnology. RajasekaraPandian M and Senthilkumar B (2007). Panima Publishing Corporation , New Delhi.
9. Immunology 6th Edn. Goldsby RA, KindtTJ.Osborne BA, Kuby J (2003WH Freeman &Co. New York.
10. Immunology .4th Edn. Benjamini E, Coico R and Sunshine G (2000) . A John Wiley & sons, Inc. Publication.
11. Handbook of Experimental Immunology. Weir DM (1979). Black Well Scientific Publications. 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

Introduction

historical development, scope and concept of soil and agricultural microbiology. Distribution of microorganisms in soil, their importance in maintaining soil fertility, factors affecting soil microflora. Microbes and bio-geochemical cycles (nitrogen, carbon, sulfur & phosphorous).Microflora of rhizosphere, phyllosphere and spermosphere, R/S ratio; Nitrogen fixing bacteria (Rhizobium, Azatobacter, Azosphirillum and blue green algae) and phosphate solubilizing microbes (bacteria, fungi) and mycorrhiza.

Unit II

Production of bio fertilizers

screening, selection of potential strains, Large scale production of bacterial, blue green algal and fungal fertilizers. Methods of application and evaluation of biofertilizers. Green manure, organic matter, compost & composting, vermi -composting. Bacterial - *B.thuringiensis*, *Bacillus sphericus*; fungi- *Culicinomyces*, *langenidium* and coelomomyces; NPV of Heliothissps, Development of genetically modified crop plants for control insect pests, Bt cotton; Transgenic crop plants. Plant pathogen interaction - positive and negative integrations Defense mechanisms in plants – biochemical and structural.

Unit III

Plant pathology

Diseases caused by Bacteria-fire blight of apple, potato scab, citrus canker, lethal yellowing of coconut; Fungi-powdery scab of potato, damping off, lite blight of potato, downy mildews of pearl millet, grapes, *Fusarium* wilt of tomato, blast disease of rice, stem rust of wheat, corn smuts; Mycoplasma- Biological control, its importance in crop pests and disease management, merits and demerits of biological control.

Unit IV

Microbial Infections

Parasitism and Disease Development Parasitism and pathogenecity, Host range of pathogens, Disease triangle, Diseases cycle / Infection cycle, Relationship between disease cycles and epidemics; Pathogens Attack Plants – Mechanical forces, Microbial enzymes and toxins, Effect on physiology of Host – Photosynthesis, Translocation and transpiration, Respiration, Permeability, Transcription and translation. Environment and Plant Disease. B) Defense Mechanisms of Plant: Disease Pre-existing structural and chemical defenses, Induced structural and biochemical defenses

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. SundaraRajan 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.

11. Plant pathology. By George Agrios; academic press new York.

12. Microbial Ecology: Fundamentals and Applications by Rinald Atlas and Richard Bartha; Benjamin/Cummings Science Publis., 2725 Sand Hill Road, Menlo Park, California
94025, USA.

13. Plant pathology. By George Agrios; academic press new York

SPT 3.3 B - BIOINFORMATICS AND BIOSTATISTICS

UNIT I

Introduction to Computer and Network

Computer Architecture- Internal and External device. Computer software- operating system- Windows, UNIX and Linux, Application software- word processor, spread sheet. Structure, architecture, advantage, types (LAN, MAN & WAN). Network protocol – Internal protocol (TCP/IP). File transfer protocols (FTP), WWW, HTTP, HTML, URL. Network security – Group polices Fire-walls, C programming and PERL- Algorithm and flowchart, Structure of C program, Header file, Globule declaration, Main function, variable declarations, Control statement – conditional and unconditional- sub functions. Introduction and application of PERL and Bio Perl.

UNIT II

Biological Databases and Sequence Analysis

Introduction Database generation. Data mining and applications.Accessing bibliographic databases–pub med, nucleic acid sequence databank–NCBI and EMBL.Protein sequence databank–NBRF–PIR, SWISSPROT.Structural databases–protein databank (PDB). KEGG: Kyoto Encyclopedia of Genes and Genomes (metabolic pathway data bank), Microbial genomic database (MBGD), Cell line database (ATCC), virus data bank (UICTVdb). Sequence alignment-Global and Local alignment.Scoring matrices. Restriction mapping–WEB CUTTER and NEB CUTTER, similarity searching (FASTA AND BLAST), Pair wise comparison of sequences, Multiple Sequence alignment of sequences, Identification of genes in genomes and Phylogenetic analysis with reference to nucleic acids and protein sequences, Identification of ORFs, Identification of motifs.

UNIT III

Protein Structure and Molecular Interaction

Chemical bonding and non-bonding interactions, stability of electrovalent bond. Co-valent bond – partial ionic character of co-valent bonds and Vander Waals forces. Introduction to protein structure-secondary structure prediction, tertiary structure prediction, protein modeling-principles of homology and comparative modelling. Threading, structure evaluation and validation and *ab intio* modeling, Applications- Rational Drug design and Molecular docking – Auto dock.

Unit IV

Introduction to Biostatistics

Methods for collecting data, tabulation and representation of data, sampling and sample design, types of classification, tabulation, diagrammatic representation line diagram, bar diagram, pie diagram, histogram, frequency polygon, frequency curves and cumulative frequency curves. Measures of central tendency: mean, median, mode, range, mean deviation and standard error. Correlation analysis and regression analysis, probability analysis of variables. Tests of significance: t- test, Chi square test and goodness of fit; ANOVA-Analysis of variance: one way classification and two way classification

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 - A Practical Guide to the Analysis of Genes and Proteins. 2nd Edition by

IV SEMESTER

CPT 4.1 INDUSTRIAL MICROBIOLOGY AND BIOPROCESS ENGINEERING

Unit I

Introduction to bioprocess

Historical development of bioprocess technology, an overview of traditional and modern applications of biotechnology in industry, outline of an integrated bioprocess and unit operations

involved in bioprocesses, process flow sheets. Industrially important microorganisms – Isolation, Screening for new metabolites (general, primary and secondary metabolites) and Preservation; Strain development- (Mutation, Recombination, Protoplast fusion technique), Inoculum development for industrial fermentation.

Unit II

Media for industrial fermentations

Criteria, Media formulation, Typical media, Water, Carbon sources, Nitrogen sources, Minerals, Vitamin sources, Nutrient recycle, Buffers, Precursors Growth factors, Oxygen requirement, Chelaters, Antifoaming agents. Design of a fermenter - Bioreactor design, parts and their functions; Manual and automatic control systems; online monitoring. Types of bioreactors (Tower, Jet, Loop, Airlift, Bubble, Column, Packed bed, Fluidized bed). Sterilization - Design of sterilization process (batch and continuous), Sterilization of Bioreactor, Media, Air and Exhaust air. Filter sterilization. Fermentation - Meaning and Brief history of fermentation, an overview of aerobic and anaerobic fermentation processes and their application. Types of fermentation processes (Surface, Submerged, Batch, Continuous, Solid-substrate, Dual, Fed batch fermentation and its applications).

Unit III

Kinetics of microbial growth and product formation

Phases of cell growth in batch cultures, Simple unstructured kinetic models for microbial growth, Monod model, Growth of filamentous organisms. Growth associated (primary) and non - growth associated (secondary), product formation Kinetic Recovery and purification of fermentation products - Filtration (Micro, Cross-flow and Ultra), Centrifugation (High-speed, Continuous and Ultra), Cell disruption methods, Precipitation, Coagulation, Flocculation, Solvent /Aqueous 2-phase extractions, Dialysis, Electro-dialysis, Reverse osmosis, Ultra filtration, SDS-PAGE, HPLC & Column Chromatography, Gel Filtration, Ion Exchange, Drying, Crystallization Immobilized cells and enzyme technology - Definition and concept of immobilization, Methods immobilization (Carrier-Binding, Adsorption, Entrapment, Ionic bonding, Encapsulation, Cross Linking), whole cell and enzyme immobilization, Application of immobilized cells/ enzymes in fermentation. Fermentation economics and Feasibilities. Enzymes (Amylase, Proteases), Organic acids (Lactic acid, Citric acid, Vinegar), Amino acids (L-lysine, L-glutamic acid), Antibiotics (Penicillin, Streptomycin),Alcoholic beverages (Beer, Wine, Brandy, Rum) Antitumours and Anticholesterol agents, SCP and SCO.

Unit IV

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 & Biotechnology 2nd 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. Vogel A & L. Celeste Todaro 2005 Fermented and Biochemical Engineering Hand Book 2ndStandard Publishers Distribution New Delhi

11. Harvey,W., Blanch, S.Clark. 2007 Biochemical Engineering, Marcel Dekker

CPT 4.2 MEDICAL AND DIAGNOSTIC MICROBIOLOGY

Unit I

Microbiology and Medicine

Historical development, major milestones and significant contributions; Germ Theory of disease, Koch postulates, Recent trends. Overview of Human Anatomy and physiology - Human anatomical and physiological terms/concepts with special reference to microbial infections. Concept of Disease, Disorder, Syndrome - Communicable Diseases – Microbial Infections and Diseases. Microbial Pathogenicity – factors responsible for Microbial pathogenicity. (Communicability infectivity Virulence). 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),Bacteria in the blood and tissues.

Unit II

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. Chemotherapy – Chemotherapeutic agents – antibiotics, (Classification based on chemical structure, mode of action and range of effectiveness), Recent trends – Drug resistance and its consequences, Antibiotic policy, NCCLS (CLSI) guidelines and standards, WHO Guidelines.

Unit III

Systematic study of important pathogenic bacteria

Enterobacteriaceae (*Salmonella, Shigella, E-coli, klebsiella*etc). *Mycobacterium*, Staphylococci, Streptococci, *Vibrio cholerae* , *Treponema, Brucella, Clostridium welchi* & *C. tetani*. Brief account of *Leptospira, meningococci, Camphylobacter* and others. *Corynebacteriam diphtheriae, Bordetella*, Overview/Brief account of Important viral diseases – Pox, Herpes, Adenovirus, Papovo, Picarno, myxoiviridae, retrovirus, arboviruses, hepatitis viruses and Rabies.

Unit IV

Brief account of diseases

Superficial/ dermatomycosis, deep mycosis and dimorphic fungi, Direct and Indirect upper respiratory tract infection, Pyogenic Infections, acute diarrheal diseases; cholera, Endemic Fever; 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 Churchill Livingstone.
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

Concepts and scope of food microbiology

Food as substrate for microorganisms – Hydrogen ion concentration (pH), Moisture requirement, Oxidation-reduction potential, Nutrient content, Inhibitory substances and Biological Structure. Contamination of foods – From green plants, animals, sewage, soil, water, air and handling. Microorganisms important in food microbiology and their source. Food poisoning and intoxication: Significance of food borne diseases, Detection methods

Unit II

General principles of food spoilage and its preservation

Food Spoilage, causes of spoilage, classification of foods by ease spoilage, factors affecting kind and numbers of microorganisms in food, chemical changes caused by microorganism. Spoilage of Meat and meat products, egg and egg products, cereal and cereal products, fruits and vegetable products. Food borne disease and their control – Food infection and intoxication, detecting of food borne pathogens and their toxin by conventional, rapid automated method, genetic and immunological techniques. 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 food preservation. Modern techniques like high electronic field pulses, oscillating magnetic fields – pulses, intense light pulses and ultra high hydrostatic pressure.

Unit III

Dairy Microbiology

Milk – Definition, compositions, food and nutritive value of milk, properties and its constituents, microbiology of milk. Contamination, preservation and spoilage of milk.Testing of milk and milk products, and safety system in dairy industries. Fermented milk products - cheese, yogurt, shrikhand, acidphilus milk and tempeh, Probiotics and their role in controlling food borne disease. Microbial examination of milk.

Unit IV

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

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 of regulatory motifs, In genome Single nucleotide polymorphisms (SNP) in medical genetics and basic research.

Unit II

Transcriptomics

Experimental techniques: microarrays, EST, SAGE. Microarray data: normalization and analysis. Genevestigator and OncoMine – browsing microarray-derived gene expression profiles, tissue and stage-of-development-specific patterns of expression, coexpression of genes, pre-computed lists of differentially expressed genes. Standalone analysis of publicly available microarray expression data: GEO database, TM4 analysis suite. Assembly of EST: CAP3 program Examples of basic research in transcriptomics

Unit III

Proteomics

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

Unit IV

Metabolomics

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

References:

Bioinformatics: Methods and Applications Genomics, Proteomics and Drug Discovery by Rastogi S.C. , Mendiratta Namita , Rastogi Parag

- Applying Genomic and Proteomic Microarray Technology in Drug Discovery, Second Edition by Robert S. Matson
- 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

Fundamentals of Microbiology

Discovery of Microbial world. Controversy over spontaneous generation. Evolutions of Microbiology with its recent developments in Medicine. Role of Microbes in transformation of organic matter and in the causative diseases. Modern trends in microbial taxonomy.

UNIT II

Microbiology of Food and Industry

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

UNIT III

Microbiology of Agriculture and Environment

Distribution of soil microorganisms in soil. Factors influencing the soil microflora- Role of microorganisms in soil fertility. Interactions among microorganisms, mutualisms, comensalism, competition, amensalism, parasitism, predation - Interactions between microbes and plants - rhizosphere, phyllosphere, mycorrhizae. Microbial interactions in animals-Rument microbiology - Microbial contribution to food digestion.

Unit IV

Microbiology of Health

Basics in Medical microbiology - Infectious diseases overview. Medically important microbes. Microbial diseases - sources, route of transmission. Pathogenesis - adhesion, invasion, host cell damage, release of pathogens. Microbial virulence and virulence factors - Signs and symptoms of

microbial diseases. Treatment, Prevention and control of microbial infections. Immunity of microbial diseases.

References:

1. Adams MR and Moss MO. (1995). Food Microbiology, The Royal Society of Chemistry, Cambridge.

2. Alexander M. (1977) Introduction to soil microbiology. John Wiley & Sons, Inc., New York.

3. Andrews AT, Varley J. (1994) Biochemistry of milk products. Royal Society of Chemistry.

4. Banwart GJ. (1989), Basic food microbiology, Chapman & Hall, New York.

5. EcEldowney S, Hardman DJ, Waite DJ, Waite S. (1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical.

6. Frazier WC and Westhoff DC. (1988) Food microbiology, TATA McGraw Hill Publishing Company Ltd. New Delhi

7.Balasubramanian D, Bryce CFA, Dharmalingam K, Green J, Jayaraman K. (1996).

8. Concepts in Biotechnology, University Press, India

9. Dubey RC and Maheswari DK (2005). A text book of Microbiology, Revised Multicolour edition, S.Chand Publishers, New Delhi.

OEPT 3.4 APPLIED MICROBIOLOGY

Unit I

Microorganisms in the service of mankind

Past, present and future. Genetically engineered microorganisms – applications in health, industries, agriculture, environment, fate of genetically engineered microorganisms in the environment.

Unit II

Microbial fuels

Alternate sources of energy - methane and hydrogen production, their significance, of commercial production of biofuels. Single cell proteins & single cell oil, MEOR.

Unit III

Production of commercially important products

Alcohol and alcoholic beverages, antibiotics, enzymes, vitamins and monoclonal antibodies. – mushroom cultivation, composting, vermicomposting, overview of biofertilizers and biopesticides .

Unit IV

Microbes in Bioremediation

Microorganisms in the recovery of precious metals, biodegradable polymers from microorganisms heavy metal tolerant microbes -Mechanism of heavy metal and antibiotic resistance - role of biosorption -biotransformation of Xenobiotics - Superbug - rDNA application. Biodegradation of oil and petroleum products. Microbial leaching - Copper - 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.
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12.

PART – B

Write Short Notes (Answer any four) **4 x 6=24**

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2.
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4.
5.
6.

PART- C

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

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2.
3.
4.
5.

Note: Equal Weightage should be given to all the units while setting the question 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: 04 Marks

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

Max. Marks = 40

Time: 03 hours

1. Major Experiment: 12 Marks

2. Minor Experiment: 06 Marks

3. Spotters (04): 12 Marks

4. Records: 05 marks

5. Viva –Voce: 05 marks