

**GOVERNMENT OF KARNATAKA
DEPARTMENT OF COLLEGEIATE EDUCATION**

**M.Sc Microbiology (PG) Syllabus
From 2018-2019**

**M.Sc DEGREE (SEMESTER) COURSE UNDER CBCS- SCHEME
SCHEME OF TEACHING AND EXAMINATION
(Effective from the academic year 2018-19 and onwards)**

**DEPARTMENT OF STUDIES (PG) AND RESEARCH IN
MICROBIOLOGY**

**GOVERNMENT COLLEGE (AUTONOMOUS),
KALABURAGI**

Approved by Academic Council



PRINCIPAL

Govt. College

Kusnoor Road, GULBARGA-585 105

GOVERNMENT OF KARNATAKA
DEPARTMENT OF COLLEGEIATE EDUCATION

GOVERNMENT COLLEGE (AUTONOMOUS), KALABURAGI

M.Sc DEGREE (SEMESTER) COURSE UNDER CBCS- SCHEME

SCHEME OF TEACHING AND EXAMINATION

(Effective from the academic year 2018-19 and onwards)

Subject Code	PAPERS	Total Credits	Teaching hrs/week	Exam Marks	IA	Exam hrs	Total marks
I SEMESTER							
CCT 1.1	Fundamentals of Microbiology	4	4	80	20	3	100
CCT 1.2	Cell Biology & Biochemistry	4	4	80	20	3	100
CCT 1.3	Bacteriology	4	4	80	20	3	100
DSET 1.1	a. Mycology and Virology b. Biological Chemistry	4	4	80	20	3	100
CCP/DSEP1.1	Practical 1.1	4	8	80	20	4	100
CCP/DSEP1.2	Practical 1.2	4	8	80	20	4	100
	Total	24				Total	600
II SEMESTER							
CCT 2.1	Microbial Metabolism & Enzymology	4	4	80	20	3	100
CCT 2.2	Microbial Genetics	4	4	80	20	3	100
DSET 2.1	a. Environmental Microbiology b. Bioprocess Technology	4	4	80	20	3	100
GET 2.1	General Microbiology	4	4	80	20	3	100
CCP/DSEP2.1	Practical 2.1	4	8	80	20	4	100
CCP/DSEP2.2	Practical 2.2	4	8	80	20	4	100
	Total	24				Total	600

III SEMESTER							
CCT 3.1	Medical Microbiology & Pharmaceuticals	4	4	80	20	3	100
CCT 3.2	Food & Dairy Microbiology	4	4	80	20	3	100
DSET 3.1	a. Genetic Engineering & R-DNA Technology b. Molecular Biology	4	4	80	20	3	100
GET 3.1	Microbes in Human Welfare	4	4	80	20	3	100
CCP/DSEP3.1	Practical 3.1	4	8	80	20	4	100
CCP/DSEP 3.2	Practical 3.2	4	8	80	20	4	100
	Total	24				Total	600
IV SEMESTER							
CCT **4.1	Industrial Microbiology	4	4	80	20	3	100
CCT 4.2	Immunology & Immunotechnology	4	4	80	20	3	100
DSET 4.1a 4.1 b	Agricultural Microbiology Microbial Technology	4	4	80	20	3	100
CCP/DSEP4.1	Practical 4.1	4	8	80	20	4	100
CCP/DSEP4.2	Practical 4.2	4	8	80	20	4	100
CCPR 4.1	PROJECT WORK	6	6	120	30	4	150
	Total	26				Total	650
	TOTAL MARKS (I TO VI SEMESTERS)	98		1960	490	Grand Total	2450

CCT – Core Course Theory.
GET- General Elective Theory
DSEP- Discipline Specific Elective Practical
CCPR –Project Work

DSET – Discipline Specific Elective Theory
CCP - Core Course Practical
GEP- General Elective Practical

- II Semester water plant visit and soil & water sample collection study trip submit the report at the time of examination.

**** IV Semester- Industrial visit Study tour and submit the Report at the time of examination compulsory**

I SEMESTER

PAPER – CCT 1.1 : Fundamentals of Microbiology

- Unit-1.** **12 hrs**
History of Microbiology: Development and scope of Microbiology; Theories of spontaneous generation; Biogenesis and Germ theory of disease; Contributions of Antony van Leeuwenhook, Edward Jenner, Joseph Lister, Louis Pasteur and Robert Koch
Micro organisms; General characteristics of major groups of micro organisms; Prokaryotes and Eukaryotes- viruses, bacteria, fungi, algae and protozoa. A comparative account of prokaryotes and eukaryotes; General structure and functions of cell membrane, membrane bound organelles and cell organelles.
- Unit-2** **10hrs**
Distribution of Microorganisms: Distribution of micro organisms in soil, air and water,.
Microscopy: Working principle, construction and operation of different types- Simple, compound, phase contrast, fluorescent and electron microscope. Micrometry and photomicrography.
- Unit-3** **10hrs**
Sterilization and Disinfection: Principles, types and technique, physical, chemical, radiation and mechanical methods. Microbiological media: Components, preparation and types- basal, special differential, indicator, enriched and transport media.
- Unit-4** **10hrs**
Pure culture techniques: isolation of different micro organisms from different environment. Simple collection, preservation and enrichment. Different methods of isolation- pour plates, spread plate, serial dilution. Maintenance and preservation of microbial cultures: slant culture, stab culture, soil culture, mineral oil and overlaying and glycerol preservation. Lyophilization. Type culture collection centres- Indian and global- ATCC, MTCC and NCIM etc.
- Unit-5** **10hrs**
Staining techniques: Nature and types of stains. Principle, mechanism, -Simple, differential – gram's, AFB staining, Negative staining, Structural staining techniques- spores staining, flagella staining, capsule staining, cell wall staining, food granules staining. Algae and fungal staining methods, wet mounting methods.
- Unit-6** **12hrs**
Working principle and operation of instruments used in microbiology laboratory- Autoclave, laminar air flow system, incubator, pH meter, spectrophotometer, electrophoretic unit, centrifuge, chromatography, x ray diffraction crystallography; R, NMR and Mass spectroscopy. Safety measures of microbiological laboratory, levels of laboratory and good laboratory practices.

Reference Books:

1. Booth C, 1971, Methods in Microbiology, 4th Ed., Elsevier
2. Alfre Pingond, 2002, Biochemical Methods, Wiley VCH Publ.
3. Jeffrey C Pommerville, 2011, Fundamentals of Microbiology, Bartlett Series.
4. Roger Y. Stanier, 1987, General Microbiology, MacMillan Publ.
5. Lammart JM, 2006; Techniques in Microbiology – a student handbook, amzon.com.
6. Madigan MT et al, 2008; Brock – Biology of Microorganisms, amzon.com.
7. Atlas RM, 1995; Principles of Microbiology, Mosby Yearbook Missouri
8. Pelczar, Chan & Kreig, 1982; Microbiology, McGraw Hill Book Co, New York
9. Bernard D. Davis et al, 1990; Microbiology Vol. I & II, Himalaya Publ., New Delhi
10. Cappuccion & Sherman, 1990; Microbiology – A Laboratory Manual, Addossian Weisley.

PAPER – CCT 1.2 : CELL BIOLOGY AND BIOCHEMISTRY

Unit-1

12hrs

Tools of cell biology. Ultra structure of prokaryotic and eukaryotic cells, organelles structure marker and function, Endoplasmic reticulum, Golgi complex, Types of vesicles - transport and their functions, Lysosomes. Nucleus - Internal organization, Nuclear pore complex, Nucleosomes Chromatin. Mitochondrial Genome, Structure and Function – Oxidative Metabolism in the Mitochondrion – The Role of Mitochondria in the formation of ATP, Peroxisomes. Genome studies of Mitochondria.

Unit-2

10hrs

Chloroplast structure and function – An overview of photosynthetic Metabolism, Cytoskeleton – components of Cytoskeleton, Microtubules, Intermediate filaments – Microfilaments, Protein trafficking, Cell- to -Cell Signaling: Hormones and Receptors, Intracellular signalling. Transport across Cell Membranes, Protein Sorting: Organelle Biogenesis and Protein secretion, Stem Cell Biology, Cancer, Regulation of Cell Death; Apoptosis, Circadian Rhythms

Unit-3

8 hrs

Cell- to -Cell Signaling: Hormones and Receptors , Transport across Cell Membranes Protein Sorting: Organelle Biogenesis and Protein secretion, Stem Cell Biology, Cancer, Regulation of Cell Death; Apoptosis Circadian Rhythms

Unit-4

12hrs

Basic concepts of Biochemistry: Atoms,elements,molecules, compounds and biomolecules. Atomic bonds-covalent and non covalent.Hydrogen bonds and Vander waal forces. Biological solvents:Structures and properties of water molecules. Wter as an universal solvent .Polarity, hydrophilic and hydrophobic properties. Acids and Bases- concepts and types, electrolytes, pH, buffers and physiological buffer systems.

Unit-5

10hrs

Bioenergetics: Free energy, enthalpy,Entropy, classification of high energy compounds, redox potenential, law of thermodynamics. Biological oxidation: Electron transport system, oxidative phosphorylation, inhibitors and mechanisms of oxidative phosphorylation.

Unit-6

12hrs

Carbohydrates: classification,structures, prop erties and functions. Lipids: classification, structures, properties and functions. Amino acids: classification,structures and properties .Proteins ; types, structures and properties.

Reference Books:

1. Felix Franks, 1993; Protein Biotechnology, Humana Press, New Jersey.
2. Stryer L, 1995; Biochemistry, Freeman and Company, New York.
3. Voet & Voet, 1995; Biochemistry, John Wiley & Sons, New York.
4. Nelson & Cox, 2000; Lehninger's Principles of Biochemistry, Elsevier Publ.
5. Freifelder D, 1982; Physical Biochemistry, Freeman & Co. New York.
6. Harper, 1999; Biochemistry, McGraw Hill, New York.
7. Colowick S P and Kaplan N D, 1955; Methods in Enzymology. Vol. I. Academic Press.
8. Sualter C H, 1985; Practical Guide to Enzymology. John Wiley & Son.
9. Price & Steeves, Fundamentals of Enzymology
10. Kapler, Advances in Enzymology, Academic Press.

PAPER – CCT 1.3 : BACTERIOLOGY

Unit-1

12hrs

Introduction: Discovery of bacteria, origin and evolution. Morphology and ultra structure of bacteria: size, shape and arrangement- structure chemical composition of cell wall of arechaebacteria, gram negative bacteria, gram positive bacteria and acid fast bacteria : Fine structure, composition and function of cell membrane,capsule , pilli,flagella,gas vesicles, ribosomes,mesosomes,reserve food materials, magnetosomes and phycobillisome, bacterial nucleic acids and genome organisation.

Unit-2

12hrs

Bacterial systematic: classification systems, major characteristic used nucleic acid ,serology,chemical composition and pylogenetic mode of classification. .Numerical taxonomy, cluster analysis and construction of taxonomy groups based on dendograms. bacterial nomenclature and its role in taxonomy. Salient features of Bergy's manual of systematic bacteriology:characteristics of major groups of bacteria.

Unit-3

10hrs

Reproduction in bacteria: Binary cell division, Septum formation,planes of cell division, other forms of bacterial reproduction .Bacterial endospore: spore forming bacteria-formation,properties and germination of endospores, induction of endospores formation.

Unit-4

10hrs

Archaeobacteria: General characteristics and classification;extremophilic nature; type studies-adaptaion, role of archarebacteria in the evolution of microbial world and their economic imporatance. Actinobacteria: General characteristics and classification, diversity and distribution, economic importance.

Unit-5

10hrs

Cynobacteria: General characteristics and classification- ultra structure, reproduction and economic importance.Bioluminescent bacteria: characteristics and examples,mechanisms of bioluminescence , applications.

Unit-6

10hrs

Mycoplasma: General characteristics and examples growth and multiplication,their significance. Richettsiae and Chalmydia: general characteristics and examples,life cycle, growth and multiplication, their significance. Diversity of bacteria: concept, signifancance and conservation of biodiversity; methods of bacterial diversity,culturable and non culturable bacteria.

Reference Books:

1. W D Frost and E. F. McCampbell, 2010; Text Book of General Bacteriology, Bibliobazaar, Publ.
2. N. Woodford & A.P. Johnson 1996; Molecular Bacteriology, Human Press Inc.
3. J.K. Struthers & R.P. Westram, 200; Clinical Bacteriology, Manson Publ. Ltd.
4. William Henarl, 2000, Bergy's Manual of Determinative Bacteriology, 9th Ed., Lippincott
5. A.J. Salle, 1974; Fundamental Principles of Bacteriology, Tata McGraw Hill Edition.
6. S.H. Gillespie & P.M. Hawkey 2006; Principles and Practice of Clinical Bacteriology; John Wiley
7. G.G. Meynell & Elinor Meynell, 2000; Theory & Practice of Experimental Bacteriology, Cambridge
8. Peter Hawkey & Deidre Lewis 1990; Medical Bacteriology, Oxford University Press.
9. Bergey's Manual of Systematic Bacteriology. 9th Edn. Lippincott Williams, Wilkin Bacteriology,
10. Brock Biology of Microorganisms by Madigan, Martinko and Parker. 2005 al Inc.

PAPER - DSET 1.1 a : MYCOLOGY AND VIROLOGY

Unit-1

10hrs

Introduction to virology: History, origin, development and evolution of viruses. General structures of viruses: configuration and symmetry-helical and icosahedral, physical and chemical components-capsomere, capsid, matrix and envelope; viral genome, nucleoprotein organization, multiplication of viral genomes.

Unit-2

10hrs

Isolation, purification and cultivation of viruses, Detection of viruses-physical, biological, immunological and molecular methods. Taxonomy of viruses: Salient features of viral classification-Baltimore classification of viruses ICTV classification of viruses.

Unit-3

12hrs

Phages: Bacteriophages, cyanophages, mycophages and phycophages –general characteristics, isolation, identification and cultivation, replication of phages, classification significance and applications. Plant viruses: general characteristics, isolation, identification, cultivation, classification; translocation and distribution of viruses in plants; different mode of transmission of plant viruses- type studies and significance of plant viruses.

Unit-4

12hrs

Animal viruses: general characteristics, isolation, identification and cultivation and classification; dissemination of animal viruses- direct and indirect contacts through vectors; structure and life cycle of some of the important animal viruses; type studies and significance of animal viruses. Oncogenic viruses; definition, general characters. Subviral particles; characteristics and their significance; satellites virus and satellite RNA, prions and viroids.

Unit-5

10hrs

Introduction to mycology; general characteristics of fungi and classification of fungi with distinguishing characteristics up to class level, distribution of fungi. Fungal structures: fine structure of hypha, mycelium and yeast; structure and composition of fungal walls, plasma membranes, septa, cytoskeleton, modes of nutrition fungal adaptation for nutrient capture [apical growth, enzymes secretion defences of territory]

Unit-6

10hrs

Reproduction in fungi: vegetative reproduction-fragmentation fission, budding, spawn, sclerotia, rhizomorphs; asexual reproduction- endospores, conidia, oidia, chlamyospores, pycniospore- ascospores, basidiospores, urediospores and teliospores; sexual reproduction- planogametic population, gametangial contact, gametangial population, sperm metogamy, somatogamy; reduction of sex in fungi. Economic importance of fungi; life cycle of economically important yeast, mold, mycorrhiza and lichens.

Reference Books:

1. Benson's Microbiological Application: Lab Manual in General Microbiology by A.E. Brown; 2008.
2. Jawetz's Medical Microbiology. By GF Brooks (25th Ed.) 2007; Prentice Hall International Inc.
3. Fraenkel-Contrat H. edited; Virology, (1988). Prentice Hall, New Jersey.
4. Aneja A.K., Experiments in Microbiology. 2005.
5. Cappuccino Sherman's Microbiology- A Laboratory Manual, 7th Ed., 1994; Pearson Education India
6. Topley and Wilson's Microbiology and Microbial infections, Vol-2: Virology. 1994.
7. Dubey RC & Maheshwari DK. Practical Microbiology. 2005 ed.
8. Mathew's Plant Virology by Roger Hull. 4th ed., (2002); Academic Press, U.K.
9. George Agrios; Plant pathology. 4th ed. 1997; Academic Press, New York
10. Sullia SB & Shantharam S. General Microbiology. 2nd Ed. 2005; Oxford & IBH Publ., New Delhi

DSET 1.1 b : BIOLOGICAL CHEMISTRY

Unit -I

Carbohydrates: Characters and classification; Monosaccharide -classification, structure and physico-chemical properties, glycosides, derivatives of monosaccharide – amino sugars, sugar acids and phosphorylated sugars. Disaccharides- sucrose, lactose and maltose. Structure, occurrence and biological significance of polysaccharides (starch, cellulose, chitin, glycogen and peptidoglycan).

Unit -2

Amino acids – Standard amino acids, nonstandard amino acids, D-amino acids, beta-and-gamma-amino acids. Classification of amino acids. Analysis of mixtures of amino acids. Derivatives of amino acids.

Unit - 3

Lipids - classification of lipids; fatty acids – physico - chemical properties, separation, distribution in nature, characterization and saponification and iodine number.

Unit -4

Nomenclature, outline structure, properties and functions of glycerides, neutral lipid (waxes, fats and oils) phospholipids, sphingophospholipids and glycolipids. Steroids plant sterols, ergosterol, stigmasterol and cholesterol. Important features of bacterial lipids.

Unit -5

Vitamins: Classification- water and fat soluble vitamins, structure and their biochemical properties. Proteins classification, organization and specificity of proteins, supramolecular assemblies of proteins, purification methods, glycoprotein and proteoglycans..

Unit-6

Nucleic acids: Structure of purine and pyrimidine bases, nucleosides and nucleotides and their nomenclature. Types of RNA and DNA their structure.

Recommended Books

1. Voet Donald and Voet J.G .3rd Edition , Biochemistry John Wiley and sons INC
2. Zubay .G. Biochemistry- Wm.C.brown Publishers
3. White .D. 2000 The Physiology and Biochemistry of prokaryotes-Oxford Univ.press
4. Lehninger A.L.Cox and Nelson -2006,4th Edition, Principles of Biochemistry –CBS Publishers and Distribution Pvt.Ltd
5. Gottschalk .G.1985 Bacterial metabolism –Springer Verlag
6. Stryer .L.5th Edition –Biochemistry . W.H.Freeman and Co
7. Doelle H.W.1975 Introduction to bacterial metabolism –Academic press
8. Wilson. K. and Walker.J.2000 Principle and Techniques –Practical Biochemistry- Cambridge University press
9. Murray, Harpers Biochemistry Mc Graw Hill
10. White , Handler and Smith-Biochemistry
11. West and Todd –Biochemistry Mac Millan Publishers
12. Corn and Stumpf, 5th Edition-Outlines of Biochemistry-Wiley Eastern Publications.
13. Upadhyaya and Nath- Biophysical chemistry (Himalaya Publications)
14. Morrison –Physical Biochemistry (Oxford)
15. Satyanarayana and Chakrapani 3rd Edition-Biochemistry Books and Allied Publishers
16. Trevor Palmer 2004 Enzymes, Affiliated East-West Press Pvt .Ltd

II SEMESTER

PAPER – CCT 2.1 : METABOLISM AND ENZYMOLOGY

- Unit-1** **12Hrs**
Microbial growth: Phases of growth, factors influencing growth, Measurement of growth, Continuous and Synchronous growth. Microbial Photosynthesis: Light Energy, Photolysis of Water. Photosynthetic Pigments, Cyclic and Non-Cyclic Photophosphorylation, Calvin's Cycle. Microbial Nutrition: Classification of organisms based on Carbon source, energy source and electron source, Macro and Micronutrients.
- Unit-2** **10Hrs**
Fermentation Reactions: Types of fermentation reactions, Homo and Hetero fermentation pathways; Alcohol and Lactic acid fermentation pathways. Enzyme Kinetics: Concept of kinetics; Michaelis – Menton equation, Line weaver- Burk plot, Haldane and Briggs equation.
Factors influencing enzyme activity –pH, temperature, substrate concentration and enzyme concentration. Concept and significance of K_m and V_{max} . Basics of enzyme turnover- Kinetics, measurement and rates of enzyme turn over.
- Unit-3** **10Hrs**
Mechanism of enzyme action: Hypothesis for enzyme-substrate binding –lock & key and induced fit model; Specificity-reaction and substrate specificity; Acid base catalysis, covalent catalysis and metal ion catalysis.
Enzyme Activation and Regulation: Concept of enzyme activation; enzyme activators and Allosteric enzymes (Threonine dehydratase and aspartate transcarbomylase); covalently modulated enzymes (Glycogen phosphorylase); Multienzyme complex (PDH and fatty acid synthase) and Membrane bound enzymes (ATPase).
- Unit-4** **10Hrs**
Enzyme Inhibition: Concept of enzyme inhibition; types of enzyme inhibitors-reversible, competitive, non-competitive, uncompetitive and irreversible; significance and applications of enzyme inhibitors. Isoenzymes (Isozymes):
Definition and significance of isoenzymes. Examples and applications of important isoenzymes - Lactate dehydrogenase, creatine phosphokinase, alcohol dehydrogenase, alkaline phosphatase and isocitrate dehydragenase.
- Unit- 5** **10Hrs**
Isolation and Purification of microbial enzymes. Enzyme Stability: Concept and significance of enzyme stability; Principles of enzyme stabilization; methods of enzyme stabilization and applications of stable enzyme. Structural elucidation of enzymes and methods of enzyme

detection. Carbohydrate metabolism: Glycolysis-significance, regulation. Glycogenesis, glycogenolysis, gluconeogenesis- Significance, regulations; TCA cycle-significance, regulations. Glyoxylate cycle. Amphibolic nature of TCA cycle. HMP shunt.

Unit- 6

12Hrs

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, ketosis), extra mitochondrial biosyntheses of long fatty acids (palmitate), significance and regulation. Synthesis of triacylglycerols, metabolism of phospholipids and glycolipids.

Biosynthesis and degradation of cholesterol. Metabolism of amino acids: Transamination, deamination, decarboxylation; Urea cycle - regulation. Metabolism of ammonia; Synthesis and degradation of Glycine, phenylalanine and Tyrosine, Synthesis and degradation of Sulfur containing amino acids

Reference Books:

1. Felix Franks, 1993; Protein Biotechnology, Humana Press, New Jersey.
2. Stryer L, 1995; Biochemistry, Freeman and Company, New York.
3. Voet & Voet, 1995; Biochemistry, John Wiley & Sons, New York.
4. Nelson & Cox, 2000; Lehninger's Principles of Biochemistry, Elsevier Publ.
5. Freifelder D, 1982; Physical Biochemistry, Freeman & Co. New York.
6. Harper, 1999; Biochemistry, McGraw Hill, New York.
7. Colowick SP and Kaplan N D, 1955; Methods in Enzymology. Vol. I. Academic Press.
8. Sualter C H, 1985; Practical Guide to Enzymology. John Wiley & Son.
9. Price & Steeves, Fundamentals of Enzymology
10. Kapler, Advances in Enzymology, Academic Press.

PAPER – CCT 2.2 : Microbial genetics

Unit -1

12Hrs

Historical Preview of Genetics: Mendelian principles and classical genetics, Genetic concepts, Development of microbial genetics, contributions of various scientists, time line of the development of microbial genetics Chemical basis of heredity; early concepts of genes; discovery of the chemical basis of heredity - experimental evidences. Genomic structure and organization: Organization of genetic material - Genome organization in bacteria . Interrupted genes, gene clusters. Structure of nucleosome, chromatin and chromosome.

Unit- 2

10Hrs

Genetic recombination: In bacteria; transformation, competence, lysogeny, generalized and restricted transduction, conjugation, sexduction, fine structure mapping, recombination in viruses, phenotypic mixing Transposable elements Insertion sequences, transposons, and integrons. Replicative transposition, Nonreplicative transposition, Excision and transposase-mediated rearrangements, Regulation of transposition, Use of transposons. Chromosomal rearrangements, Transposons and evolution.

Unit- 3

10Hrs

Mutations: Types of mutations, null, leaky, and conditional mutations, mutations as random or adaptive events; Mutants – isolation, selections, screening and enrichments, Uses of mutants. Mutagenic agents – physical, chemical and biological; molecular basis of mutations; Reversion and suppression - Reversion assays –Ames Test. Structure of nucleic acids: Structure of DNA and its elucidation, structural polymorphism in DNA, extra-chromosomal DNA. Structure of RNA.

Unit- 4

10Hrs

Systems that safeguard DNA: DNA repair mechanisms – photo reactivation, mismatch repair, recombination repair, SOS repair, DNA restriction and modification. Replication of DNA, evidence of semi-conservative replication. Mechanism and enzymology of DNA replication. Regulation of DNA replication. Replication of RNA.

Unit- 5

12Hrs

Transcription: 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, Involvement of ribosome in translation, ribosome structure, initiation, elongation and termination of polypeptide chain synthesis in prokaryotes and eukaryotes, extra ribosomal factors, ribosome cycle, post translation modifications of proteins.

Unit-6

10Hrs

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. Gene silencing: Transcriptional – genomic imprinting, paramutation, transposon silencing, histone modifications, position effect; Post transcriptional – RNA interference, RNA silencing.

Reference Books

1. William Hays, 1980; The genetics of bacteria and their viruses, CBS Publ. New Delhi.
2. Jenkins JB, 1995; Genetics, Houghton Mifflin Co., Boston.
3. Strickberger MW, 1990; Genetics MacMillan Publ. Co. Inc. New York.
4. Stent GS & Calendar R, 1978; Molecular Genetics, Freeman & Co., San Francisco.
5. Benjamin Lewin, 2005, Genes - VIII, John Wiley & Sons, New York
6. Watson JD et al, 2004; Molecular biology of the Gene, Pearson Education India
7. Hartwell LH et al, 2000; Genetics – from Genes to Genomes, McGraw Hill Publ.,
8. Griffith Miller et al, 1996; An introduction to Genetic Analyses, Freeman & Co., NY.
9. Maloy, Cronan & Freifelder, 1994; Microbial Genetics, Jones & Bartlett Series.
10. Streps UN & Yasbin RE, 2005, Modern Microbial Genetics, Wiley Blackwell Publ.

PAPER – DSET 2.1 a : Environmental Microbiology

Unit- 1

10Hrs

Introduction: Origin, Concept and Development of Environmental Microbiology. Microbial Community: Ecosystem, habitat and niche. Concept and dynamics of microbial population and community. Structure and functions of microbial communities. Ecological succession.

Unit-2

12Hrs

Microbial diversity: Diversity of microorganisms in different environments. Conventional and molecular methods of studying microbial diversity. Microbes in extreme environments. Extremophiles - Psychrophilic, thermophilic, acidophilic, alkalophilic, halophilic and barophilic. Mechanism of adaptation in extremophilic microorganism. Water Pollution: Sources, Characteristics of water pollutants, health hazards due to water pollution. Standard water quality criteria, Water quality testing (MPN technique). Eutrophication - causes, consequences and prevention.

Unit- 3

12 Hrs

Waste water treatment: Primary-physical processes; Secondary-biological treatment by fixed biofilm systems (trickling filters, RBC, fluidized bed reactors), suspended systems (activated sludge process, oxidation lagoons, anaerobic digesters, septic tank); Tertiary- Filtration (sand beds & membrane filters) chlorination, ozonization, radiation and reverse osmosis. Air pollution and Radiation hazards: Sources and characteristics of air pollutants; Health hazards due to air pollution; Green house gases and green house effect. Ozone hole and acid rain. Radiation hazards and safety measures – sources, effect of radiations and safety measures.

Unit- 4

10 Hrs

Soil pollution: Sources and characteristics of soil pollutants. Effects of soil pollution on human health and crop productivity. Solid waste management: Handling and treatment of solid wastes. Sludge handling and disposal- sludge processing, screening, dewatering, thickening, conditioning; stabilization-aerobic and anaerobic digestion (biomethanogenesis). Handling of biohazard and hospital wastes.

Unit- 5

10 Hrs

Microbiological indicators: Concept and significance. Microbiological indicators of water and air pollution. Biodegradation of xenobiotics: Microbial degradation of pesticides, polycyclic aromatic hydrocarbons, natural and synthetic polymers (cellulose, pectin, lignin, detergents, plastics).

Unit- 6

10 Hrs

Microbial remediation: Concept and scope of bioremediation. Methods and types of bioremediation of contaminated soil and water using microorganisms. Microbial leaching: Origin and concept. Mechanism and role of microorganisms in recovery of important minerals - Iron, Copper and Gold.

Reference Books:

1. Brock T.D. Principles of Microbial Ecology. Prentice Hall Publ. Co. Philadelphia.
2. Martin Alexander. Microbial Ecology. John Willey & Sons. New York.
3. Atlas & Bertha. 1998. Microbial Ecology. 3rd Ed.
4. Gabriel Britton, 1994, Wastewater Microbiology, John Willey & Sons, New York.
5. Ralph Mitchell, 1995, Environmental Microbiology, Wiley Liss, New York.
6. Criston J. Hurst, Manual of Environmental Microbiology, ASM Publ., New York.
7. Feltcher, M. & Grey TRG, 1987, Ecology of Microbial Communities, Cambridge Univ. Press.
8. Rose R.D. Air Pollution & Industry. Reinhold Co., New York.
9. Metcalf and Eddy. 1991. Waste Water Engineering. McGraw Hill Int. Publ.
10. APHA, 1994, Standard Methods, 17th Ed., American Public Health Association.

Paper-DSET b: Bioprocess Technology

Unit – 1

10 hrs

An overview of fermentation technology, range of fermentation processes, primary and secondary metabolites, components of fermentation process. Industrial micro organisms: isolation, preservation, screening and strain improvement and maintenance.

Unit-2

10 hrs

Formulation of industrial media: Medium requirements for fermentation processes, carbon, nitrogen, mineral sources, buffers, antifoam agents, medium optimization. Stoichiometry of cell growth and product formation, Sterilization of media and fermenters, scale – up process and starter culture technology

Unit – 3

12hrs

Basic design of a microbial fermentor, types of fermentation vessels. Aseptic operation, containment, Body construction (stirrer glands, bearing, valves, steam traps) baffles, spargers and impellers. Types of fermentations: batch, continuous, fed-batch, solid state, sub-merged. Aerobic and anaerobic, dual and multiple fermentations, their advantages and disadvantages.

Unit – 4

10 hrs

Importance of downstream processing in industrial fermentation processes. Problems and requirements of bio product recovery and purification. Physico- chemical basis of bio separation processes.

Unit – 5

8 hrs

Fermentation economics - Market potential, some effects of maintenance legislation on production of antibiotics and recombinant proteins, plant and equipment.

Unit- 6

14 hrs

Continuous culture, recovery costs, water usage and recycling and effluent treatment. A brief out lines of processes for the production of the following commercially important products

a. Primary metabolites

- i. Organic acids : Citric acid, lactic acid,
- ii. Amino acids : Glutamic acid, L – lysine,
- iii. Solvents : Acetone, ethyl alcohol

b. Secondary metabolites

- i. Antibiotics : Streptomycin, penicillin
- ii. Vitamins : B12, Riboflavin,
- iii. Biofuels : Hydrogen, methane

Recommended Books

1. Ali Cinar, Satish J. Parulekar, Cenk Undey, Birol Gulnur 2003 Batch Fermentation: Modeling, Monitoring, and Control Marcel Dekker Inc
2. Anke, T 1997 Fungal Biotechnology, Chapman & Hall, London.
3. Arnold, L.Demain and Julian E. Davies, Atlas. R.M. 1999 Manual of Industrial Microbiology and Biotechnology 2nd Edition.
 1. Berry, D.R. (Ed) 1998 Physiology of Industrial fungi BSP, Oxford University.
 2. Crueger & Crueger Biotechnology: A Text Book of Industrial microbiology 2nd edition
 3. Dellweg .Biotechnology Vol III.
 4. Demain, A.L Biology of Industrial Microorganisms
 5. Diliello Methods in Food and Dairy Microbiology
 6. Glazer & Nikaido .Microbial Biotechnology
 7. Harold B. Reisman 1988 Economic Analysis of Fermentation Processes CRC Pr I Llc
 8. Henry,C.Vogel and L. Celeste Todaro 2005 Fermented and Biochemical Engineering Hand Book 2ed
Standard Publishers Distribution New Delhi
 9. Harvey, W., Blanch, S.Clark. 2007 Biochemical Engineering Marcel Dekker
 10. Hershnergen, C.L., Queener, S.W. and Hegeman, Q Genetic and Biotechnology of Industrial Microbiology
 11. Ladisch, M.R. 2001 Bioseparation Engineering: Principles, Practice and Economics, Wiley
Interscience.

PAPER – GET 2.1 : General Microbiology

Unit- 1

10Hrs

Introduction to microorganisms; Definition, Discovery of microorganisms, Types of microbes – viruses, mycoplasma, rickettsiae, bacteria, fungi, actinomycetes, algae and protozoa and their General characteristics.. Distribution of microorganisms: In air, water and soil.

Unit- 2

10Hrs

Different types of microscopes, Appearance of microorganisms: Microscopic observations, different shapes and sizes of microorganisms, staining properties, staining of cells organelles and inclusion bodies. Sterilization methods (physical and chemical); Media – preparation, ingredients and types; Isolation and cultivation of microorganisms-Pure culture techniques.

Unit- 3

10Hrs

Identification of microorganisms: Cultural and microscopic characters; Biochemical properties; Taxonomy of microorganisms. Preservation of microorganisms: Methods of maintenance and preservation of microbial cultures – slant cultures, glycerol cultures, refrigeration and lyophilization; Culture collection centers

Unit- 4

12Hrs

Microbes and Environment: biogeochemical cycles;Microbes in Agriculture: Role of microorganisms in soil fertility and crop productivity; Biological nitrogen fixation; Phosphate solubilization; Mycorrhiza; Plant growth promoting rhizobacteria; Composting. Causative agents and symptoms of major plant diseases.

Unit- 5

12 Hrs

Microorganisms and Food: Fermented food and food products; Nutritative and medicinal value of fermented foods; Probiotics and nutraceuticals; Production of various fermented foods- curds, yogurt, cheese and beverage; Principals of food spoilage and contamination. Concepts and types of immunity to microbial infections; Major human diseases caused by microbes – Typhoid Fever ,TB,Hepatitis,Rabies,Malaria,Amebiasis.

Unit- 6

10 Hrs

Microorganisms and Industry: Microbial fermentations; types of Raw materials; Types of fermenters ; Industrial Production of antibiotics, enzymes, organic acids,Alcohol,Solvents.

Reference Books:

1. Roger Y. Stanier, 1987, General Microbiology, MacMillan Publ.
2. Lammart JM, 2006; Techniques in Microbiology – a student handbook, amzon.com.
3. Madigan MT et al, 2008; Brock – Biology of Microorganisms, amzon.com.
4. Atlas RM, 1995; Principles of Microbiology, Mosby Yearbook Missouri
5. Pelczar, Chan & Kreig, 1982; Microbiology, McGraw Hill Book Co, New York
6. Frazier WC & Westhof DC; Food Microbiology, 3rd Ed., Tata McGraw Hill.
7. Doyle PM et al; Food Microbiology – Fundamentals & Frontiers, 2nd Ed., ASM Press
8. Atlas & Bertha. 1998. Microbial Ecology. 3rd Ed.
9. Ralph Mitchell, 1995, Environmental Microbiology, Wiley Liss, New York.
10. Subba Rao. 2000. Soil Microbiology. 4th Ed. Oxford & IB

III- SEMESTER

PAPER – CCT 3.1: Medical Microbiology and Chemotherapy

Unit-1

10 Hrs

Introduction: Historical developments - Major milestones and significant contributions. Human Anatomy and physiology: An overview of human anatomy and physiology. Important terms/concepts of human anatomy and physiology with special reference to microbial infections.

Unit-2

10hrs

Diseases caused by microorganisms: Concept and illustrations; Communicable diseases; normal flora of human body; opportunistic pathogens. Microbial pathogenicity and pathogenesis: Attributes of pathogenicity and pathogenesis. Mechanism of disease process and prognosis. Host and microbial factors influencing susceptibility.

Unit-3

10 Hrs

Microbial infections: Concept and types of microbial infections; Modes of transmission of pathogens, Portal of entry and exit; Types of infections; Nosocomial infections. Chemotherapy: Antimicrobial agents and antibiotics; Classification of antibiotics based on chemical structure, mode of action and range of effectiveness; Drug resistance - recent trends and its consequences; Antibiogram and Antibiotic policy; NCCLS (CLSI) guidelines and standards; WHO Guidelines.

Unit-4

10Hrs

Systematic study of important pathogenic bacteria with reference to etiology, symptoms, diagnosis, treatment and epidemiology; Enterobacteriaceae (*Salmonella*, *Shigella*, *E.coli*, *Klebsiella*); *Mycobacterium tuberculosis*, *M .leprae*, *Vibrio cholerae*, *Brucella pertusis*, *C. tetami* and Syphilis. Etiology, epidemiology, symptoms, diagnosis and treatment of diseases caused by Chlamydia, Mycoplasma and Rickettsia.

Unit-5

12 Hrs

Pathogenicity, symptoms, diagnosis, treatment and preventive measures of viral diseases caused by important viruses -, hepatitis, Rabies, SARS, Chikungunya, Ebola and H₁N₁ viruses. Fungal diseases: Types of diseases - superficial and deep mycosis; Causative agents; Diagnosis and Treatment of diseases. Protozoan diseases: Causative agents, symptoms, diagnosis and treatment of Amoebiasis, Giardiasis, , Filariasis, Leishmaniasis, Toxoplasmosis and Malaria.

Diagnostics: Collection and transport of clinical samples; Processing of clinical samples for direct and indirect diagnostics tests. Conventional, Serological and Molecular methods and techniques for the diagnosis of different types major diseases.

Unit-6

12 Hrs

Phases of drug discovery: Bioprospecting, Principles of Extraction, Purification and Characterization of bioactive molecules.

Preclinical development: Safety profile of drugs (Pyrogenicity, Toxicity –hepato, - nephro, - cardio and neurotoxicity) Toxicological evaluation of drug: LD₅₀, Acute, subacute and chronic toxicity Mutagenicity (Ames test, micronucleus test), Carcinogenicity and Drug interactions.

Reference Books:

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
5. joanstokes, Ridewaywren and Sir ashleymiles. Clinica Microbiology. Edward Arnold.
6. Dougias J and Slekh. Medical Bacteriology. Churchill Livingstone.
7. Bailey and Scotts. Diagnositic Microbiology. C.V. Mosry Company
8. Hoghl and Moffet. Clinical Microbiology. JB Lippincott Company.

PAPER – CCT 3.2: Food and Dairy Microbiology

Unit-1

10 Hrs

Introduction: Origin, Concept, Scope and historical developments. Food as substrate for microorganisms: Hydrogen ion concentration (pH), Moisture requirement, Water activity, Oxidation-Reduction potential, Nutrient content, Inhibitory substances and Biological structure.

Unit-2

12 Hrs

Food contamination: Contamination of foods from green plants, animals, sewage, soil, water, air and handling. Food spoilage: General principles of food spoilage, Causes of food spoilage, Factors affecting kind and number of microorganism. Chemical changes caused by microorganisms. Spoilage of Meat and Meat products, Egg and Egg products, Fish and Marine products, Cereal and Cereal products, Fruits and Vegetables.

Unit-3

12 Hrs

Food Preservation: General principles, Physical methods of food preservation (High temperature, Low temperature and Drying), Chemical methods of food preservation (Food additives) and Biological methods of food preservation. Food borne diseases and their control: Food Infection and Intoxication. Detection of food borne pathogens and their toxins by various methods.

Unit-4

10 Hrs

Fermented foods (Bread, Sauerkraut and temphe), Probiotics and Prebiotics. Concept and importance of Nutraceuticals and Nutraceutical products. Milk: Definition, Composition, Nutritive value and Properties. Microbiology of milk. Testing of milk quality.

Unit-5

10 Hrs

Contamination, spoilage and preservation of milk and milk products. Fermented milk products: Production, Quality control and Significance of Cheese, Yogurt, Shrikhand and Acidophilus milk.

Unit-6

10 Hrs

Food sanitation and food safety: Concept, Importance and Safety laws, GMP and LP. Quality control and food standards: Bureau of Indian Standard (BIS). PFAA, FPO, MPO, CSO, Agmark Standards, International standards – HACCP, ISO 9000 Series. Food testing laboratories.

Reference Books:

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; Biotechnology of Food Fermentation, Asia tech Publ. Delhi, India.
4. Frazier WC & Westhof DC; Food Microbiology, 3rd Ed., Tata McGraw Hill.
5. Doyle PM et al; Food Microbiology – Fundamentals & Frontiers, 2nd Ed., ASM Press.
6. Danwart GJ; Basic Food Microbiology, CBS Publ. Delhi.
7. Pitt J & Hocking. (1985); Fungi & Food spoilage, Academic Press.
8. Sandeep Sareeen; Food Preservation, Sarops & Soni, New Delhi.
9. Ananthkrishnan CP. Et al. (1994); Dairy Microbiology, Sreelakshmi Publ. Chennai.
10. Rabinson RK. (1990); Dairy Microbiology, Elsevier Applied Science, London

PAPER – DSET 3.1 a : Genetic Engineering & R-DNA Technology

Unit-1

12 Hrs

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

Unit-2

10 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. Hosts for recombinant DNA technology; Prokaryotes –Bacteriophages, *E. coli*, *B. subtilis*, *Streptomyces*, Eukaryotic – Yeasts and Fungi.

Unit-3

10 Hrs

Enzymes used in recombinant DNA technology, Restriction endonucleases – Type, I, II & III, restriction mapping, RFLP and RAPD, Nucleotide kinas, reverse transcriptase, T4 DNA ligase, klenopolymerase and others. Plasmid vectors - Use of natural plasmids as vectors, artificial plasmid vectors, pSC 101, RI, pBR 322, pUC 18, Ti-plasmid vectors.

Unit-4

10 Hrs

Bacteriophage vectors – Insertion vectors, replacement vectors, cosmid vectors, phagemid vectors, shuttle vectors and M13 based vectors. BACs, YACs and HACs. Genome libraries – construction and screening of genome libraries, chromosome walking, cDNA libraries.

Unit-5

12 Hrs

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. Insertion of recombinant DNA – Host selection, transformation, transfection, electro-poration, lipofection, Screening of recombinant, Applications of rDNA technology.

Unit-6

10 Hrs

PCR – principles, types and applications, primer design and applications. DNA micro array – principle, types, construction and applications, *in vitro* approach for studding DNA- Protein interactions.

Reference Books:

1. Brown TA. Ed. Homes BD & Richwood D, 1998; Molecular Biology – LABFAX, Academic Press.
2. Gerard Karp, 1999; Cell and Molecular Biology, John Wiley & Sons Inc., New York.
3. Miller G et al, 1996; An introduction to Genetic analysis, Freeman & Co., New York.
4. Watson JD et al, 1992; Recombinant DNA, Scientific American Books.
5. Desmond ST & Nicoll, 1994; An introduction to Genetic Engineering, Cambridge Uni. Press.
6. Nicholl DST, 1994, An introduction to Genetic Engineering, Cambridge Univ. Press.
7. Trapp BE & Freifelder D, 2007; Molecular Biology – Genes to proteins, Jones & Bartlet Publ. Inc. Learning.
8. David P Clark, 2005; Molecular Biology, Academic Press
9. Harvey F Lodish, 2008; *Molecular Cell Biology*, W.H. Freeman
10. Cornell Mechardt, 2007; Molecular Biology & Genomics, Academic press

PAPER DSET 3.1 b : MOLECULAR BIOLOGY

Unit -1

10hrs

Chromosome organization in prokaryotes and eukaryotes. b. DNA replication: General principles, enzymology, various models of replication (semi conservative, rolling circle, unidirectional and bidirectional). DNA synthesis by reverse transcription, inhibitors of DNA replication

Unit-2

8 hrs

.DNA damage and repair: Types of damages (deamination, oxidative damage, alkylation, pyrimidine dimers), repair pathways - methyl directed mismatch repair, short patch repair, excision repair, recombination repair, SOS system.

Unit- 3

14 hrs

Transcription: Structural features of rRNA, tRNA and mRNA and their functions. Transcription - general principles, basic apparatus, RNA polymerases, promoters, enhancers and other regulatory sequences, mechanism of transcription and inhibitors of transcription. Post - transcriptional modifications: Transcriptional attenuation, cutting and trimming of rRNA, mRNA modifications (capping, polyadenylation and splicing), cutting and modification of tRNA, catalytic RNA, group I and group II intron splicing and RNase P

Unit- 4

12 hrs

Translation: Basic features of genetic code, Wobble concept, prokaryotic and eukaryotic ribosomes, RNA pol. I, II and III. Details of translation- initiation, elongation and termination, factors that control the above steps, inhibitors of protein synthesis. b. Post translational modifications: Protein folding, structural analysis, signal hypothesis protein targeting and secretion, *in vitro* transcription and translation systems.

Unit - 5

10 hrs

Regulation of gene expression - Operon concept, regulatory elements of operon - inducers, apo-repressors and co - repressors. Positive and negative regulations. Catabolite repression. Detailed account of structure, function and regulation of *lac* operon, *trp* operon and *ara* operon.

Unit- 6

10 hrs

Global regulatory responses: heat shock response, stringent response, SOS response and regulation by small molecules such as ppGPP, pppGPP and cAMP, c. Eukaryotic translational control - translational control of gene expression, inhibitory RNA (RNAi) Antisense RNA. Hormone and Environmental factors affecting gene expression. Coordinate regulation of unlinked genes - The Britten - Davidson model.

Recommended Books

1. Brown, T.A. 1999 Gene Cloning. 3rd edition. Chapman and Hall Publications, USA.
2. Burrell, M.M. 1993. Enzymes of Molecular Biology, Humana Press.
3. Chirikjian, J.G. 1995 Biotechnology – Theory and Techniques, Vol. II, Jones and Bartlett Publishers.
4. Gerhardt, P. Murray, R.G., Wood, W.A., and Krieg, N.R. 1994 Methods for
- 5 General and Molecular Bacteriology, ASM Press, Washington D.C.
6. Glick, B.R. and Pasternak, J.J. 1998 Molecular Biotechnology – Principles and Applications of Recombinant DNA, ASM Press, Washington D.C.
7. Lewin, B. 2008 Genes IX. Oxford University Press, Oxford.
8. Murray Moo1992 Plant Biotechnology. Young, Pergamon Press.
9. Ratledge, C. and Kristiansen, B. 2001 Basic Biotechnology, II Edition, Cambridge University Press.
12. Winnacker, E.L. 1987 From genes to Clones: Introduction to Gene technology. V C H Publications, Federal Republic of Germany.
13. Antony, J.F., Griffiths, Gilbert, W.M., Lewontin, R.C. and Miller, J.H. 2002 Modern genetic analysis, Integrating Genes and Genomes, 2nd edition, WH Freeman and Company, New York.
14. Blackburn, G.M. and Gait, M.J. 1996 Nucleic acids in chemistry and biology. Oxford University Press.
15. Molecular Biology of cell. Albert *et al.*, 4th Edition Garland Publishing Inc.
16. George M. Malacinski, David Freifelder. 1998 Essentials of Molecular Biology. Jones and Bartlett Publishers.
17. Maloy, S.R., Cronan, J.R. Freifelder, D. 1994 Microbial Genetics, Jones and Bartlett Publishers.
18. Macinski, G.M. and Freifelder, D. 1998 Essentials of Molecular Biology, 3rd Edition, John and Bartlett Publishers.
19. Sir John Kendrew 1994 The Encyclopedia of Molecular Biology. Blackwell Science Ltd
20. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M. 1998 Molecular Biology of the Gene, 4th edition, Benjamin/Cummings publishing company.

PAPER – GET 3.1 : Microbes in Human welfare

Unit-1

8 Hrs

Concept of environment: Atmosphere, lithosphere, hydrosphere and biosphere; Ecological niche - ecosystems, ecological niches. Origin and evolution of microorganisms:

Unit-2

14 hrs

Biodiversity of microorganisms: Richness and expanding microbial world, distribution of microorganisms in various environments, Types of microbial diversity.

Cosmopolitan nature of microorganisms: Exobiology – does life exist elsewhere in the universe? X- files, news stories of 1996 – evidence for microbial life on Mars, debate, exploration for extraterrestrial life based on microbial life.

Unit-3

10 Hrs

Microbial Ecology: Use of microorganisms as clues to study complex ecosystems; Natural resources – renewable and non-renewable, microorganisms as renewable resources; Microbial interactions: Interactions of microorganisms with plants and animals, interactions among microorganisms – various types.

Unit-4

10 Hrs

Biodegradation and bioremediation: Use of microbes to clean-up toxic and xenobiotic wastes, oil spills, pesticides, industrial wastes, biomagnifications and bio-augmentation. Microbial mining: Microbial leaching of metallic ores, microbial recovery of precious elements - copper, uranium and gold.

Unit-5

10 Hrs

Biofuel and Bioenergy: microbial ethanol production; blending with automobile fuel, nutrient recycling and methane Production. Composting and soil fertility: Yard composting, municipal composting, role of microorganisms in solid waste management.

Unit-6

12 Hrs

Water pollution: Microorganisms as indicators of water pollution - waste water treatment method Green house gases, Green house effect, Climate change, Global warming, role of microorganisms in El Nino effect, role of microorganisms in Global warming and Gaia

References

1. Steinhaus. 1963. Insect Pathology. Vol I & II. Academic Press, New York.
2. Burges H D. 1970-1980. Microbial Control of Pests and Plant Diseases.
3. Plant pathology. By George Agrios; Academic Press, New York.
4. Microbial Ecology: Fundamentals and Applications by Rinald Atlas and Richard Bartha; Benjamin/Cummings Science Publis., 2725 Sand Hill Road, Menlo Park, California 94025.
5. Plant pathology. By George Agrios; Academic Press, New York.
6. Criston J. Hurst, Manual of Environmental Microbiology, ASM Publ., New York.
7. Feltcher, M. & Grey TRG, 1987, Ecology of Microbial Communities, Cambridge Univ. Press.
8. Rose R.D. Air Pollution & Industry. Reinhold Co., New York.
9. Metcalf and Eddy. 1991. Waste Water Engineering. McGraw Hill Int. Publ.
10. APHA, 1994, Standard Methods, 17th Ed., American Public Health Association

IV-SEMESTER

PAPER – CCT 4.1 : Industrial Microbiology

Unit-1

12 Hrs

Fermentation: Origin, concept and historical development of fermentation. Types of Fermentations- Surface, Submerged, Solid -State, Batch, Continuous, Dual and Fed batch fermentations . Industrially important Microorganisms: Isolation, Screening of metabolites (Primary and Secondary metabolites) and Preservation. Strain development- Mutation, Recombination and Protoplast fusion technique. Inoculum development for industrial fermentation.

Unit-2

12 Hrs

Media for industrial fermentations: Criteria, Media formulation, Media ingredients . different Nutrients recycling. Fermentor: Construction and Design of a typical fermentor. Parts and functions of a fermentor. Manual and automatic control systems. Types of fermentors- Tower, Jet, Loop, Airlift, Bubble, Column, Packed bed, Fluidized bed.

Unit-3

10 Hrs

Sterilization of media and fermentors - Design of sterilization process, microbial growth: Phases of cell growth in batch culture.growth-Monod model. Growth of filamentous organisms. Growth associated (primary) and non - growth associated.

Unit-4

10 Hrs

Bioprocess Engineering: Origin, Concept and Principles of Bioprocess Engineering. Basic components of bioprocess engineering. Upstream bioprocess: Strategies for the enhanced production - Immobilization and Response surface methodology. Downstream bioprocess: Filtration-Micro, Cross-flow and Ultra. Centrifugation-High speed, Continuous and Ultra. Cell disruption. Precipitation, Coagulation and Flocculation. Solvent /Aqueous 2-phase extractions, Dialysis and Electro-dialysis. Reverse osmosis. SDS-PAGE, Ion Exchange chromatography and HPLC. Gel Filtration. Drying. Crystallization.

Unit-5

12Hrs

Production and purification of microbial products: Enzymes-(Amylase, Proteases), Organic acids (Lactic acid, Citric acid and Vinegar), Amino acids (L-lysine and L-glutamic acid), Antibiotics (Penicillin and Streptomycin), Solvents-(Ethyl alcohol, Acetone- and butanol) Alcoholic beverages-(Beer, Wine, Brandy and Rum). Vitamins B12, Antitumours and Anticholesterol agent.

Unit-6

08 Hrs

Single cell protein and Single cell oil – Concept, production and uses. Intellectual property rights and patents.

Reference Books:

1. Ali Cinar, S.J. Parulekar, et al., (2003) Batch Fermentation: Modeling, Monitoring, and Control. Marcel Dekker
2. Arnold D & J E. Davies, Atlas. RM 1999 Manual of Industrial Microbiology & Biotechnology 2nd Ed. Berry, D.R. (Ed) 1998 Physiology of Industrial fungi BSP, Oxford University.
3. Crueger & Crueger Biotechnology: A Text Book of Industrial microbiology 2nd edition
4. Casida, Industrial Microbiology
5. Demain, A.L Biology of Industrial Microorganisms
6. Diliello Methods in Food and Dairy Microbiology
7. Harold B. Reisman 1988 Economic Analysis of Fermentation Processes CRC Pr I Llc
8. Vogel A & L. Celeste Todaro 2005 Fermented and Biochemical Engineering Hand Book 2nd Standard Publishers Distribution New Delhi
9. Harvey, W., Blanch, S. Clark. 2007 Biochemical Engineering, Marcel Dekker

PAPER – CCT 4.2 : Immunology and Immunotechnique

- Unit-1** **08 Hrs**
Introduction: Origin, concept and historical development of immunology. Immunity: Definition, Types of immunity-Innate and Acquired immunity.
- Unit-2** **10 Hrs**
Cells and organs of immune system: Circulatory and lymphatic systems. Hematopoiesis. Cells of immune system. Types, structure and functions of lymphoid organs. Biology of immune cells: B cells-Origin, development, maturation and surface molecules. T cells-Origin, development, maturation and surface molecules; Subsets of T cells. Structure and function of T Cell receptors.
- Unit-3** **12 Hrs**
MHC molecules-Types, structure, genetics and functions. Complement system-Components and pathways of component activation. Antigens and Antibodies: Antigens - Physical and chemical properties of antigens, Epitopes, Antigenicity and Immunogenicity; Types of antigens. Antibodies- Physical and chemical structures of antibodies, Types and biological functions of immunoglobulins. Monoclonal and Polyclonal antibodies- Production and applications.
- Unit-4** **14 Hrs**
Antigen-Antibody reactions: Mechanism and principles of antigen antibody reactions. Types and determination of antigen antibody reactions – Radio immune assay, Ouchterlony double diffusion technique, Complement fixation test, Enzyme linked immunosorbent assay and Immuno blotting. Immune response: Antigen processing and presentation; Activation of T and B cells; Differentiation and formation of functional T cells; Differentiation of B cells and formation of plasma and memory cells. Immune response-Primary and secondary. Effector mechanism of HMI and CMI. Cell mediated cytotoxicity, ADCC and Inflammation. Cytokines- Types, functions and applications.
- Unit-5** **08 Hrs**
Hypersensitivity- Mechanism and types of hypersensitivity. Autoimmunity and Immuno deficiency syndrome: Autoimmunity and autoimmune disorders. Immuno deficiency syndrome: IDS due to deficient T and B cells, phagocytes, complement. Severe combined immunodeficiency syndrome.
- Unit-6** **08 Hrs**
Tumor and Transplantation immunology: Tumor antigens and immunology to tumor cells. Transplantation immunology-Blood transfusion, Tissue transplantation and HLA typing. Immuno tolerance and Immuno modulators. Vaccines- Types, production and immunization schedules.

Reference Books:

1. Bradley and Mecharty. Clinical Immunology. Oxford University Press, New York.
2. Abbas AK, Lichtman and Pober. Cellular and Molecular Immunology. W.B. Saunders Co.,
3. Coleman. Fundamental Immunology. Brown Publishers. Bubuone Zowa.
4. Catty. Maintenance of Laboratory Animals and Production of antibodies.
5. Janis Kubey. Immunology. Freeman & Co., New York.
6. Janeway and Travers et al. Immunology. Churchill Publishers.
7. Stities, Tesss and Parslow. Medical Immunology. 9th Ed. Appleton & Lange, Connecticut.
8. Benjamin E, Coice R and Sunshine G. Immunology – A Short course. 4th Ed. Willey-Liss
9. Topley and Wilson. Principles of bacteriology, Virology and Immunity. Edward Arnold
10. Roitt I.M., 1994, Essential of Immunology, Raven Press, New York

PAPER – DSET 4.1 a : Agricultural Microbiology

Unit-1

08 Hrs

Introduction: Origin, Concept and Development of Agricultural Microbiology. Role of microorganisms in soil formation and soil fertility. Factors affecting soil microorganisms. Microbes and biogeochemical cycles - Nitrogen, Carbon, Sulfur and Phosphorous cycles.

Unit-2

10 Hrs

Plant - Microbe Interactions: Types - Mutualism, Commensalism, parasitism, amensalism and synergism. Concepts of Rhizosphere, Phyllosphere and Spermosphere. Rhizosphere effect and R/S ratio. Factors influencing rhizosphere microorganisms. Plant growth promoting rhizobacteria. Mycorrhizae.

Unit-3

10 Hrs

Biological nitrogen fixation: General chemistry, mechanism and genetics of biological nitrogen fixation. Nitrogen fixation by diazotrophs-Rhizobium, Azotobacter, Azospirillum, Frankia and Blue Green Algae. Phosphate solubilizing microorganisms and Mycorrhizae: Types of phosphate solubilizing microorganisms – Bacteria and Fungi, Mechanism of phosphate solubilization. Types, significance and role of mycorrhizae.

Unit-4

10 Hrs

Biofertilizers: Concept and types of microbial biofertilizers - Bacterial (Rhizobium, Azotobacter and Azospirillum), Fungal and Algal. Screening and selection of potential strains for biofertilizer. Production and quality control of biofertilizers. Phosphate solubilising microbial biofertilizers. Methods of application and evaluation of biofertilizers. Green manure, Organic matter, Compost and Composting

Unit-5

12 Hrs

Plant diseases: Etiology, pathogenesis, Symptoms and control measures of plant diseases. Bacterial diseases - Wilt and Citrus canker; Fungal diseases – Wilt, Downy mildew, Rust and Smuts); Viral diseases -Tobacco mosaic and Bunchy top of Banana; Mycoplasmal diseases - Grassy shoot of sugar cane and Coconut yellowing disease. Biological control: Origin and concept. Various microorganisms as biocontrol agents. Isolation, screening, cultivation and mode of action of microbial biocontrol agents.

Unit-6

12 Hrs

Biopesticides: Origin and concept. Types, mass production and applications of microbial biopesticides. Bacterial - *Bacillus thuringiensis* and *Pseudomonas fluorescense*; Fungal - *Trichoderma viridae* and Coelomomyces; Viral - NPV and CPV. Integrated pest and plant diseases management. Genetically modified crops: Origin and concept. Role and significance of microbial genes. Construction, evaluation and field application of BT cotton and BT brinjal. Advantages and disadvantages of GM crop plants.

Reference Books:

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. Swaminathan M.S. Biotechnology in Agriculture. McMillan.
6. Steinhaus. 1963. Insect Pathology. Vol I & II. Academic Press, New York.
7. Burges H D. 1970-1980. Microbial Control of Pests and Plant Diseases.
8. Plant pathology. By George Agrios; Academic Press, New York.
9. Microbial Ecology: Fundamentals and Applications by Rinald Atlas and Richard Bartha; Benjamin/Cummings Science Publis., 2725 Sand Hill Road, Menlo Park, California 94025.
10. Plant pathology. By George Agrios; Academic Press, New York.



Paper DSET 4.1 b Microbial Technology

Unit – 1

14 hrs

Microbes important in food microbiology: yeasts, filamentous fungi and bacteria contamination of foods. Factors influencing food spoilage (intrinsic and extrinsic) Food poisoning and food borne infections (bacterial, viral, fungal and protozoa), bacterial and fungal toxins. d. Detection of microbial contamination of foods : Direct microscopic count (DMC), standard plate count, MPN method, reductase tests, membrane filters and molecular methods

Unit -2

12 hrs

Contamination and spoilage of cereals , cereal products, fruits, vegetables , meats , meat products, fish , sea foods, eggs, poultry and canned foods. General principles of food preservation- Physical and Chemical methods. Dairy microbiology: Normal flora of milk and milk products, Spoilage of milk and milk

Unit – 3

14 hrs

products. Fermented milk products: acidophilus milk, bifidus milk ,yoghurt manufacture of cheese, evolution of quality milk d. Microbial food fermentation: Fermentation in food processing, role of microorganisms in food fermentation. Microbial products of food; SCP, mushrooms, oriental foods Fermented beverages (fruit and cereal based) and fermented meat and meat products.

Unit – 4

8 hrs

Yeasts fermentation and a yeast products: Production of active dry bakers yeast, instant yeast, quality of bakers yeast, production of brewer's yeast, wine yeast food and fodders yeast.

Unit- 5

10 hrs

Industrial production of enzymes: cellulases, amylases, proteases, phytases, pectinases, lipases, glucose isomerases Immobilization of enzymes and cells and their applications. Scope, utility and methodology of biotransformation, iotransformation of antibiotics, steroids and non – steroids.

Unit –6

6 hrs

Industrial production of:

- i) Biopesticides – Bacterial, viral and fungal
- ii) Biofertilizers – Nitrogen fixers, PSM, mycorrhizae
- iii) Biopolymers – Extracellular polymers, xanthans, dextrans, poly β hydroxyl alkanates
- iv) Biosurfactants - Classification , production and application
- v) Vaccines – Bacterial and viral vaccines.

Recommended Books

1. Adams, M.R. and Moss. M.O. 2007 Food Microbiology Royal society of Chemistry Pub Cambridge.
2. Bamforth C W 2005 Food, Fermentation and Micro-organisms Blackwell
3. Banwart, G.S. 1989 Basic Food Microbiology
4. Chaplin, M.F. & Bucke.C 1990 Enzyme Technoogy Cambridge.
5. Cliver, D.O 1990 Food borne diseases Academic Press San Diego
6. Diliello Methods in Food and Dairy Microbiology
7. Doyle P. Michael Food Microbiology 2nd Edition SAM Press
8. Ealters, R.W. (Ed) 1992 Vaccines: New Approaches to immunological problems, B.H. London.
9. El-mansi, E. M. T. A.L. Demain , C.F.A. Bryce, C.F.A. Bryce , A. R. Allman , Mansi El-Mansi , Charles



- F. A. Bryce 2006 Fermentation Microbiology And Biotechnology
10. Fellows P. J 2009 Food Processing Technology Principles and Practice, Third Edition Published by: CRC Press
11. Fogarty, W.M. & Kelly C.T. 1990 Microbial enzymes and Biotechnology Elsevier, London.
12. Frazier, W.C. and Werthaff, D.C. 1998 Food Microbiology 4th edition. Tata Mc Grow Hill New Delhi
13. Harrigan W. 1976 Laboratory Methods in Food and Dairy Microbiolog Academic Py
14. Hobbs, B.C. and Rioberts,D 1993 Food Poisoning and Food Hygiene Edward Anold, London.

Paper CCPR 4.1

PROJECT WORK: Submission of Dissertation & Project Viva voce