

SEMESTER – I

MBT 101: GENERAL MICROBIOLOGY

UNIT - I

(16 hrs)

History and scope of Microbiology: Theory of spontaneous generation, germ theory of diseases; Major contribution in the field of microbiology, importance of microbes in human welfare.

Study of microorganisms: Microscopy – principles and applications of light, scanning and transmission electron microscopes. Confocal microscopy. Preparation of microbiological samples for microscopy.

Systematic position of the microorganisms- taxonomy, nomenclature and classification (Five kingdom classification and Carl Woese classification), taxonomic ranks, major characteristics used for identification: morphological, physiological, ecological, genetic and molecular.

UNIT - II

(14 hrs)

Structure and function of prokaryotic and eukaryotic cells. Physical and chemical approaches for sterilization and disinfection -control of microorganisms by heat, radiation, pH, pressure, filters, chemical agents and safety precautions. Concepts of containment facility.

Microbiological media: Types of media – natural and synthetic media (basal, defined, complex, enrichment, selective, differential and transport media).

UNIT - III

(18 hrs)

Isolation, cultivation and enumeration of microorganism: pure culture techniques (enrichment, dilution plate, streak plate, spread plate and micromanipulator), cultivation of aerobic and anaerobic microorganisms - continuous, batch, synchronous and stock cultures, enumeration and measurement of growth of microorganisms.

Identification and characterization of microorganisms - staining techniques (simple, negative differential, capsular, spore, flagellar staining. Giemsa staining and AFB (Acid Fast Bacilli), lactophenol mounts for fungi. Preparation of tissue for thin sectioning (fixation, dehydration, infiltration, embedding and sectioning). Preservation of microbial cultures: (sub culturing technique, sterile soil or sand preservation, glycerol, deep freezing, liquid paraffin oil, drying and freeze drying).

UNIT – IV

(16 hrs)

Introduction to Mycology: systematic position and classification of fungi. General characters, structure, reproduction, life cycles and economic importance: Myxomycotina (*Physarium*, and *Plasmodiophora*) Mastigomycotina (*Synchytrium*, *Phytophthora* and *Albugo*) Zygomycotina (*Mucor*, *Rhizopus* and *Pilobolus*). Ascomycotina (Yeast, *Aspergillus*, *Penicillium* and *Neurospora*) Basidiomycotina (*Puccinia*, *Ustilago* and *Agaricus*).

Deuteromycotina (*Alternaria*, *Fusarium*, *Colletotrichum* and *Trichoderma*). General account, classification, structure, reproduction and economic importance of algae (*Chlorella*, *Senedesmus*, *Gracellaria*, Nostoc and Anabena).

References:

1. Alexopoulos CJ and C W. Mims.(1993).Introductory Mycology(3rd edition).Wiley Eastern Ltd, NewDelhi.
2. Jeffreery C Pommerville, 2011, Fundamentals of Microbiology, Barlett Series
3. Bergys Manual of Determinative Bacteriology(9th Edition), Williams and Wilkins, Baltimore
4. Black, J.G. (2005). Microbiology: Principles and Explorations, John Wiley, USA
5. Dube R C and Maheswari D. K (2000) General Microbiology. S. Chand, New Delhi Mc Graw-Hill Publishing company Ltd, New Delhi.
6. Elizabeth Moore-Landecker. (1996). Fundamentals of the fungi. (4th edition).Prentice Hall International, Inc, London.
7. K. Talaro and A. Talaro (1996) Foundations in Microbiology 2nd ed. Wm. C. Brown Publ.
8. Madigan MT Martinkl. J.M and Parker J (2008). Brock Biology of Microorganisms. (9th edition). MacMillan Press, England.
9. Pelczar Jr, M.J. Chan, E.C.S. and Kreig, N.R. (1993). Microbiology, Mc. Graw Hill. Inc, New York
10. Prescott LM Harley JP and Klein DA (2007). Microbiology (7th edition) McGraw Hill, New York.
11. S.B. Sullia, Oxford (1999) General Microbiology, IBH Publishers
12. R.M. Atlas Wm. C. Brown (1997). Principles of Microbiology. 2nd ed. Publ.
13. Sullia, S.B. and Leaderberg J (1998). General Microbiology, Oxford & IBH Publishing Pvt. Ltd., New Delhi.
14. Schaechter M and Leaderberg J (2004). The Desk encyclopedia of Microbiology. Elseiver Academic press, California
15. Salle, A.J. (1996). Fundamental principles of Bacteriology.(7th edition).Tata McGraw-Hill publishing company Ltd, New Delhi.
16. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi.
17. Rami Reddy and SM Reddy (2005). A text book of Microbiology. Vol I and II.

MBT 102: BACTERIOLOGY AND VIROLOGY

UNIT – I

(16 hrs)

Morphological types- cell walls of archaeobacteria, Gram positive, Gram negative bacteria and L-forms, capsule types, composition and function, Cell membrane- structure, composition and functions.

Structure and function of flagella, cilia, pili, gas vesicles, chromosomes, carboxysomes, magnetosomes, phycobilisomes, nucleoids, spores and cell division. Reserve food materials- poly- β -hydroxybuterate, polyphosphate granules, cyanophycin granules and sulfur inclusions.

UNIT - II

(12 hrs)

Salient features and classification of bacteria as per the second edition of Bergey's Manual of Systematic Bacteriology.

Characteristics, classification and economic importance of major bacterial groups: *Enterobacteriae*, *Rickettsiae*, *Mycoplasma*, *Mycobacteria*, oxygenic and anoxygenic photosynthetic bacteria and actinomycetes.

UNIT- III

(18 hrs)

History and general characteristics of viruses, chemical composition, morphology, symmetry and architecture with reference to T4, TMV, Adeno, Polio and Influenza. Sub viral particles- satellite viruses, viroids, DI particles and prions.

Taxonomy of viruses: classification and nomenclature of viruses as per ICTV. General methods of detection, isolation, cultivation, characterization and assay / quantification of plant, animal and bacterial viruses.

UNIT - IV

(18 hrs)

Life cycles of bacterial viruses; one step growth curve, lytic and lysogenic cycles with reference to T4, λ and ϕ X 174. Biological significance of Phages.

Multiplication strategies of plant viruses (TMV, CaMV) and animal viruses (Adeno, Influenza, Herpes, SV 40, and Retro viruses). Transmission and management of plant and animal viral diseases, interferon, antiviral drugs and vaccines.

References:

1. Alan J. Cann (1997). Principles of Molecular virology. (2nd edition).Academic press, California.
2. Bergey's Manual 2nd Ed. "Systemic Bacteriology" 2001-2005
3. Dimmock NJ, Primrose SB. (1994) Introduction to Modern Virology IV edition. Blackwell Scientific Publications, Oxford.
4. Flint, S.J., Enquist, L.W., Krung, R. Racaniello, VR. and Skalka, A.M. (2000). Principles of Virology ASM Press.
5. Roger Hull (2002). Mathews' Plant Virology. (4thEdition). Academic press- Harcourt Science and technology company, New York.
6. Ram Reddy S and Reddy SM (2007) essentials of Virology Scientific Publishers (India) Jodhpur.
7. W.D. Frost and E.F. Mc Camp Bell (2010). Text book of general Bacteriology, Bibliobazaars Publications.
8. J.K. Struthers and R.P. Westram 2000. Clinical Bacteriology. Mansion Publication Ltd.
9. William Henarl 2000. Bergey's Manual of Determinative Bacteriology. 9th Edition Lippincott Publications.
10. S.H. Gillespie and P.M. Hawkey 2006. Principles and practice of Clinical Bacteriology. John Wiley.
11. A Text - Book of Bacteriology 4th Edition **Authors:** R. W. Fairbrother
ISBN: 9781483225340 (2018)
12. A Text-Book of General Bacteriology Paperback– Import, 15 Feb 2018 by William Dodge Frost & Eugene Franklin Campbell).

MBT 103: BIOLOGICAL CHEMISTRY

UNIT – I

(16 hours)

Introduction of biomolecules: Classification of carbohydrates: mono, di and oligosaccharides - identification and analysis. Structure, occurrence and biological significance of polysaccharides (starch, cellulose, chitin, peptidoglycons).

Lipids- classification, physico chemical properties, separation, distribution, characterization, saponification and iodine number. Nomenclature, structure and functions of glycerides, neutral lipids (waxes, fats and oils) phospholipids, sphingolipids and glycolipids. Steroids- cholesterol, ergosterol, stigmasterol and cholesterol. Lipoproteins- classification, composition and importance of bacterial lipids.

UNIT –II

(16 hours)

Amino acids and Proteins – Essential and non essential amino acids. Peptide bond, peptides of non protein origin (glutathione and gramicidin), Acid – base properties of peptides, chemical properties and synthesis of peptides. Proteins – classification, physico – chemical properties and biological functions. Ramachandran plot, Peptides and protein sequencing.

Nucleic acids: types and composition, nucleosides, nucleotides and polynucleotides; structure and properties and functions of nucleotides; DNA and RNA, denaturation and renaturation of nucleic acids, factors influencing hybridization, cot values.

UNIT –III

(17 hrs)

Enzymes: Classification and nomenclature. Kinetics of enzyme catalyzed reaction – Michaelis – Menten equation, Lineweaver-Burk plot. Effect of factors on enzyme activity (concentration, pH temperature, enzyme and substrate concentration - enzyme catalyzed reactions).

Enzyme functional groups, mechanism of action of lysozyme, chymotrypsin and RNase. Regulatory enzymes, covalently and non covalently regulated enzymes, allo – steric, regulated enzymes, isozymes, ribozymes and abzymes.

UNIT -IV

(15 hrs)

Principles of Bioenergetics, laws of thermodynamics, enthalpy, entropy, concept of free energy, chemical equilibrium. Energetics of ATP and other high energy compounds. Oxidation and reduction reactions.

Measurement of redox potentials, electron carriers in bacteria and mitochondria. Chemi-osmotic theory, biological energy transducers, respiration limited proton translocation, photorespiration and bioluminescence.

References:

1. Conn and Stump, Outlines of Biochemistry (5th edition) BRUENING & DOI.
2. Donald Voet and Judith G. Voet (1995). Biochemistry – Second Edition. John Willey and Sons, Inc.
3. Geofferey, L and Zubay (1998). Biochemsitry. (Fourth Edition) Wm. C. Brown Publishers.
4. Jeremy M. Berg. John L. Tymoczko and Lubert Stryer (2002). Biochemistry. (5th edition). W. H. Freeman and company, New York.
5. Lubert Stryer. (1995). Biochemistry. (4th edition). W.H. Freeman and company, New York.
6. Lehninger (2000) Principles of Biochemistry, 3rd edition, NELSON & COX (Worth) Publ.
7. Martin, Mayer and Roadwell Harper's Review of Biochemistry (2006).
9. Thomas M. Devlin. (2002). Textbook of Biochemistry with clinical correlations. (5th Edition). A John Wiley and sons, Inc., publication, New York.
10. Trudy McKee and James R. McKee. (1999). Biochemistry-An Introduction. (2nd Edition). WCB McGraw- Hill, U.S.A
11. U. Satyanarayana U.Chakrapani (2005) Biochemistry, 3rd Edition, Books and allied Publications.

MBT 104: BIOPHYSICAL AND ANALYTICAL TECHNIQUES

UNIT – I

(14 hrs)

Measurement of pH and Buffers, ionization, Pka, Henderson-Hasselbalch equation. Types of electrodes and biosensors. Viscosity, Osmosis and Cell disruption methods.

Concentration of Biomolecules: Ammonium sulfate precipitation, dialysis, flash evaporation, lyophilization, membrane filtration and their applications.

UNIT – II

(18 hrs)

Centrifugation – Principle, methodology and applications of preparative, differential, density gradient, analytical ultra centrifugations and their applications. Analysis of sub cellular fractions.

Chromatography – Principles, methodology and applications of liquid – solid (paper and TLC) and Column chromatography (Ion – exchange, gel permeation, affinity, GC, FPLC and HPLC).

UNIT –III

(12 hrs)

Spectroscopy - Laws governing the light absorption, principles, instrumentation and biological applications of colorimeter, UV-VIS, Infrared (IR), FTIR, Atomic absorption (AAS), electron Spin – resonance (ESR).

NMR. Mass spectrometry (MALDI-TOF). X-Ray crystallography. Circular Dichroism (CD) and Optical Rotary Dispersion (ORD) and their applications.

UNIT – IV

(20 hrs)

Electrophoresis - Electrophoretic process. Native PAGE and SDS - PAGE. Iso electric focusing (IEF), two – dimensional gel electrophoresis, determination of molecular weight, pulsed field electrophoresis. Methodology and applications of Southern, Western and Northern blots.

Radio Isotopes - Half life, detection and measurement, GM counter, liquid scintillation counter, gama-ray counters, Cerenkov counting, autoradiography and Quenching. Laboratory safety measures in handling isotopes and biological applications.

References:

- 1) Avinasu, Kakoli, Nirmalendu Nath, UPHADYAM, 4th relid ed. July 2011. Himalaya publishing house.
- 2) B.L. Williams and K. Wilson (Edward Arnold) A Biologists's guide to principles and Technuques of practical biochemistry, 2nd edition. Ed.
- 3) C.R. Cantor and P.R. Schimmel, W.H. Freeman & Co., NY. Biophysical Chemistry.
- 4) David Freifelder, (1982) Physical Biochemistry: Applications to Biochemistry and Molecular Biology, 2nd ed. H. Freeman and company.
- 5) David J. Holmes and Hazel peck. Analytical biochemistry Publ.
- 6) Drewer Pesec, AJ. And As worth, R.B. Experimental techniques in Biochemistry.
- 7) K. Wilson and J.Walker (2018) Principles and Techniques of Biochemistry and Molecular Biology. 8th-edition. Cambridge University Press.
- 8) R.F. Boyer (1993) Modern Experimental Biochemistry. 2nd Ed. The Benjamin Cummings Publ. Company.
- 9) S.K. Sawhney and Randhir singh (2000) Introduction to Practical Biochemistry (ed.) Narosa Publ. House.
- 10) S. Sadasivam and A. Manikam (1992) Biochemical Methods for Agricultural Sciences. Wiley Eastern Ltd.

MBP: 101 – General Microbiology and Bacteriology and Virology

1. Microbiological laboratory safety measures
2. Sterilization Methods a. Physical and chemical methods b. Phenol coefficient method (Redial-Walker test)
3. Preparation of different media for cultivation of bacteria and fungi
4. Plating techniques – streak plate, spread plate and pour plate methods
5. Enumeration of bacteria by serial dilution
6. Isolation and enumeration of bacteria and fungi from soil
7. Isolation of bacteria from diseased plant leaf
8. Isolation of fungi from plant leaves and seeds
9. Slide culture technique
10. Hanging drop technique for bacterial motility
11. Morphological studies - bacteria, fungi and algae
12. Staining techniques : Simple, Gram, negative, spore, capsular, acid fast and Lacto phenol – cotton blue staining
13. Determination of thermal death point of bacteria
14. Biochemical tests - IMVIC Tests; catalase; oxidase; coagulase, amylase, urease; gelatin hydrolysis; oxidation – fermentation tests; sugar fermentation; triple sugar iron test; H₂S production.
15. Isolation of Bacteriophage from sewage water
16. Growth phases of phage and burst size one step growth curve
17. Cultivation of viruses in embryonated Eggs: different routes of inoculation
18. Sap transmission of a plant virus
19. Aphid transmission of a plant virus
20. Graft transmission of plant virus
21. Virus inclusion bodies (slides)

Suggested books/manuals.

1. Microbiological Applications: Laboratory Manual in General Microbiology, 7th ed. By J. Benson.
2. Microbiology: A Laboratory Manual. 4th edition. By J.G. Cappucciono and N. Sherman.
3. Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom cultivation. 3rd edition. By K.R. Aneja.
4. Practical Microbiology, 2002 by R.C. Dubey and D.K. Maheshwari.
5. Laboratory Manual in Microbiology, 2000. By P. Gunasekaran.
6. Laboratory Experiments in Microbiology by Johnson.
7. Laboratory Manual in Microbiology by Alcamo.
8. Virology – A Laboratory Manual, 1992. By Burleson, et al., Academic Press.
9. Virology Methods Manual, 1996. B.W.J. Mahy and H.O. Kangro. Academic press.
10. A Laboratory Manual. By SM Reddy and S Rami Reddy. Scientific Publications (2005)

MBP: 102 – Biological Chemistry and Biophysical and Analytical Techniques

1. Qualitative tests for identification of carbohydrates, amino acids and nucleic acids
2. Quantitative tests for Protein (Lowry and Bradford methods), glucose (DNS method), Glycine, bilirubin, cholesterol, Inorganic phosphorous.
3. Determination of activity of peroxidase and polyphenol oxidase from leaves/tubers/fruits
4. Purification and study of acid phosphatase from potato tubers: Extraction of enzyme; Effect of substrate concentration; temperature; pH on enzyme activity.
5. Measurement of pH
6. Micrometry for cell size determination
7. Cell counting by Haemocytometer
8. Verification of Beer's Law
9. Determination of λ max for colored solutions
10. Determination of DNA and RNA by UV spectrophotometry and DPA and Orcinol methods.
11. Determination of nucleic acid bases by UV spectrometry
12. Paper chromatography for separation of amino acids / pigments
13. TLC for separation of lipids / amino acids
14. Dialysis
15. SDS – PAGE for separation of proteins
16. Agarose gel electrophoresis for DNA separation
17. Isolation of chloroplasts by sucrose density gradient centrifugation
18. Ion – exchange column chromatography
20. Gel permeation column chromatography (demonstration).
21. Spun column chromatography (demonstration).
22. Separation and determination of concentration of green / yellow pigments by spectrophotometry

Suggested books/manuals.

- 1) Biochemical Methods per Agricultural Sciences, 1992. By S. Sadasivam and A. Manikam
- 2) Practical Biochemistry: Principles and Techniques 1995, 4th Ed. By K. Wilson and J. Walker, Cambridge University Press.
- 3) Modern Experimental Biochemistry. 1993. 2nd Ed. By R.F. Boyer. The Benjamin Cummings Publ. Company.
- 4) Physical Biochemistry: Applications to Biochemistry and Molecular Biology, 1982, 2nd Ed. By David Freifelder. W.H. Freeman and Company.
- 5) Introduction to Practical Biochemistry. 2000. by S.K. Sawhney and Randhir Singh (eds.) Narosa Publ. House.
- 6) An introduction to Practical Biochemistry, 1987. D.T. Plummer.
- 7) Laboratory Manual in Biochemistry, 1996. By J.Jayaraman.
- 8) Florence C. Barseon, Thomas M. Chanders Danny. Wild Brank – Practical Virology.
- 9) Manual of Biochemistry Deshpande and Shashidhar Rao I K International Publishers.

SEMESTER – II

MBT 201: MICROBIAL PHYSIOLOGY AND METABOLISM

UNIT – I (12 hrs)

Microbial nutrition- classification of microorganisms based on carbon, energy and electron sources. Major and minor nutritional elements and growth factors.

Chemotrophism - sulphur, ammonia, nitrite, iron, hydrogen and carbon monoxide oxidizers and their importance, Chemoheterotrophism - Acetogens, methanogens, methanogenesis and their importance.

UNIT – II (12 hrs)

Phototrophism - Photosynthetic pigments, photochemistry of PSI and PSII. Modes of CO₂ fixation (Calvin cycle, reductive acetyl CoA pathway, HP pathway). Halobacterial photosynthesis. Anaplerotic reactions.

Carbohydrate metabolism – EMP, ED, HMP and phosphoketolase pathway in microorganisms. Gluconeogenesis and its significance.

UNIT – III (20 hrs)

Aerobic respiration: TCA cycle- intracellular location and reactions, amphibolic nature, Glyoxalate cycle. Mechanisms of substrate-level phosphorylation. Respiratory electron transport in mitochondria and bacteria. Mechanism of oxidative phosphorylation, uncouplers and inhibitors.

Anaerobic respiration: sulphate and nitrate respiration and their ecological significance. Fermentation: alcoholic, lactate, propionate, mixed acid butyrate and butanol fermentations and their industrial importance. Concepts of primary and secondary metabolism. Biosynthesis of secondary metabolites with special reference to penicillin and polyketides.

UNIT – IV (22 hrs)

Lipid metabolism – Biosynthesis of glycerol's phospholipids and glycolipids, oxidation of saturated and unsaturated fatty acids. Nucleotide metabolism – Biosynthesis of purine and pyrimidines, nucleotide-salvage and de novo pathways. Biosynthesis of deoxy ribonucleotides and regulation.

Protein metabolism – Assimilation of inorganic nitrogen and sulphur, biosynthetic pathways of amino acids and their regulation with emphasis on tryptophane and histidine. Catabolism of amino acids (transamination, decarboxylation, deamination). Degradation of proteins-proteases.

References:

1. Arora D.K and Seema Gupta, (1996). Bacterial Physiology. Anmol Publications. New Delhi.
2. Caldwell, D.R. (1995). Microbial Physiology and metabolism, Wm. C. Brown Publishers, USA
3. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2007). Microbiology. (5th Edition). McGraw-Hill Company, New York
4. Larry McKane and Judy Kandel. (1996). Microbiology-Essentials and applications. (2nd edition). McGraw Hill, Inc., New York.
5. Lubert Stryer. (1995). Biochemistry. (4th edition). W.H. Freeman and company, New York.
6. Moat, A.G. and Foster, J.W. (1988). Microbial Physiology (Second Edition). John Wiley & Sons, New York.
7. S. Ram Reddy and S.M. Reddy (+92006) Microbial Physiology, Scientific publications (India) Jodhpur
8. Voet D and Voet J.G. (1995). Biochemistry. 2nd ed. John Wiley and Sons.
9. White, D. (1995). The physiology and biochemistry of Prokaryotes, Oxford University Press, Oxford, New York.
10. Zubay, G. (1998). Biochemistry WCB. Mc Graw – Hill, Iowa.
11. Lehninger, Nelson and Cox Principles of Biochemistry, 3rd Edition.
12. Gotchak. – Bacterial metabolism.

MBT 202: MOLECULAR BIOLOGY

UNIT – I

(20 hrs)

Chromosome organization in Prokaryotes and eukaryotes. DNA replication - semi conservative, rolling circle, unidirectional and bidirectional. DNA synthesis by reverse transcription, Inhibitors of DNA replication.

DNA damage and repair mechanisms (methyl directed, mismatch repair, short patch repair), excision repair, recombination repair, SOS system.

UNIT – II

(15 hrs)

Transcription - Structural features of rRNA, tRNA and mRNA and their functions. General principles, basic apparatus of transcription. RNA polymerases, mechanism, promoters, enhancers and other regulatory sequences, inhibitors of transcription.

Post-transcriptional modifications - Transcriptional attenuation, cutting and trimming of rRNA, mRNA modification (capping, polyadenylation and splicing), cutting and modification of tRNA, catalytic RNA, group I and group II intron splicing and RNase P.

UNIT – III

(15hrs)

Translation: Basic features of genetic code, Wobble concept, prokaryotic and eukaryotic ribosomes, RNA pol. I, II and III. Initiation, elongation and termination factors. Inhibitors of protein synthesis.

Post translational modifications: Protein folding, structural analysis, signal hypothesis, protein targeting and *in vitro* transcription and translation systems. CRISPR-Cas 9 technology.

UNIT – IV

(20 hrs)

Regulation of gene expression – Operon concept, regulatory elements of operon – inducers, apo-repressors and co – repressors. Genetic evidence for positive and negative regulation. Catabolite repression. Structure, function and regulation of *lac*, *trp* and *ara* operons.

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

References:

1. Baumberg, S ed. (1999): Prokaryotic Gene Expression, Oxford, United Kingdom, Oxford University Press.
2. Brock T.D (1990): The Emergence of Bacterial Genetics, Cold Spring Harbor, New York.
3. Burrell, M.M. (1993). Enzymes of Molecular Biology, Humana Press.
4. Brown, T.A. (1995). Gene Cloning. An introduction 3rd edition. Chapman and Hall.
5. Brown T.A. (1999): Genomes, BIOS Scientific Publishers Oxford.
6. Gardener EJ, Simmons M.J. and Snustad D.P. (2001): principles of Genetics, 8th Edi. John Wiley & Sons, Inc
7. Griffith AJF Gelbart W.M. Lewontin, RC and Miller JH (2002): Modern Genetic Analysis 2nd Edi. W.H. Freeman, New York.
8. Lewin, B. (2004): Genes VIII. Oxford University Press, Oxford.
9. Lodish, H. Biology, 4th ed. Scientific American Books, W.H. Freeman, New York.
10. Maloy S.R. Cronan J.E., (Jr) and Freifelder D (1994): Microbial genetics, Jones and Bartlett Publishers.
11. Molecular Biology of cell. Albert et al 4th Edition Garland Publishing Inc.
12. Macinski, G.M. and Freifelder, D. (1998). Essentials of Molecular Biology, 3rd Edition, John and Bartlett Publishers.
13. Nelson DL and Cox MM (2000): Lehninger Principles of Biochemistry, 3rd ed. Worth Publishing, New York.
14. Primrose, S. Twyman R and Old B (2001): Principles of Gene Manipulation, 6th ed. Blackwell Science.
15. S. Ram Reddy, K. Venkateshwrlu, V. Krishna Reddy, (2007): Molecular Biotechnology, Kakatiya University.

MBT 203: MICROBIAL GENETICS

UNIT – I

(20 hrs)

Modern concept of gene- gene structure, co-linearity and one gene - one enzyme concept, types of genes. General properties of mutations- molecular basis of mutations (base substitution, insertion and deletions Frameshift mutations, transitions, transversion, site directed mutagenesis), spontaneous (non-adoptive, mutation rate and hotspot), induced (chemical, physical and base analogue mutagens).

Mutation screening methods (bacteria, bacteriophages and fungi), evaluation of mutagens using microbial systems. Mutation analysis, Benzers concepts with reference to rII locus in T4 bacteriophage.

UNIT – II

(15 hrs)

Gene Transfer mechanisms - Transformation, conjugation, transduction and transfection: mechanism and applications. Over view of bacterial genetic map, Mapping of genes.

Molecular recombination (bacteriophages, and *E.coli*) Genetic models of recombinations (Holliday model, invasion model and break repair model) synapse of homologous duplexes, breakage and reunion. Role of RecA in recombination, Legitimate and illegitimate recombinations. Genetic analysis of recombinations (complementation test).

UNIT – III

(15 hrs)

Plasmids: Occurrence, types, classification, purification of plasmids and functions. Transfer and replication of plasmids and its applications in modern biology.

Transposons: transposable elements, IS elements, P elements, transposition, reverse transposons and their applications in genetic analysis. Uses of phages in microbial genetics, phenotypic mixing, DI particle and genetic evolution of viruses (Influenza, HIV, Herpes).

UNIT – IV

(15 hrs)

Cell cycle – over view, phases of cell cycle, regulations of cell cycle, progression (MPF cyclins and cyclin dependent kinases, cell differentiation) cell cycle check points, inhibitors of cell cycle.

Molecular Biology of tumorigenesis: Terminology, types of tumors, physical, chemical and biological carcinogens. Carcinogenesis, metastasis, Protooncogenes, oncogenes, Tumor suppressor genes, apoptosis, role of oncogene products in signal transduction. Induction of tumors by *Agrobacterium*.

References:

1. Maloy, S.R., Cronan Jr. Je. Freifelder D (1998). Microbial genetics. Jones and Barlett Publishers.
2. 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.
3. Voet, D, and Voet, J.G (1995): Biochemistry, 2nd ed. John Wiley and Sons, New York.
4. Watson, J.D. Baker T.A., Bell S.P., Gann A, Levine M ad Losick R (2004): Molecular Biology of the gene, 5th Ed. Pearson Education, Inc.
5. Weaver R.F. (2002): Molecular Biology, 2nd Edi., Mc Graw-Hill Higher Education, New York.
6. Winnacker, E.L. (1987). From genes to /Clones: Introduction to Gene technology VCK Publications, Federal Republic of Germany.
7. White R.J (2001): Gene Transcription, Mechanisms and Control.
8. Microbial Genetics by Frifielder.
9. Introduction to Genetics by Gardner.
10. Fundamentals of Microbial Genetics by T.A. Brown.

MBT 204: BIOSTATISTICS, RESEARCH METHODOLOGY AND BIOINFORMATICS

UNIT – I (20 hrs)

Measures of Central tendency - mean (arithmetic, harmonic and geometric) median and mode; Correlation, Co-efficient, Simple linear regression; basic idea of Significance Test, hypothesis tests, levels of significance, Student 't', 'Chi' square and goodness of fit.

Analysis of co-variance: introduction, procedure, t-Test for multiple comparisons. Line fitting through graph points, standard curves, MLR. Construction of histograms and interpretation.

UNIT – II (15 hrs)

Research methodology- Characteristics of research-definition, steps in research process, selection of research problem, literature survey, hypothesis, ability to construct, presentation and interpretation of research data, preparation of abstract/technical report/manuscript for publication in scientific journals.

Project writing skills – preparation of research proposal for grants, Background analysis of problem, proposed goal, objectives, targets, implementation of plan and annual budget for project proposal. National and international funding agencies for life sciences research.

UNIT – III (18 hrs)

Introduction to computers - Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Computer Memory, Concepts of Hardware and Software; Concept of Computing, Data and Information; Applications of IECT; Connecting keyboard, mouse, monitor and printer to CPU and checking power supply Types of operating systems – DOS, UNIX and Windows.

Basics of presentation software - Creating Presentation; Preparation and Presentation of Slides; Slide Show (Word, Excel and PPT). Basic of Computer networks; LAN, MAN, WAN; Concept of Internet and its applications in biology, special software for microbiological approach.

UNIT – IV (22 hrs)

Bioinformatics: Definition, scope and relevance of bioinformatics, databases, visualization tools, genomics, proteomics, molecular mining, molecular modeling, Drug designing, gene therapy, structure and functional relationship of biomolecules.

Sequence analysis: Concepts, importance and alignment methods (pair wise and multiple sequence alignments). Methods of structure prediction for known and unknown folds. Applications of bioinformatics - *Ab initio* methods for determining proteins structure, *In silico* Analysis.

References:

1. Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press London Sokal & Rohif, (1973) Introduction to Biostatistics - Toppan Co. Japan.
2. A Practical Guide to the Analysis of Genes and Proteins by Baxevanis A.D. and Ouellette, Third Edition. John Wiley and Son Inc., 2005.
3. Bioinformatics Sequence and Genome Analysis by Mount D.W., CSHL Press, 2004.
4. Introduction to Bioinformatics by Tramontano A., Chapman & Hall/CRC, 2007.
5. Understanding Bioinformatics by Zvelebil, M. and Baum, Chapman & Hall/CRC, 2008.
6. Introduction to Biostatistics by K.S. Sharma.
7. Introduction to Bioinformatics by Attawood.

NC- 1: Fundamentals of Microbiology

UNIT – I

(18 hrs)

Basic microbiology- History and achievements, Major contribution of Leeuwenhoeck, Edward Jenner, Alexander Flemming, Joseph Lister, Robert Koch, Louis Pasteur, Hargobind Khorana.

General Characteristics- Prokaryotic and eukaryotic microbes. Preparation of culture media, Isolation and characterization of microorganisms, pure culture techniques, preservation and maintenance of microorganisms.

UNIT – II

(15 hrs)

Microscopy- Dark field, bright field, resolving power, numerical aperture, chromatic aberration, phase contrast microscopy, fluorescent microscopy, inverted microscopy, stereo microscopy, electron microscopy, TEM and SEM.

Staining Techniques- Simple staining, negative staining, differential staining, Gram and acid fast staining, flagella staining, capsule and endospore staining.

UNIT – III

(10 hrs)

Whittaker's five- kingdom system of classification- Major characteristics used in identification and classification of microbes: Morphological, physiological, ecological, genetic and molecular.

UNIT – IV

(18 hrs)

Control of microbes- Sterilisation, disinfection, antiseptic, tyndallisation, pasteurization: Physical- dry heat, moist heat, UV light, ionizing radiation, filtration, HEPA filter, Chemical- phenol and phenolic compounds, (halogen aliphatic alcohol, formaldehyde, ethylene oxide, heavy metals) anionic and cationic detergents.

Scope of Microbiology- significance of microbes in human health, agriculture, food and dairy industries, waste management and environment protection.

References:

1. Microbiology Pelczar, Chan and Krieg. (Indian edition)
2. Microbiology Vol II Power and Dagainawala.
3. Outlines of Biochemistry Cohn and Stumpf.
4. Microbiology by Dubey & Maheswari
5. Microbiology by Purohit.

MBP 201 - Microbial Metabolism and Molecular biology

1. Determination of microbial growth curve
2. Effect of temperature, pH and salts on bacterial growth
3. Demonstration of Oligodynamic action
4. Isolation of photosynthetic bacteria
5. Estimation of bacteriochlorophyll pigments
6. Isolation of chemoautotroph's : *Thiobacillus ferroxidans*
7. Demonstration of microbial stratification in aquatic ecosystem through Winogradsky column
8. Carbohydrate fermentation: acid and gas production
9. Isolation of hydrocarbon utilizing bacteria
10. Alcoholic and lactate fermentations
11. Assay of microbial enzymes (cellulase, pectinase, lipase and proteases)
12. Isolation and cultivation of anaerobic microorganisms
13. Demonstration of microbial toxins
14. Isolation and cultivation of antibiotics producing organisms.
15. Setting of molecular biology/Genetic engineering laboratory
16. Creating ribonuclease free environment in the laboratory
17. Isolation of DNA from microbes, plant/ animal tissues
18. Estimation of DNA by DPA method.
19. Isolation of RNA from bacteria/yeast
20. Estimation of RNA by Bial's Orcinol method
21. Determination of purity of DNA by spectrophotometric method
22. Transformation
23. Isolation of plasmid DNA

Suggested books/manuals.

- 1) Biotechnology: A Laboratory Course. 1996. 2nd ed. J.M. Becker, et al. Academic Press.
- 2) Methods in Biotechnology. 2002. By Ignacimuthu.

MBP 202 – Microbial Genetics and Biostatistics and Bioinformatics

1. Isolation of auxotrophic mutants
2. Replica plating technique
3. UV survival curve
4. Petite mutants
5. Phage titration
6. Induction of mutations in bacteria by physical/chemical agents.
7. Observation of mitotic divisions in onion root tips and meiotic divisions in flower buds
8. Observation of lambrush chromosomes in *Chironomus* salivary glands
9. Demonstration of Ames' test.
10. Demonstration of conjugation in bacteria

b). Problems

- I. DNA characteristics (T_m value, GC/AT, Chargaff's rule)
 - II. Transcription
 - III. Translation
 - IV. Mutations
 - V. Phage titrations
 - VI. Restriction mapping
11. Graphical representation of data, histograms and frequency curves.
 12. Descriptive statistics of distribution: Mean mode, median, variance, standard deviation and standard error.
 13. Probability distribution – binomial, poisson and normal distributions.
 14. Tests of significance on means and proportions – standard normal deviate test,
 15. Paired and unpaired test.
 16. Application of Chi square test, contingency tables with Yate's correction.
 17. Correlation and regression coefficients and their testing, partial and multiple correlation coefficients, multiple regression.
 18. Application of analysis of variance (ANOVA). Distance of similarity analysis
 19. Basics of computers – basic commands – file creation, copying, moving and deleting in Linux and Windows.
 20. Using email, browsing and search engines
 21. Using biological databases – Pubmed, NCBI, Swissprot – protein data bank and genebank
 22. Different types of sequence analysis queries in BLAST and FASTA
Multiple sequence alignments and Phylogenetic alignments (phylogenetic tree analysis).
 23. Usage of gene and protein structure prediction softwares.
 24. Genomic and proteomics available on the web and their use.
 25. Statistical software available on the web and their use.

Suggested books/manuals.

1. Recombinant DNA Laboratory manual. 1989. J.W. Zyskind and S.I. Bernstein. Academic Press.

MBT 301: RECOMBINANT DNA TECHNOLOGY

UNIT – I

(15 hrs)

Concept of Recombinant DNA technology, Isolation of desired genes, DNA manipulation, expression and principles of Scope of recombinants and importance of recombinant DNA technology in Genetic engineering.

Restriction enzymes - modification, classification, Nomenclature and importance. Restriction mapping, DNA ligases, Polynucleotide Kinase, alkaline phosphatases, S1 nuclease, Terminal transferase, Bal 31 nuclease.

UNIT – II

(18 hrs)

Cloning Vectors – Characteristics, classification, advantages and disadvantages. Natural and artificial plasmids and their importance in *E. coli* (plasmids, phagemids, cosmids and BAC s), Yeast (YAC s, shuttle vector), higher plants (Ti plasmid, binary vectors) and animal cells (SV 40 and retrovirus vectors). Characteristics of expression vectors. (Shot-gun method, southern analysis and cDNA synthesis).

Vector digestion, Ligation by linkers, adaptors and homopolymer tails. Preparation of DNA probes, construction of DNA libraries (genomic and cDNA libraries). Screening of recombinants – genetic, biochemical and hybridization methods. Microarrays and Macro arrays.

UNIT – III

(16 hrs)

Polymerase chain reaction – principle, types (RT-PCR, nested PCR, inverse PCR, immunocapture PCR and Real-Time PCR), primer designing and applications of PCR. Sequencing methods – Sanger's and Maxim-Gilbert's methods. Automated sequencing. Profiling of nucleic acids by DNA fingerprinting, RFLP, RAPD and AFLP.

Introduction of recombinant DNA molecules in appropriate hosts – competent cell preparation, electroporation, microinjection and particle gun-bombardment methods and selection of transformants. *Agrobacterium* – mediated transformation. Transfection - Salient features and its significance. *In vitro* packaging of recombinant cosmids.

UNIT – IV

(18 hrs)

Expression of cloned genes – IPTG, x-gal, lac, taq promoters. Expression of fusion protein tags, purification of tags, plasmid copy number, inducible expression system, inclusion bodies and solubilization of proteins.

Genetically engineered organisms (GEO): Transgenic Microorganisms, animals and plants as protein/cell factories, genetic engineering for fungal and bacterial diseases. Recombinant DNA technology applications in biology.

References:

1. J.M. Walker and R. Rapley (2002). 4th ed.: Molecular biology and Biotechnology. (Panima Publ.)
2. Demain, A.L., Manual of Industrial Microbiology and Biotechnology, (1999) second edition. Editor in Chief, ASM Press.
3. H. Kreuzer and A. Massey. Recombinant DNA and biotechnology: A guide for Teachers 2nd ed. ASM Press.
4. H. Kreuzer and A Massey. Recombinant DNA and biotechnology: A guide to students 2nd ed. ASM Press.
5. C. Ratledge and B. Kristiansen: .Basic Biotechnology, 2001. 2nd ed. Cambridge University Press.
6. Sambrook and Russel, Molecular Cloning, 2001. Vol. I – III CSH Press.
7. D. Freifelder - Essential of Molecular Biology
8. D. Freifelder - Microbial genetics
9. Gerald Karp (2004) 2nd edition - Cell and Molecular Biology
10. Lewin, B (2004): Genes VIII, Oxford University Press Oxford.
11. Lubert Stryer. (1995). Biochemistry. (4th edition). W.H. Freeman and company,
12. .Lehninger (2000) Prnciples of Biochemistry, 3rd edition, Nelson and Cox (Worth) Publ.
13. Molecular Biology of the Gene by James Watson, Tania Baker, Stephen Bell, Alexander Gann, Michael Levine & Richard Losick , 6th Edition; CSHL Press; 2007.
14. Molecular Biotechnology by T.A. Brown.

MBT 302: BIO - PROCESSING TECHNOLOGY

UNIT – I

(15 hrs)

History of fermentation technology, Exploitation of Microorganisms in fermentation Process. Components of fermentation process.

Industrial media and Inoculum: Medium composition, preparation and optimization. Sterilization of media and fermenter. Inoculum development, Starter culture technology and preservation methods of microbial cultures.

UNIT – II

(15 hrs)

Fermenter – Design, parts and types of fermenters, probes for online monitoring, physical, chemical and biological sensors. Applications of computer in fermentation process, measurement and control of fermentation process.

Microbial growth kinetics in batch, fed batch and continuous culture systems. Substrate utilization, specific growth rate, yields of biomass, product formation kinetics.

UNIT – III

(20 hrs)

Fermentation process: Aeration and agitation. Power requirement, oxygen transfer kinetics. Concepts of Newtonian, Non – Newtonian and plastron fluids, apparent viscosity, foam and antifoam. Scaling up of process.

Downstream processing: Solid-liquid separation, release of intracellular components, concentration of biological products, purification, production, formulation, monitoring of downstream processing, process integration.

UNIT- IV

(15 hrs)

Process economics: The starting point, cost estimates, process design, design exercise, capital cost estimates, the operating cost estimates and Goods and Services Tax (GST).

Legal protection and IPR: WTO, IPR in India, Convention on Biodiversity (CBD), Patent Cooperation Treaty (PCT), forms of patents and patentability, process of patenting, Global scenario of patents and India's position, patenting of biological materials.

References:

1. Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology and Biotechnology. ASM Press.
2. Glick, B.R. and Pasternak, J.J. (1994). Molecular Biotechnology, ASM Press.
3. Stanbury, P.F., Whitaker, A. and Hall, S.J. Principles of Fermentation Technology, Pergamon Press.
4. Doran, P. M. (1995). Bioprocess Engineering principle. Academic Press. London.
5. Moses, V. Cape, R. E. and Springham, D. G. (1999) Biotechnology: The science and the Business. 2nd ed. Harwood Academic. New York.
6. Nielsen, J., Villadsen, J. and Liden, G. (2002). Bioreaction Engineering. 2nd ed. Kluwe Academic/Plenum Publishers. New York.
7. Garcia, A., Bonen, M. R., Ramirez-Vick, J., Sadaka, M. and Vuppu, A. (1999). Bioseparation process science. Blackwell. Massachusetts.
8. Sommeleitner, B. (2000). Bioanalysis and biosensors for bioprocess monitoring. Advances in biochemical engineering/biotechnology. Vol.66. Springer-Verlag. Berlin.

MBT 303: IMMUNOLOGY

UNIT – I

(15 hrs)

History and scope of immunology, structure, composition and function of cells and organs involved in immune system. Immune response (humoral and cell mediate) Types of immunity, innate immunity, acquired immunity; immunohematology, blood groups, blood transfusion and Rh – incompatibility, phagocytes, inflammation, and extra cellular killing.

Antigens and Antibodies: Antigens – structure, properties – types (Iso and allo), haptens, adjuvants, antigenic specificity. Antibodies- structure, heterogeneity, types and sub types, properties (physico chemical and biological), theories of antibody diversity – production of polyclonal, monoclonal and recombinant antibodies and their applications.

UNIT – II

(15hrs)

Antigen - Antibody interactions: Invitro methods – Flocculation, Precipitation, Immuno diffusion, Agglutination Phagocytosis Opsonization, Neutralization, Complement fixation. Immuno electrophoresis, Immunofluorescence. RIE, CIE, RIA, ELISA and Western Blot, Flow cytometry.

Complement system: complement components, types, complement activation, regulation of complement system, biological consequences and pathways of complement activation, and complement deficiencies.

UNIT – III

(10 hrs)

Structure and functions of MHC and the HLA system; HLA and tissue transplantation tissue typing, graft versus host reaction and rejection. Antigen Processing and presentation, T-Cell maturation and differentiation, T- cell activation, co-stimulation and T-Cell Receptors.

Auto immunity, autoimmune diseases and their treatment, tumor immunology–tumor specific antigens, immune response to tumor, immunodiagnosis of tumors, immunodeficiency, Immunotherapy of tumors (alphafeto-protein, carcino embryonic antigen).

UNIT – IV

(20 hrs)

Hypersensitivity reactions: classification and types (type I. Anaphylaxis; type II Antibody dependent cell cytotoxicity; Type III Immune complex mediated reactions; type IV cell mediated hypersensitivity reactions)

Immunization: Objectives of immunization, Active and passive, types of vaccines: whole organism vaccines, recombinant vector vaccines, DNA vaccines, synthetic peptide vaccines, subunit vaccines, immunization procedures, adverse reactions of vaccines. Immunotherapy, various cytokinines and Assay methods.

References:

1. Coleman, R.M Lambard, M. F and Siccard R.E. 1992, Fundamentals of Immunology 2nd Ed.
2. Kuby, J. 1992 Immunology New York, W.H. Freeman.
3. Paul, W.E 1990 Fundamental Immunology 2nd Ed.
4. Riott, I.M. 1991, Essential Immunology 7th Ed.
5. Tizarrd, I.R. 1998. Immunology An Introduction 2nd Ed
6. Ross, G.D. Ed Immuno biology of the Complement System.
7. Riott, I.M. Brostoff, J. and Male, R.K. 1989. Immunology 2nd Ed.
8. Leskowitz, Alan R. Lisi (1988).Immunology – a short course elibezamini and Sidney Inc. New York.
9. J.H.L. Playfier (1987) 4th Ed. Immunology at a glance Blackwell Scientific Publication.
10. John W. Kinball –Introduction to Immunology.
11. Abul Abbas, Andrew K. Kich Amn Jordan S. Pober. Cellular and Molecular Immunology 3rd ed
12. Bacterial Evasion of the Host Immune System Edited by: Pedro Escoll Published: 2017

MBT 304: MEDICAL AND DIAGNOSTIC MICROBIOLOGY

UNIT – I

(20 hrs)

Classification and characteristics of medically important microorganisms: infection, virulence, pathogenicity, sources and modes of transmission of infections. Normal Microflora of human body: Detailed study of morphology, cultural characteristics, biochemical properties, pathogenesis, diagnostic laboratory tests, epidemiology and prophylaxis of the following organisms, *Haemolytic Streptococci*, *Pneumococci*, *Corynebacterium diphtheria* *Mycobacterium tuberculosis* and *M. leprae*, *Neisseria meningitidis*, *Hemophilus influenzae*.

Bacteria causing sexually transmitted diseases – clinical significances - *Treponema*, *Neisseria gonorrhoea*, LGV agent (*Chlamydia H. ducreyi*, *Calymmoto Bacterium*, *Grannulomatis*). Bacteria causing water borne infections (*E. coli*, *Salmonella*, *Shigella*, *Vibrio*), and wound infections (*Clostridium tetani*, *C. welchii*, *Staphylococci*, *Pseudomonas*).

UNIT - II

(15 hrs)

Detailed study of morphology, cultivation, pathogenesis, diagnostic laboratory tests, epidemiology, prevention and treatment of air borne, waterborn, insect borne, contact, and sexually transmitted viral diseases. *Enterovirus*, and zoonotic viral infections. *Influenza virus*, *Chicken gunea*, *Rhinovirus*, *rubella*, *adenovirus*, *mumps*, *measles*, *varicella*, *zoster virus rabies*, *Japanese encephalitis*. HAV, HBV, HCV, HIV.

Superficial mycoses, cutaneous and subcutaneous mycoses, Opportunistic mycoses and their control. Detailed study of morphology, pathogenesis, Prevention of Malaria. Amoebiasis, Leshmaniasis, Toxoplasmosis, Exhnhinococcus grannulosus, Ascariasis, Ancylostomiasis, Filariasis.

UNIT - III

(15 hrs)

Types of specimens, specimen collection, handling, transport, processing of material for laboratory investigations, specific and non specific laboratory tests, morphological identification (light and electron microscopy), culture isolation detection of antigen by immunological assays, serological tests, antibody stains, Immuno blotting.

Molecular diagnosis:- DNA – DNA or DNA – RNA hybridization, 16srRNA, target ramification systems (PCR, reverse transcript PCR, TMA, NASBA, LAMP) probe amplification systems – Ligase chain reaction (LCR), signal amplification techniques. Applications of nanotechnology in clinical diagnosis.

UNIT – IV

(20 hrs)

Antimicrobial agents: Bacterial, viral, fungal and protozoan. Microorganisms producing the antimicrobials, screening and assay of antimicrobial compounds, (*in vitro* and *in vivo*) minimum inhibitory concentrations (MIC), MLC.

Mode of action of antimicrobials: Cell wall, nucleic acid, purine, pyromidine, protein. respiration, oxidative phosphorylation ,enzyme inhibitors, cell membrane disruptors, and metabolites, analogues, drug resistance and its side effects.

References:

1. G.F. Brooks, J.S. Butel and S.A. Morse, (2002) 5th edition Medical Microbiology Mc Graw – Hill pebbles.
2. Murray PR et al (1999) Manual of clinical Microbiology (Ed.) American Society for Microbiology.
3. Lippincott – Raven, (1996) Fields Virology (3rd Edition) Fields BN et al (editions)
4. Davies et al Microbiology 4th edition.
5. Ananthanarayana, R & Panicker CKJ 6th Ed Test Book of Microbiology, Orient Longman, (2000).
6. Evans EGV et al (ed.) Medical Mycology Oxford University press
7. Reichmann, DD et al Churchill Livingstone, 1997 Clinical virology,
8. Skinner, FA and Carr, JG 1974 (ed.) The Normal microbial Flora of Man, Academic press, London,
9. Beily and Scott (2001) Diagnostic Microbiology 4th ed. ASM Press. Principles and Applications, American Society for Microbiology, 1993
10. Panjarathinam R Orient Longman (1990). Text book of Medical Parasitology.
11. Foot-and-Mouth Disease Virus: Current Research and Emerging Trends Edited by: Francisco Sobrino and Esteban Domingo Published: 2017
12. **Clinical Microbiology 8th Edition- An Introduction for Healthcare**

Professionals: Jennie Wilson (2018) Paperback ISBN: 9780702023163

NC-2: Microbial Technology and Entrepreneurship

UNIT – I (15 hrs)

Microorganisms in the service of man and society– Past, Present and Future. Traditional Microbial Technologies – Curdling of Milk, Bread and Wine, making other traditional foods of India and the World.

Microorganisms of Industrial importance – Over view of Isolation, Screening and Maintenance, Microbial Industries and Commercially important products, Status and Demand and Production – Indian and Global Scenario.

UNIT – II (15 hrs)

Raw materials for Microbial Processes – Availability and utilization, Significance of locally available raw material. Production of Pharmaceutically and Commercially important products – Alcohol and Alcoholic beverages.

Antibiotics, Enzymes, Vitamins and Monoclonal antibodies. Production of fermented milk products Yogurt and Cheese.

UNIT – III (15 hrs)

Microbes in Agriculture – Composting, Nitrogen fixation, Vermi composting, over view of bio fertilizers and bio pesticides – Production and applications. Microbial fuels – Alternate sources of energy – Methane and Hydrogen production, their significance, microorganisms in the recovery of precious metals, bio degradable polymers from microorganisms.

Microbes in Food - Single cell proteins and Single cell oil – Mushroom cultivation, Genetically engineered micro organisms – Applications in health, industries, agriculture, environment, fate of genetically engineered micro organisms in the environment.

UNIT – IV (15 hrs)

Microbial entrepreneurship – Government schemes for commercialization of microbial (Biotech) technology, Govt. regulations, Entrepreneurship – Developing a business plan, basic concept of financial, management, major financial statement – over view of Human resource management.

Legal and statutory requirements, Marketing, Negotiation skills, Rural and Women entrepreneurship. Patenting and intellectual property rights

References:

1. Martin Gross, 2013, Entrepreneurships in Biotechnology
2. De Hayne and J Kapelers, 2006, Innovation and Entrepreneurships in Biotechnology
3. Richard Dana Ono, 1991, Business of Biotechnology, Butterworths
4. Crueger and Crueger, Biotechnology: A Text book of Industrial Microbiology, 2nd Ed.
5. Casida, Industrial Microbiology
6. Demain AL, Biology of Industrial Microorganisms
7. Frazier WC and Westhof DC, Food Microbiology, 3rd Ed. TMH
8. Doyle PM et al, Food Microbiology- Fundamentals and Frontiers, 2nd Ed. ASM Press
9. Ananta Krishnan CP et al, 1994, Dairy Microbiology, Sri Lakshmi Publications, Chennai
10. Rabinson RK, 1990, Dairy Microbiology, Elsewhere applied Science, London
11. Peppler.H., Microbial Technology and processing

MBP: 301 – Recombinant DNA Technology and Bio process Technology

1. Restriction digestion of sticky ends and blunt ends
2. RNA polymerase activity
3. Polyribosome's
4. Southern blotting
5. Ti plasmid / crown gall disease
6. Replica plating
7. DNA Ladder 1000bp (super coiled plasmid)
8. Lambda DNA (ECORI/ Digest)
9. λ DNA/ ECORI/ Hind III digest
10. PBR 322 DNA/ Hinf 1 digest
11. PBR 322 DNA/ Ahe 1 Digest
12. Lambda / Hind III PUC 18 / save 3A1 PUC 18/ Taq / digest
13. Restriction analysis and Agarose electrophoresis
14. Dioxix growth
15. Preparation of competent cells.
16. Use of logerttherms in microbial growth during fermentation process.
17. Determination of mid of the bacterial growth curve.
18. Harvesting of microbial cells and demonstration of yield of products.
19. Manometric study in fermentation process.
20. Bacterial growth kinetics
21. Mid point of bacterial growth curve
22. Mono metric study in fermentation process
23. Design of fermenter

Suggested Books/Manuals.

- 1) Recombinant DNA Laboratory Manual. 1989. J.W. Zyskind and S.I. Bernstein. Academic Pess.
- 2) Manual of Industrial Microbiology and Biotechnology, 2nd edition, by Demam A.L., Editor in chief 1999, ASM Press.
- 3) Recombinant DNA and Biotechnology: A Practical guide to students 2nd edition. H. Kreuzer and A. Massey.
- 4) Molecular clonming Vol. I, II, III, A Practical by Sambrook, and Russel (2001) CSH press.
- 5) Experimental Biochemistry, A Student companion (2003) Vijay Deshpandes. I.K. Int. Pvt. Ltd.

MBP: 302 – Immunology, Medical and Diagnostic Microbiology

1. Separation of serum proteins by SDS PAGE.
2. Production of polyclonal antibodies- demonstration of different routes of immunization, bleeding of experimental animals, collection of blood, serum separation, purification and characterization of immunoglobulins.
3. *In vitro* serological tests: single radial immuno diffusion and double diffusion, Ochterlonly double diffusion, immunoelectrophoresis--counter immunoelectrophoresis, rocket immune electrophoresis, DAC- ELISA. DAS-ELISA.
4. Agglutination reactions, Widal, HA, blood typing
5. Flocculation- VDRL.
6. Neutralization tests.
7. Separation of serum WBC, RBC, Plasma proteins.
8. CBP and differential blood picture.
9. Lymphoblast transformation B Jerme plaque test
10. Blot Transfer and detection of protein on blot by staining
11. Lymphocyte viability test
12. Indirect Agglutination a. Hepatitis; b. Pregnancy test (HCG)
13. Identification of Staphylococcus and Mycobacteria using Gram and acid fast Staining.
14. Collection and culture of nosocomial microorganisms
15. Bacterial examination of blood, urine and pus.
16. Examination of Blood smear for malaria.
17. Blood hemoglobin estimation
18. Erythrocyte sedimentation rate.
19. Liver function test for hepatitis virus
20. Slide observations: *Candida albicans*, *Mycobacterium leprae*, bacterial spores, *Corynebacterium* sp., *Clostridium tetani*, *Aspergillus fumigatus*.
21. Preparation of different types of culture media, staining techniques – Gram’s staining, F.B. Staining, Albert staining, Capsular staining etc.,
22. Identification of various pathogenic bacteria by biochemical, enzymatic and serological methods.
23. Bacteriological examination of urine, blood, pus, sputum, stools etc, from patients for diagnosis.
24. Microscopic studies of virus infected materials.
25. Handling of lab animals.
26. Examination of pathogenic fungi.
27. Examination of stools for helminthes and Amoeba.
28. Examination of blood smear to identify malarial parasite.
29. Isolation, observation and identification of normal microbial flora of human body.

Suggested Books/Manuals.

1. Manual of clinical Microbiology by Murray PR et al (1999) ASM.
2. A Practical Manual for Medical Microbiology – M aechie and Maecortney 4th ed. (1990).
3. Practical Medical Microbiology (14th ed.) collect JG et al Edinburgh: Churchill living (1996).
4. A Practical book for Microbiology, Techniques and Immunology by Ochie et al (1996) 4th ed. ASM Press.

MBT 401: Agricultural Microbiology

UNIT – I

(15 hrs)

The soil: Definition, components, physical chemical characteristics and classification. Qualitative and quantitative nature of bacteria, actinomycetes, fungi, algae, Protozoa and nematodes. Influence of environmental factors on soil microflora. Methods of isolation and enumeration of soil micro flora.

Soil organic matter – nature, microbial degradation of carbohydrates, Proteins and other nitrogenous substances, fats, hydrocarbons and pesticides in soil. Humous significance and degradation. Soil enzymes – Nature, isolation, occurrence and ecological significance.

UNIT – II

(15 hrs)

Plant – microbe interactions - Rhizosphere. Microflora on plant growth, Ecology of phyllosphere Microflora, Biological importance of Phyllosphere microorganisms, Plant growth promoting rhizobacteria (PGPR). Diversity of nitrogen fixers; Mechanism of symbiotic and asymbiotic nitrogen fixation; nodule formation and gene regulation of nitrogen fixation.

Biofertilizers- Microbes used, cultivation and mass production of biofertilizers and bioinoculants (Rhizobium, Frankia, Azotobacter, Azolla, Azospirillum, and Blue- green algae, Mycorrhizae), Phosphate solubilizing bacteria (PSB), Vermicomposting, methods and applications.

UNIT – III

(15 hrs)

Plant pathology: Brief history and development of plant pathology, types of plant diseases and their significance. Symptoms of plant diseases. Basic procedures in the diagnosis of plant diseases. Host pathogen interactions- virulence factors of pathogens and defense mechanisms of plants against pathogens. Environmental effects on disease development and disease epidemiology. Control of plant diseases by various approaches.

Biocontrol of Pests and pathogens: Introduction, biocontrol of foliar and soil borne pathogens and microbial pesticides (bacteria, virus, fungi) production, formulations, economics, safety, advantages and disadvantages. Development of genetically modified crop plants for control of pests, integrated pest management.

UNIT – IV

(20 hrs)

Plant diseases: Symptomatology, etiology, epidemiology, disease cycle, control measures of fungal diseases: damping off of seedlings, Phytophthora leaf rot and stem rots, downy mildew of grapes, rust of groundnut, red rot of sugarcane, tikka disease of groundnut, blast disease of rice.

Bacterial diseases: Citrus canker, blight of rice and angular leaf spot of cotton. Viral and viroid: rice tungro, sugarcane mosaic/ streak, potato spindle tuber viroid diseases, tomato/ tobacco leaf curl, tobacco mosaic, citrus yellow mosaic, papaya ring spot, banana bunchy top. Phytoplasmal diseases: Little leaf of brinjal.

References:

1. Stolop H.- Microbial ecology : Principles, methods, & applications & biological nitrogen fixation.
2. N.S. Subba Rao - Soil microorganisms and plant growth
3. R.S. Singh - An introduction to principles of plant pathology
4. Lynch poole - Microbial ecology : A conceptual approach
5. N. S. Subba Rao - Advances in Agriculture Microbiology
6. G. Rangaswamy and D.J. Bhagya Raj - Agricultural Microbiology
7. B.N. Richard - An introduction to soil ecosystem
8. N.S. Subba Rao - Bio fertilizedrs
9. R.S. Methotra - Plant pathology
10. S.A. J. Tarr - Principles of plant pathology
11. Vander Plank - Plant disease resistance
12. Vidyasekaran - Molecular plant pathology
13. Charudattan R (1982), . John Wiley & Sons. Biological Control of Weeds with Plant Pathogens
14. George N Agrios (2000), Plant Pathology. 4th Ed. Academic Press.
15. Norris J.R. and Pettipher G.L, (1987), Essays in agricultural and Food Microbiology. John Wiley and Sons. Singapore.
16. Singh. R.S (1997), Introduction to Principles of Plant Pathology. 3rd Ed. Oxford and IBH.
17. Subba Rao N.S (1995), Soil Microorganisms and Plant Growth. Oxford and IBH.
18. Sylvia D M, Jeffrey J Fuhrmann, Peter G Hartel, David A Zuberer (1997), Principles and Applications of Soil Microbiology. 1st Edition, Prentice Hall

MBT 402: ENVIRONMENTAL MICROBIOLOGY

UNIT – I

(18 hrs)

Habitat for microorganisms: General description of soil, water, air. Physical and chemical factors influencing the distribution of microbial flora. Types of microbial interactions, community dynamics.

Bio – geochemical cycles and ecological significance. Role of microorganisms in cycling of bioelements – carbon, nitrogen, sulphur, phosphorus and iron, Ecological significance of ammonification, nitrification and denitrification.

UNIT – II

(12 hrs)

Aerobiology- Microbes and microbial propagules in air. Methods for microbial analysis of air, Brief account of air – borne transmission of microbes – viruses, bacteria and fungi, their disease fore casting and preventive measures.

Aquatic Microbiology - Water ecosystems types – fresh water (ponds, lakes, streams). Marine habitats (estuaries, mangroves, deep sea, hydrothermal vents , saltpans, coral reefs). Zonations of water ecosystem, up welling, eutrophication, food chain. Potability of water, Sampling and microbial assessment of water quality and water purification.

UNIT – III

(12 hrs)

Bioremediation- Bioremediation of contaminated soil and water using microbial consortia, reversal of global warming, Degradation of xenobiotics – oil slicks, detergents, plastics, recalcitrance of pesticides in soil (eg. DDT), volatilization of toxic metals by microorganisms Fate of engineered microorganisms in the environment.

Biofouling and corrosion- Biofouling organisms, problems due to biofouling, antifouling paints and its environmental pollution, biotechnological approach to biofouling control, aerobic and anaerobic corrosion.

UNIT – IV

(20 hrs)

Extremophiles – Microbes in extreme environments, adoption mechanisms, applications of extremophiles. Microbial leaching of mineral ores – organisms involved, factors affecting leaching, leaching process of uranium, copper and gold.

Waste treatment - Solid and liquid wastes and their characterization. Liquid waste treatment (microbial diversity and treatments), solid waste treatment- saccharification, gasification, composting, utilization of solid wastes for food (SCP, mushroom, composting, yeast), fuel (ethanol, methanol) and fertilizers. Treatment of industrial fermentation unit effluents.

References:

- 1) Alexander, M. (1977). Introduction to Soil Microbiology. John Wiley and Sons Inc New York.
- 2) Alexander, M. (1971). Microbial Exology. John Wiley and Sons Inc. New York.
- 3) Baker K. H. and Herson, D.S. (1994), Bioremediation. Mc Graw Hill Inc., New York
- 4) Burns R.G. and Slater J.H. (1982), experimental Microbial Ecology, Blackwell Scientific Publications. Oxford, London.
- 5) 5. Burges A. and Raw F, (1967), soil Biology. Academic Press, London
- 6). Metagenomics: Current Advances and Emerging Concepts
Edited by: Diana Marco Published: 2017
- 7). Gabriel bitton, (1999), Waste Water Microbiology. 2nd Edition. Wiley – Liss.
Harriet A. Burge, (1995), Bioaerosols. Lewis Publishers Inc.
- 8). Ian L. pepper, Charles P Gerba, Jeffrey W (1995), Environmental Microbiology:
Laboratory Manual. Academic Press.
- 9). Marshall K. C (1985), Advances in Microbial Ecology. Vol 8, Plenum press.
- 10) Robert L. Tate, (2000), Soil Microbiology 2nd Edition. John Wiley and Sons.
- 11) . Atlas and Batra - Microbial Ecology – Fundamentals and applications 1998
- 12) .D. Colwd 1999 Microbial diversity Academic press.
- 13). C.J. Hurst, editor in chief 2002, ASM press 2nd edition Manual of environmental
Microbiology
- 14) . Paul A. Rochell 2004, Environmental Molecular Microbiology – Protocols &
Applications
- 15). Eugenia J. Alguin, Gloriasanchez, Elizabethhernandez, environmental Biotechnology
cleaner, Bioprocess 2005
- 16). Mark coyne, 2004, Soil Microbiology: An exploratory approach.
- 17). Brewing Microbiology: Current Research, Omics and Microbial Ecology
Edited by: Nicholas A. Bokulich and Charles W. Bamforth Published: 2017

MBT 403: FOOD MICROBIOLOGY

UNIT – I

(15 hrs)

Introduction- Definition, concepts and scope of food microbiology. Importance of microbes in food, food as substrate for microbes. Factors influencing food spoilage (intrinsic and extrinsic), microbial growth, survival and death in food.

Detection of microbes in food - Direct microscopic count (DMC), standard plate count, MPN method, reductase test, membrane filters and molecular methods.

UNIT – II

(15 hrs)

Food fermentation - Bread, cheese, vinegar, fermented vegetables, dairy, meat, poultry and fish products. Fermented foods of therapeutic value (probiotics and prebiotics), spoilage and defects of fermented dairy products – oriental fermented foods, their quality standards and control.

Microbes as Food - Single cell proteins (SCPs), edible mushrooms and their cultivation, bioconversions, production of alcohol, fermented beverage, beer and wine. Genetically modified foods.

UNIT – III

(10 hrs)

Food-borne disease and their control - Food infection and intoxication, detection of food borne pathogens and their toxins by conventional, rapid automated, molecular and immunological techniques. Food control agencies and its regulations, Employee's health standards, waste treatment, disposal and quality control.

UNIT – IV

(20 hrs)

Contamination and spoilage - Microbiological (yeasts, bacteria) contamination of food. Microbial spoilage of cereals, sugar products, vegetables, fruits, meat and meat products, milk and milk products, fish and sea foods, poultry. Spoilage of canned foods. Detection of spoilage and characterization.

Principles of food preservation. Preservation methods, Factors influencing microbial growth in food (extrinsic and intrinsic factors). Food additives, canning, processing for heat treatment – D, Z, and F values and working out treatment parameters. Hazard analysis and critical control points (HACCP). Good manufacturing process (GMP). Microbiological standards - Codex Alimentarius and Food legislation.

References:

1. M.P Dolye et al. (2001) Food Microbiology: Fundamentals and frontiers. 2nd ed. ASM Press.
2. Adams, M.R. and Moss M.O. (1995) Food Microbiology. Royal Society of Chemistry Publication, Cambridge.
3. Frazier WC and Westhoff DC (1988). Food Microbiology Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
4. Stanbury, PF., Whitekar, A and Hall, S.J. (1995) Principles of Fermentation Technology. 2nd Edition. Pergamon Press.
5. S.N. Tripathy (2004) Food Biotechnology Dominant Publishers and Distributors, Delhi.
6. S.P. Narang (2004) Food Microbiology methods of Enumeration. APH Publishing Corporation, Delhi.
7. A.H. Patel Industrial Microbiology (2004) Rajiv Beri for micmillan India Ltd. New Delhi.
8. Alexander N: Microbial Biotechnology – Fundamentals of Applied Microbiology (1995).

MBT 404: INDUSTRIAL MICROBIOLOGY

UNIT – I

(10 hrs)

Introduction- History, industrially important microorganisms and their characteristics, Strain improvement through conventional and modern genetic engineering approaches.

Screening of microbes for products – Primary and secondary screening, detection and assay of products by physico- chemical and biological assays. Strategies for selection and preservation of Industrial strains. Culture collection centers.

UNIT – II

(18 hrs)

Yeast and Yeast products - Production of active dry baker's yeast, instant yeast, quality of bakers yeast, production of brewer's yeast, food and fodders yeasts.

Immobilization of cells and enzymes - Techniques and supports – Adsorption, covalent linkage, entrapment and cross-linkage and their advantages and disadvantages, applications of microbial fermentations with immobilized cells / enzymes.

UNIT – III

(20 hrs)

Industrial production of enzymes - amylases, cellulases, pectinases, xylanases, proteases and lipases. Scope, utility and methodology of biotransformation, biotransformation of antibiotics, steroids and nonsteroids.

Biofuels Production - ethanol, methane, hydrogen from starch and lignocellulose. Production methods and applications of organic acids- citric acid, lactic acid, acetic acid. Industrial production of Vitamin B₁₂.

UNIT – IV

(20 hrs)

Single cell oils (SCOs). Biopolymers (PHAs and PHBs), extra cellular polymers (xanthenes, rhamnosan, dextrans, pullulan), Biosurfactants-classification, production and applications.

Antibiotic and Vaccine production – History of antibiotics, producing organisms, industrial production of penicillin, streptomycin, avermectins. Production of anticarcinogenic agents from microbes. Production of bacterial and viral vaccines.

References:

- 1) P.F Stanbury al. Aditya books (2005) Principles of Fermentation Technology. 2nd edition published by Elsevier, Reed Elsevier India Pvt. Ltd.
- 2) Ratiedge and B. Kristiansen (2001). 2nd ed. Basic Biotechnology, Cambridge University Press.
- 3) A.L. Demain and Davis Second edition. (1999) Manual of Industrial Microbiology and biotechnology Editor in chief, ASM press.
- 4) Cruger & Cruger (2004) Ed. Biotechnology: A text book of Industrial Microbiology. Panima publishing corporation New Delhi/Bangalore.
- 5) M.J. Waites et al. Blackwell Science. (2001)Industrial Microbiology: Am Introduction.
- 6) Prescott & Dunn (2002) Industrial Microbiology published by Agrobios (India)
- 7) Peppler H.J Pertman D (editor) 1979, Microbial Technology, Vol-1and 2 Academic Press New York
- 8) E.M.T EL-MANSI and C.F.A BRYCE, (2004Reprinted), Fermentation Microbiology and Biotechnology Taylor and Francis Ltd, New Fatter Lane London Ec4P 4EE.
- 9) Ajit Varma and Gopik Podila (2007) Biotechnological Applications of Microbes, I.K. International Pvt. Ltd. New Delhi (India)
- 10) Jeffrey M. Becker et al (2004) Biotechnology Laboratory course 2nd edition. Academic press Elsevier India Pvt. Ltd.
- 11) Nduka okfor (2007) Modern Industrial Microbiology and Biotechnology, Published by Science Publishers, Enfield NH, USA.

MBP: 401 – Agricultural Microbiology and Environmental Microbiology

1. Determination of physico – chemical characteristics of the soil environment – Soil Texture and P^H and conductivity.
2. Estimation of organic matter content in soils.
3. Study of microbial activity in soil by respirometry (CO₂ evolution)
4. Decomposition of cellulose in soil by microflora
5. Isolation and study of Rhizosphere microflora, determination of R:S ratio.
6. Isolation of Rhizobium from root nodule.
7. Population estimation of Azotobacter from rhizosphere soil
8. Population estimation of Azospillum sp. in rhizosphere soil
9. Population estimation of nitrifiers from rhizosphere soil
10. Isolation of phosphate solubilising bacteria from rhizosphere soil
11. Observation of VA mycorrhizae in crop plants
12. Estimation and enumeration of bacteria, actinomycetes and fungi in soil by Dilution – Planting method
13. Visit to local field crops for observation of diseases caused by bacteria, fungi and viruses.
14. Humus estimation in the soil
15. Estimation of moisture content of soil
16. Observation of bacteroids of rhizobia by section cutting
17. Observation of Phyllosphere microbial flora
18. Contact slide technique
19. Winogradsky's column
20. Ammonification in soil
21. Nitrification in soil
22. Denitrification in soil
23. Isolation of antibiotic producing microorganisms from soil
24. Most probable Number Test for coli forms
25. Quantitative analysis of water for microbial members (SPC)
26. Chemical oxygen demand (COD)
27. Effect of heavy metals on the growth of bacteria.
28. Microbial inter relationships (Synergism), Antagonism

Suggested Books / Manuals

1. APHA 5th edition (2001) Prince Hall.
2. Experiments in Microbiology, Plant Pathology and Biotechnology. IV edition K.R. Aneja
3. Principles and Methods of Plant Molecular Biology, Biochemistry and genetics (2005) Agrobios. India.
4. Practical Microbiology by, RC. Dubey and D.K. Maheswari (2008) S. Chand Publ.
5. Manual Industrial Microbiology and Biotechnology Second edition. (1999) A.L. Demain, Editor in chief, ASM press.

MBP: 402 – Food Microbiology and Industrial Microbiology

1. Assay of the following microbial products:
 - (a). Streptomycin
 - (b). Lactic acid
 - (c). Ethyl alcohol
 - (d). Penicillin
 - (e). Indole acetic acid
2. Assay of microbial enzyme / product from culture filtrate:
 - (a). DMC of milk
 - (b). β - Amylase
 - (c). Protease
 - (d). Lipase
 - (e). Asparaginase
 - (f). Phosphatase
 - (g). Siderophore
 - (h). Characterization of wine
3. Demonstrate the following::
 - (a). Mycotoxin (Aflatoxin)
 - (b). Litmus milk
 - (d). Antagonism
 - (e). Preparation of Immobilized cells
 - (d). Vitamin B12
 - (f). Mycorrhizal root infection index
4. Isolation of Yeasts from grapes
5. Preparation of wine from grape juice and estimation of alcohol
6. Estimation of ethanol by dichromate method
7. Production of citric acid by fungus and its estimation
8. Determination of lactic acid concentration In commercial curd samples
9. Antibiotic Sensitivity test
10. Microbiological examination of spoiled foods
11. Enumeration of surface Microflora of vegetables
12. Microbiological examination of milk
13. Detection of number of bacteria in milk by breeds count
14. Determination of milk quality by Methylene blue reduction test (MBRT)
15. Role of yeasts in bread making
16. Extraction and analysis of aflotoxins
17. Immobilization of microbial cells/enzymes.
18. Culturing of mushrooms
19. Visits to Food and Industrial chemical production units

Suggested Books / Manuals

- 1) Manual of Industrial Microbiology and Biotechnology 2nd edition (1999) A.L. Demain
- 2) and Davis Editor in chief, ASM press.
- 3) Experiments in Microbiology, Plant Pathology and Biotechnology by K.R. Aneja 4th
- 4) ed. (2005).
- 5) Practical Microbiology by R.C. Dubey and D.K. Maheswari (2008)
- 6) Microbiology – A Laboratory Manual by S.M. Reddy and S.Ram Reddy, 3rd Ed.
- 7) (2005).
- 8) Laboratory experiments in Microbiology by Gopal Reddy et al (2005) 1st ed. Himalaya Publications.