PSG College of Arts & Science

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M.Sc. APPLIED MICROBIOLOGY

2017 - 2019

MSc Applied Microbiology
Scheme of Examinations
(For students admitted from 2016-17 & onwards)

Code No.	Subject	Duration (Hrs)	Max. Marks			Credit Points
			CA	CE	Total	
First Semester						
14MBP01	Introductory Microbiology	3	25	75	100	2
14MBP02	Microbial Systematics and Diversity	3	25	75	100	3
14MBP03	Microbial Physiology and Metabolic Regulation	3	25	75	100	4
14MBP04	Cell Biology and Biological Chemistry	3	25	75	100	4
14MBP05	Bioresearch Instrumentation	3	25	75	100	4
14MBP06	Microbiology Practicals I	9	40	60	100	5
Second Semester						
16MBP07	Molecular Biology	3	25	75	100	4
16MBP08	Microbial Genetics	3	25	75	100	4
14MBP09	Applied Virology	3	25	75	100	4
14MBP10	Fermentation and Bioprocess Technology	3	25	75	100	4
14MBP11	Environmental, Agricultural and Food Microbiology	3	25	75	100	4
14MBP12	Microbiology Practicals II	9	40	60	100	5
14SBP01	**Skill Based Subject** : Cyber Security	---	100	---	100	2
Third Semester						
16MBP13	Medical Microbiology	3	25	75	100	4
14MBP14	Immunotechnology	3	25	75	100	4
14MBP15	Principles of Genetic Engineering	3	25	75	100	4
14MBP16	Biostatistics and Research Methodology	3	25	75	100	4

Code No.	Subject	Duration (Hrs)	Max. Marks			Credit Points
			CA	CE	Total	
14MBP17A 14MBP17B	**Core Elective I** Pharmaceutical Microbiology OR GMP, GLP & Quality Control	3	25	75	100	3
14MBP18	Microbiology Practicals III	9	40	60	100	5
14MBP19A 14MBP19B 14MBP19C 14MBP19D	**CLUSTER IDC THEORY** Pharmaceutical Chemistry OR Food Chemistry & Quality Control OR Clinical Biochemistry OR Environmental Pollution Management	3	25	75	100	2
14MBP20A 14MBP20B 14MBP20C 14MBP20D	**CLUSTER IDC PRACTICAL** Pharmaceutical Chemistry Practicals OR Food Chemistry & Quality Control Practicals OR Clinical Biochemistry Practicals OR Environmental Pollution Management Practicals	3	40	60	100	2
Fourth Semester						
14MBP21	Applied Biotechnology	3	25	75	100	4
14MBP22A 14MBP22B	**Core Elective II** Introduction to Bioinformatics - Genomics & Proteomics OR Microbial Nanotechnology	3	25	75	100	4
14MBP23	Project & Viva Voce	-	80	120	200	5
					Total	**90**

Cluster IDC Offered by the Department

Cluster IDC **:**

14CHP19C/14NDP15C/ 14BCP15C/14ESP17D	Clinical Microbiology (Theory) (Cluster IDC for MSc Chemistry, MSc Foods & Nutrition, MSc Biochemistry & MSc Env. Science)
14CHP20C/14NDP16C/ 14BCP16C/14ESP18D	Clinical Microbiology Practical (Cluster IDC for MSc Chemistry, MSc Foods & Nutrition, MSc Biochemistry & MSc Env. Science)

14MBP01 INTRODUCTORY MICROBIOLOGY I Semester

Objectives

Fundamentals of Microbiology deals with

- The early developments of Microbiology.
- Basic concepts of different groups of microorganism and its salient features.
- Classification of different groups of microbes and its reproductive strategies.
- Economic importance of the microorganisms.

Unit – I (10 Hrs)

Basic concepts in Microbiology: History of Microbiology-Spontaneous generation theory-disproval of spontaneous generation theory - Germ theory of diseases. Contributions of Antonie van Leeuwenhoek-Louis Pasteur- Joseph Lister - Edward Jenner – Robert Koch – Paul Ehrlich-Elie Metchnikoff- Alexander Flemming.

Unit – II (10 Hrs)

Methods of sterilization: Physical methods – Dry heat, moist heat, radiation methods, filtration methods, chemical methods and their application. Concept of containment facility, sterilization at industrial level. Sterilization and disinfection methods and their quality control.

Unit – III (10 Hrs)

Identification methods and classification of bacteria: - Microscopic identification characteristics, staining methods – simple staining, differential staining, structural staining and special staining methods. Acid Fast, metachromatic, granules, nuclear staining, capsule, silver impregnation, flagella and other special staining methods. Ecological identification methods, Nutritional (cultural) identification characters, chemical identification characters, biochemical identification methods, immunological characteristics, pathogenic properties identification, genetic characteristics identification

Unit – IV (10 Hrs)

Microbial cultures: Concept of pure culture, Methods of pure culture isolation, Enrichment culturing techniques, single cell isolation and pure culture development. Lyophilizers, deep freezer. Preservation and Maintenance of Microbial Cultures: Repeated subculturing, preservation at low temperature, sterile soil preservation, mineral oil preservation, deep freezing and liquid nitrogen preservation, freeze-drying (lyophilization). Advantages and disadvantages of each method. Type culture collections.

Unit V (08 Hrs)

Isolation and Enumeration of Microorganisms: Isolation of different types of Bacteria, Fungi, Actinomycetes, Cyanobacteria and Protozoa. Enumeration of bacteria, fungi and actinomycetes from soil and water, cultural characteristics, Anaerobic culture techniques. Demonstration of Growth of microorganisms- Haemocytometer, Viable count, Filtration, Biomass determination and Turbidometry.

Text Book:

Jeffrey C.Pommerville, Alcamo's Fundamentals of Microbiology, 8th edition. Blackwell Publications.

Reference:

- Prescott L.M ; J.P Heavy and D.A. Klein 1993 Microbiology 7th edition Wm C- Brown Publishers.
- Michael J. Pelczar, Chan, ECS and Kreig, R, Microbiology, 5th edition (Tata Mc Graw Hill Education ,1998), New Delhi.

- Ketchum, Microbiology, John Willey & Sons, 1998
- Roger Y. Stanier, Edward A. Adelberg, John L. Ingraham General Microbiology. 5th edition. Macmillan Education. London.
- Jacquelyn G. Black, Microbiology, Principles and Exploration 7th edition. Prentice Hall international Inc.
- Michael T. Madigan, John M. Martinko, Kelly Bender, Daniel P Buckley, David A.Stahl. Brock Biology of Microorganisms, 13th edition, Prentice hall International, Inc.

14MBP02 MICROBIAL SYSTEMATICS AND DIVERSITY I Semester

Objectives:

- To provide an integrated and conceptual approach of the distribution of microorganisms and their diversity.
- To understand the diversity of various microorganisms

Unit – I (13 Hrs)

Diversity in the microbial World: Definition, Concepts and Scope of microbial diversity. Types of Diversity: Morphological, Structural, Metabolic, Ecological and Evolutionary diversity (Genetic diversity) of the Microbial World. Microbial succession. Methods for the detection of microbial diversity - culture and culture independent methods. The expanse of microbial diversity, estimates of total number of species, measures and indices of diversity. Newer approaches for exploring unculturable bacteria: Culture independent molecular methods, Methods of extracting total bacterial DNA from a habitat.

Microbial systematics: Microbial evolution and phylogeny – Molecular chronometers – volutionary distance. Taxonomy and classification – classical approach – Numerical taxonomy – molecular based classification – phylogeny of microbial diversity – Phylogenetic group of prokaryotes and eukaryotes. Methods in Taxonomy of Bacteria (including archaebacteria) and Fungi: Morphological Methods, Chemotaxonomy, Genetic Methods, Methodology of rRNA sequencing, Methodology of identification of unknown pure cultures: Strategy and methods. Implications of molecular and biochemical methods including rDNA analysis, RFLP, RAPD and other fingerprinting techniques in systematics.

Unit – II (12 Hrs)

Bacterial diversity: Conventional and molecular systematics, general discussion on the occurrence, diversity, characteristic features, significance and potential applications of various groups of bacteria according to Bergey's Manual of Systematic Bacteriology. Spirochaetes – Aerobic, microaerophilic, motile, Gram negative, non motile gram-negative, Gram negative microaerophilic rods and cocci – Facultatively anaerobic Gram negative rods – Gram negative, anaerobic, straight, curved and helical bacteria – sulfate reducing bacteria – Anaerobic gram negative cocci- Rickettsias and Chlamydia.

Unit – III (10 Hrs)

Bacterial diversity: Phototrophic bacteria, Aerobic chemolithotrophic bacteria – budding and appendaged bacteria, sheathed bacteria, bacteria with gliding motility, Gram positive cocci – Endospore forming rods and cocci. Asporogenous Gram positive rods – Mycobacteria – Actinomycetes – Mycoplasmas.

Unit – IV (12 Hrs)

Archaeal diversity: Physiology of Archaea – cell structure and function – metabolism-methanogenesis. Ecology of Archaea – Taxonomic functional groups of Archaea – Methanogens, Archaeal sulfate reducers, extremely halophilic, cellwall less archaea. Systematics, and occurrence, diversity, characteristic features, significance and potential applications (eg. biochips, methane generation, ultrafiltation membranes, production of PHB and

PHA) of different groups of archaebacteria (Crenarchaeota, Euarchaeota, Korarchaeota, Nanoarchaeota).

Unit – V **(13 Hrs)**

Fungi, algae and protozoa: Protozoa – Morphological diversity – Classification - Reproductive strategies. Fungi – filamentous fungi – Growth and reproduction – Modern classification of fungi - Ascomycetes (*Aspergillus*), Deuteromycetes (Candida), Zyomycetes (Mucor), Basidiomycetes (Agaricus), Acrasiomycetes (Dictyostelium), oomycetes (Saproleina), Myxomycetes (Ceratiomyxa). Algae – Morphological diversity – structures – Chloroplast – structural organization – reproductive strategies – life cycles – Algal ecology. Structure of algal cells – classification – reproduction and characteristics of chlorophyta (green algae) chrysophyta (golden-brown and yellow), green algae, diatoms, Euglenophyta (Euglenoids), Rhodophyta (Red algae), Cyanophyta, Xanthophyta, Phaeophyta (Brown algae) Importance of algae in production of algal pigments, biofuels, hydrogen production, important bioactive molecules, role of algae in sustainable environment.

Text Books:

Atlas, R.M. 1997. Principles of Microbiology, Second edition. WCK. McGraw – Hill.
Prescott LM, Harley JP and Klein DA (2007) Microbiology (7th Edition) McGraw Hill New York

References:

- Alexopoulus CJ and C. W. Mims (1993) Introductory Mycology (3rd edition) Wiley Eastern Ltd. New Delhi
- Algae: Anatomy, Biochemistry and Biotechnology by Laura Barsanti and Paolo Gualtieri. Taylor and Francis Group, LLC; 2006.
- Bacterial Systematics, by Logan, A., Niall A. Logan, Wiley-blackwell; 1994
- Balows, A., HG Truper, M. Devorkin, W. Harder, K.H. Schleifer. 1992. The Prokaryotes. Springer link. New York.
- Brock Biology of Microorganisms (12th edition) by Madigan and John M. Martinko, Paul V. Dunlap, David P. Clark Benjamin Cummings; 2008.
- Elizabeth Moore Landecker (1996) Fundamentals of the Fungi (4th edition) Prentice Hall International Inc, London
- Fundamentals of the fungi by Elizabeth Moore, Fourth edition, Benjamin Cummings; Landecker; 1996.
- Holt, JS., Kreig NR., Sneath P.H.A and Williams S.T Bergeys Manual of Determinative Bacteriology (9th edition) Williams and Wilkins, Baltimore
- Microbiology : An Introduction by Gerard J Tortora, Berdell R Funke, Christine L Case Benjamin- Cummings Publishing Company ; 2008.
- Mycotechnology: Present status and future prospects. Edited by Mahendra Rai. I.K., International Publishing House Pvt. Ltd.; 2007.
- Pelczar Jr, M.J.Chan, E.C.S and Krei N.R (1993) Microbiology McGraw Hill New York
- Principles of Microbiology by R.M. Atlas , Mosby publishers, St. Louis; 1995
- The Prokaryotes. A handbook on the biology of bacteria: ecophysiology, isolation, identification, applications. Volumes I-IV by Balows, A., Truper, H. G., Dworkin, M., Harder, W., Schleifer, K. H. Springer-Verlag, New York; 1992

- The Yeast Handbook: Biodiversity and Ecophysiology of yeasts by Carlos A. Rosa and Gabor Peter. Springer- Verlag Berlin Heidelberg; 2006.

Web Site Address

http://www.sheffcol.ac.uk/links/Science/Biology/Microbiology
http://www.cat.cc.md.us/courses/bio141/Labmanal/index.html
http://www.microbiologyonline.org.uk/links.html
http://www.bact.wisc.edi/Microtextbook/index.php
http://www.bris.ac.uk/vetpath/cpl/tut.html
http://www.bmb.leeds.ac.uk/mbiology/ug/ugteach/elect/elect.htm
http://www.kensbiorefs.com/Microbio.html
http://www.microbeworld.org/

14MBP03 MICROBIAL PHYSIOLOGY AND METABOLIC REGULATION

I Semester

Objectives:

Microbial Physiology & Metabolic Regulation describes in detail about

- The various transport systems available for different organisms for their nutritional uptake
- Giving a broader edge to the students about the process of Growth cycle, Morphogenesis, Endospore formation, Photosynthesis.
- The pathways for utilization of nutrients incorporated by the organism to gain their living,
- About proteins and enzymes, their structural and functional role.
- To understand the structure, properties and metabolism of different microorganisms
- To know the regulation and interrelationships between different metabolism.

Unit – I (13 Hrs)

Growth and regulation – Transport of Nutrients: Growth curve – factors affecting growth – growth determinations – bacterial growth kinetics – batch, continuous and synchronous culture. Cell Differentiation – Morphogenesis – Development of Dormant and Resting structures – Sporulation in Bacillus. Germination and Regulation. Solute Transport: Primary and Secondary transport: ABC transporters, Phosphotransferase system, Drug export systems, amino acid transport.

Unit – II (12 Hrs)

Photosynthesis and Chemolithotrophy: Chlorophyll, bacteriochlorophyll, rhodopsin, carotenoids, phycobilliproteins, Oxygenic and Anoxygenic Photosynthesis– Autotrophic generation of ATP. Fixation of CO_2. – C3, C4 pathway. Chemolithotrophy – Sulphur, Iron, Hydrogen, Nitrogen oxidations Methanogenesis, Bioluminescence.

Unit – III (13 Hrs)

Carbohydrate metabolism and Fermentation: – glycolytic pathways – Embden – Meyerhoff pathway - the pentose phosphate pathway – the Entner Douderoff pathway – the tricarboxylic acid cyclic – glyoxyate cycle. Aerobic respiration – chemoorganogtrophic bacteria. Electron Transport Chain. Substrate level phosphorylation – Oxidative phosphorylation – lipid catabolism – beta oxidation. Anaerobic respiration – sulfur compounds – nitrate and carbon dioxide as electron acceptors. Fermentation – alcoholic, propionic, butyric, lactic and mixed acid. Fermentation by *Ruminococcus albus.*

Unit – IV (10 Hrs)

Biosynthesis of cellular molecules: Synthesis of fatty acids, phospholipids and archaeal lipids. Biosynthesis of nucleotides – purines and pyrimidines. Biosynthesis of amino acids and biosynthesis of bacterial cell wall of gram positive and gram negative cell.

Unit – V (12 Hrs)

The Regulation of Metabolic pathways: Patterns of regulation of metabolic pathways – kinetics of regulatory and nonregulatory enzymes – conformational changes in regulatory enzymes. Regulation by covalent modification.

Physiological Adaptations and Intercellular signaling: Introduction to two component system, regulatory systems during aerobic- anaerobic shifts. Quorum sensing. Heat-Shock responses pH homeostasis, osmotic homeostasis.

Text Books:

David White, D. 2011. The physiology and Biochemistry of prokaryotes. Oxford University press. New York. 4th Edition
Moat, A.G. and J.W. Foster. 2002. Microbial physiology, Wiley–Liss. New York. 4th Edition
Rose A.H. 1976. Chemical Microbiology- An introduction to Microbial Physiology . 3rd ed. Plenum.

References:

- Alcomo, I.E. 2001. Fundamentals of Microbiology. VI Edition, Jones and Bartlett Publishers,
- Co. Pvt. Ltd.
- C. Ratledge and SG Wilkinson, 1988. Microbial lipids, Academic Press, Second edition.
- Caldwell, D.R. 1995 Microbial Physiology and Metabolism, Wm. C. Brown Publishers, U.S.A.
- David L. Nelson and Michael M. Cox. 2008. Lehninger Principles of Biochemistry by W.H. Freeman and Company. Fifth Edition.
- Doelle, H.W. 1975. Bacterial Metabolism 2nd edition. Academic press.
- Geoffrey L. Zubay. 2008. Biochemistry. Addison-Wesley educational publishers Inc., Fourth Edition.
- Gopal Reddy et al. Laboratory Experiments in Microbiology.
- Gottschalk, G. 1986. Bacterial Metabolism 2nd edition. Springer – verlag. New York.
- Johri, B.N. 2000. Extremophiles. Springer Verlag. New York
- Perry, J.J., Staley, J.T. and Lory, S. 2002. Microbial Life. Sinauer Associates, Publishers,
- Schaechter, M. Ingraham, J.L. and Neidhardt, F.C. 2006. Microbe. ASM Press, Washington.D.C.
- Seoley HW and Van-Demark, PJ. Microbes in Action.
- Sudbury. Massachusetts.
- Sullia, S.B. and Shantharam, S. 2000. General Microbiology (Revised) Oxford & IBH Publishing
- Sunderland, Massachusetts.
- Tortora, G.J., Funke, B.R. and Case C.L. 2004. Microbiology-An Introduction. Benjamin Cummings. San Francisco.

14MBP04 CELL BIOLOGY AND BIOLOGICAL CHEMISTRY I Semester

Objective:

- To study the structural and functional organization of cells and their genetic makeup.
- To understand the molecular architecture of cells.

Unit – I (12 Hrs)

Prokaryotic and Eukaryotic cell structures: Organs of Locomotion – Cell wall – extramural Layers – cell membrane – structure and function – Transport of solutes – Cytoplasmic contents – Nucleus, Nucloelus, Endoplasmic reticulum, Golgi apparatus, Protein trafficking, Lysosomes, plastids, vacuoles, Mitochondria, Chloroplasts, and their genetic organization, Peroxisomes, Microtubules – structure and function. Structural organization of: Cytoskeleton (structural proteins – microfilaments, actins, etc.) and its role in motility.

Unit – II (13 Hrs)

Prokaryotic and Eukaryotic Cell cycle and regulation: Events in cell cycle, Regulation of cell cycle. Cell division - Mitosis and Meiosis, their regulation, steps in cell cycle, regulation and Control of cell cycle. Cell death – Apoptosis.

Cell adhesion, signalling and communication - Host parasite interaction Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.

Cellular communication- general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

Cell signaling – signal molecules, receptors – signal transduction. Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathway. Bacterial chemotaxis.

Unit – III (12 Hrs)

Introduction to Bioorganic Chemistry

a. Chemical reactivity: Concept and factors affecting reactivity (Inductive effect, Resonance / Mesomeric effect, Conjugation and Hyper-conjugation, Tantomerism, etc.)

b. Bonding other than covalent – H-bonds, Van der Wall's interaction, charge transfer complexes, ionic bonding, Ion-dipole, Host-guest interactions

c. Reactions of organic molecules: A brief overview of important reactions in organic chemistry e.g. Substitution, Addition, Elimination, Rearrangement, Oxidation, Reduction, etc.

d. Stereochemistry: Three dimensional shape of molecules, conformation and configuration, structure and biological activity

e. Concept of pH of weak acids and weak bases, concept of buffer, strength of buffer, buffer value, important biological buffers

Unit – IV (12 Hrs)

Carbohydrate Chemistry:

Mono, di, oligosaccharides and polysaccharides, with examples, D-series, L-series, dextro, leavo-rotatory, reducing and non-reducing sugars, sugar derivatives such as sugar alcohols, amino sugars, sugar acids, deoxy sugars, estimation of carbohydrates

Protein Chemistry:

Structural features of amino acids, classification of amino acids, peptide linkage, determination of primary structure of polypeptide (N-terminal, C-terminal determination, method of sequencing

of peptides), structural classification of proteins, primary, secondary, tertiary, quaternary structures of proteins, protein detection and estimation.

Nucleic acid Chemistry:

Structure of bases, nucleosides, nucleotides, phospho-diester linkages, 5' phosphate, 3'hydroxyl polarity of nucleic acids, tautomeric forms of bases and their implication in pairing of bases, structure of DNA (A, B and Z forms), structure of t-RNA, r-RNA, and m-RNA, estimation of nucleic acids

Unit – V **(11 Hrs)**

Lipid Chemistry: Classification of lipids according to chemical structure, fatty acids, saturated, unsaturated, branched, structure and function of triglycerides, phospholipids, sphingolipids, steroids, detection and estimation of lipids

Vitamins: Structure and function of fat soluble vitamins as vitamins A, D, E and K.

Enzymology- Introduction, General characteristics of enzymes, Activation energy, Enzyme kinetics, Applied enzymology: Application of enzymes in analytical labs. (clinical and industrial), enzymes as industrial catalysts, Immobilized enzymes, enzyme electrodes, assay of enzyme activities for diagnostic purposes, abzymes.

Text Books:

Lodish, H; A.Berk; S.L. Zipursky; Paul Matsuclaira; D. Baltimore and J Darneel. 1999. Molecular and Cell Biology, 4th edition. N.H. Freeman and Company.

Rose A.H. 1976. Chemical Microbiology – An Introduction to Microbial physiology 3rd ed., Company Plenum.

Alberts Bruce (1985) *Molecular Biology of Cell.* Garland Pub.

Freifelder. D. 1995. Microbial Genetics, Narosa Publishing House, New Delhi.

Lewin B. 2002. Genes VIII. Oxford.

References:

- Berg Jeremy, Tymoczko John, Stryer Lubert (2001) *Biochemistry.* 6th Edition, W. H. Freeman, New York.
- Clayden, Greeves, Warren and Wothers, *Organic Chemistry*, Oxford Press
- Conn Eric, Stumpf Paul K., Bruuening George, Doi Roy H., (1987) *Outlines of Biochemistry Edition* , John Wieley and Sons, New Delhi.
- Conn Eric, Stumpf Paul K., Bruuening George, Doi Roy H., (1987) *Outlines of Biochemistry.* 5th Edition , John Wieley and Sons, New Delhi.
- Dawes Edwin A. (1972). *Quantitative Problems in Biochemistry*, Churchill Livingston, Edimberg.
- De Robertis E. D. P. and De Robertis E. M. F. (1987), Cellular and Molecular Biology Lea and Febiger, Philadelphia.
- Gibert Scott F. (2003). *Developmental Biology*. 7th Ed. Sinauer Associates Inc. Mass. USA.
- Hamilton W. Allan, (1987) *Biofilms: Microbial Interactions and Metabolic activities*, in Ecology of Microbial Communities, (Eds. M. Fletcher, T. R. G. Gray and J. G. Jones) Cambridge University Press, Cambridge.
- Jerry March, *Advanced Organic Chemistry*, John Wiley
- Laskin A. I. and Lechevalier H. A. (1977), *CRC Handbook of Microbiology*, Vol. 1, Bacteria, CRC Press Ohio.
- Metzler David E. (2001) *Biochemistry: The Chemical Reactions of Living Cells*, Volume 1 & 2, Academic Press California.

- Muller W.A. (1997) Developmental Biology, Springler – Verlag, New York, Inc.
- Nelson D. L. and Cox M. M. (2002) *Lehninger's Principles of Biochemistry*, Mac Millan Worth Pub. Co. New Delhi
- Peberdy John F. (1980), *Developmental Microbiology*, Blackie, London.
- Petersn J. E. (1969) Isolation, cultivation and maintenance of *Myxobacteria*, Methods in Microbiology (Eds. Norris J. R. and W. Ribbons) Vol. 3B, Academic Press London, 185-210.
- Schlegel Hans G. (1995) General Microbiology, Edition 7, CUP, Cambridge.
- Segel Irvin H. (1997). *Biochemical Calculations*. 2nd Ed. John Wiley and Sons, New York.
- Stanier R. Y., Adelberg E. A., Ingraham J. L., (1976) *General Microbiology*, 4th edition, Mac Millan Press, London.
- Stephen W. Paddock, *Confocal Microscopy*, from Methods and Protocols Vol. 122, Methods in Molecular Biology, Humana Press, Press Inc., Totowa, NJ
- Toole 'O' George, H. B. Kaplan, R. Kolter,(2000) *Biofilm formation as microbial development* Annual Review of Microbiology, Vol. 54 49-79
- Weaver, R.F.1999. Molecular Biology, International edition. WCB McGraw- Hill.
- White Abraham, Handler Philip, Smith Emil, Hill Rober, Lehman J. (1983) Principles of Biochemistry, Edition 6, Tata Mc-Graw Hill Companies, Inc.
- White David (2000) *Physiology and Biochemistry of Prokaryotes*. 2nd Ed. Oxford University Press, New York.
- Wolpert Lewis. (1998). *Principles of Development*. Oxford University Press. Oxford.

14MBP05 BIORESEARCH INSTRUMENTATION I Semester

Objective:

- To expose the students to the biochemical basis of life
- To learn the principles and working of instruments used in biology.

Unit – I (12 Hrs)

Microscopy: Bright field – dark field – phase contrast – fluorescence – Nomarski electron microscopy – transmission electron microscope (TEM), Scanning Electron micrscope (SEM). Preparation and staining of specimens. Basic principles and applications of high resolution – TEM (HRTEM), atomic force microscopy, scanning tunneling microscopy, energy dispersive X-ray analysis.

Radiography: Tracer elements in Biology, Radioactive isotopes, Autoradiography, Phosphor imaging.

Unit – II (12 Hrs)

Analytical techniques - Spectrophotometry: Basic principles – Beer & Lambert's law – UV – Visible spectophotometry – Instrumentation – pH meter. Spectroscopy: basic principles and applications of Raman Spectroscopy, FTIR. Molecular analysis using light scattering, different types of mass spectrometry. X-ray crystallography, NMR spectroscopy, MALDI-TOF.

Principles & Instrumentation of Centrifugation: Analytical centrifugation: Ultracentrifuge – Preparative centrifugation: Differential centrifugation, Density gradient centrifugation, Isopycnic centrifugation. Bioluminescence – Chemiluminescence.

Unit – III (12 Hrs)

Seperation techniques: Chromatography - Adsorption chromatography – Paper & thin layer chromatography, Column chromatography. Partition chromatography: Gas – liquid chromatography – Gel filtration, Gel permeation chromatography – Ion-Exchange chromatography – Affinity chromatography, High Performance Liquid Chromatography.

Electrophoresis: Gel electrophoresis – sub merged gel electrophoresis – SDS polyacrylamide gel electrophoresis Native PAGE. 2-Dimensional gel electrophoresis – Immuno electrophoresis. Isoelectric focusing, Pulse Field Gel electrophoresis (PFGE), ELISA.

Unit – IV (12 Hrs)

Molecular detection & Identification of Microbes: Restriction endonuclease analysis – Amplified fragment length polymorphism (AFLP), Metagenomics.

Biosensors – detection of bacterial UTI using electrochemical DNA biosensors, HIV detection using surface Plasmon resonance (SPR) – based optical techniques, light – addressable potentiometric sensor (LAPS) for food borne pathogen detection. Flow cytometry, microarrays, catalysed reporter deposition – fluorescence in situ hybridization (CARD – FISH).

Unit – V (12 Hrs)

Molecular Diagnostic techniques: Rapid antigen testing – Lateral flow immunochromatography, molecular diagnosis of STD – probe hybridization, gene amplification, Ligase chain reaction (LCR), strand displacement amplification. Molecular diagnosis of drug resistant microbes – Mycobacterium tuberculosis. MRSA, VISA, VRSA. Molecular differential diagnosis (MDD) of infectious diseases.

Automation in Microbiology – RIA, EIA, Carbon dioxide detection – Blood culture system – Chemiluminescent EIA system – Luminometer.

Text Books:

Prescott. C.M; J.P. Harley, D.A. Klein. 2011. Microbiology 7th edition. WCB McGraw-Hill.
Wilson.K and J. Walker. 2010: Practical Biochemistry, Principles and techniques, 7th edition. Cambridge University Press, Cambridge.
Jayaraman, J. 1981. Laboratory manual in Biochemistry. Wiley Eastern Limited.

References:

- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006) *Biochemistry.* 6th Edition. Freeman, New York.
- Cavanagh John *et.al.* (1995) *Proteins NMR Spectroscopy: Principles and Practice*, Academic Press
- Cotterill, R. M. J. (2002) *Biophysics: An Introduction.* John Wiley & Sons, England.
- Daune M. & W. J. Duffin (1999) *Molecular Biophysics: Structures in Motion*, Oxford University Press.
- Drenth, J. (2007) *Principles of protein X-ray crystallography.* 3rd Ed. Springer, Germany.
- Garrett, R. H. and Grisham, C. M. (2004) *Biochemistry.* 3rd Ed. Brooks/Cole, Publishing Company, California.
- Keeler, J. (2002) *Understanding NMR Spectroscopy.* John Wiley & Sons, England.
- Mount, D. W. (2001) *Bioinformatics: sequence and genome analysis.* Cold Spring Harbor Laboratory Press, New York.
- Nalting B. & B. Nalting (2003) *Methods in Modern Biophysics* Springer Verlag Voit E. O. (2000) *Computational Analysis of Biochemical Systems* Cambridge University Press.
- Narayanan, P. (2000) *Essentials of Biophysics*. New Age International Publication, New Delhi
- Nölting, B. (2006) *Methods in modern biophysics.* Second Edition. Springer, Germany.
- Pattabhi, V. and Gautham, N. (2002) *Biophysics.* Kluwer Academic Publishers, New York and Narosa Publishing House, Delhi.
- Plummer, D.T. 1971. An Introduction to practical Biochemistry. 3rd ed. Tara McGraw – Hill, Publishing Company Limited.
- Stephenson, F. H. (2003) *Calculations in molecular biology and biotechnology: A guide to mathematics in the laboratory.* Academic Press, Elsevier Science, London. (For numerical problems in instrumentation)
- Upadyay Biophysical Chemistry. Books and Allied Publishers.
- Wilson Keith and Walker John (2005) *Principles and Techniques of Biochemistry and Molecular Biology*, 6th Ed. Cambridge University Press, New York.

14MBP06 Microbiology Practicals I & Viva-Voce I Semester

Microscopy: Bright Field Microscopy

1. Motility determination.
2. Morphological variations in Bacteria
   a) Stains and Staining methods b) Cleaning of slides and smear preparation
   c) Simple staining d) Differential staining-Gram staining
   e) Endospore staining f) Capsular Staining
3. Morphological variation in Cyanobacteria
4. Morphological variation in Fungi.
5. Morphological variation in Protozoa.

Culture Methods:

6. Pure culture techniques:
   a) Pour plate method
   b) Spread plate method
   c) Looping out method
7. Microbiology of soil: Enumeration of bacteria, fungi and antionomycetes from the rhizosphere soil by serial dilution plating technique.
8. Isolation and culturing of green algae and Blue green algae.
9. Anaerobic culture techniques;
   a) RCM
   b) Wright's tube method

Microbial Growth:

10. Measurement of microbial growth
    a) Total count by direct microscopy (yeast)
    b) Counting viable cells: serial dilution and spread plates
    c) Turbidometry
    d) Determination of generation time.
11. Influence of Environment on Microorganisms; Factors affecting growth– pH, temperature, nutrients & salts.

Physiological characteristics of microorganisms:

a) Carbohydrate fermentation
b) Triple sugar iron agar (TSI) test
c) Methyl red test
d) Voges Proskauer test
e) Citrate utilization test
f) Indole production test
g) Hydrogen sulphide production test
h) Urease test
i) ONPG (β – galactosidase) test
j) Nitrate reduction test
i) Gelatin hydrolysis
k) Casein hydrolysis
l) Starch hydrolysis
m) Catalase test
n) Oxidase test

12. Enzyme kinetics – Enzyme assay, Km, Vmax, LB plot.
13. Phenol coefficient test.

16MBP07 MOLECULAR BIOLOGY II Semester

(For students admitted from 2016-17 & onwards)

Objective:

- To study the structural and functional organization of cells and their genetic make up.
- To understand the molecular architecture of cells.

Unit – I (12 Hrs)

The nature of Genetic material: The structure of DNA and RNA; Melting of DNA, Superhelicity, Organization of Microbial Genomes, Organization of Eukaryotic Genomes, Chromatin arrangement, nucleosome formation. Prokaryotic and Eukaryotic genome. Types of histones, histone modifications - Methylation, Acetylation, Phosphorylation and its effect on structure and function of chromatin. DNA methylation and gene imprinting C value paradox and genome size, repetitive and non-repetitive DNA sequence, Pseudogenes, Gene families, Gene clusters, Super-families

Unit – II (13 Hrs)

DNA replication: Arrangement of replicons in a genome, Various modes of replication, continuous, discontinuous synthesis, Different models for replication of linear and circular DNA, replication features of single stranded phages. Replication Enzymes, DNA – composition - Physical structure – Meselson and Stahl experiment – autoradiographic experiment - Rolling circle mode – D-loop model. Replication Fork and priming, leading and lagging strand, elongation, termination, specific features of replication in Prokaryotes and Eukaryotes, action of topoisomerases, Telomere maintenance and Chromatin Assembly, Single stranded DNA replication, Relationship between DNA replication and cell cycle, DNA copy number maintenance. DNA replication in *E. coli*, Origin of replication, regulation of replication. Eukaryotic DNA replication. - Eukaryotic DNA replication, multiple replicons, eukaryotic DNA polymerases, ARS in yeast, Origin Recognition Complex (ORC), regulation of replication.

Unit – III (12 Hrs)

Transcription: Transcription machinery of prokaryotes, various transcription enzymes and cofactors, initiation, elongation and termination, sigma factors, Transcription machinery of eukaryotes, various forms of RNA polymerase and cofactors, initiation, elongation and termination, promoters, enhancers, silencers, activators, effect of chromatin structure, regulation of transcription.

Post-transcriptional processes: RNA processing, splicing, capping and polyadenylation, rRNA and tRNA processing, RNA Editing; RNAi and miRNAs, Antisense RNA, Post-transcriptional gene regulation.

Unit – IV (12 Hrs)

Translation: Protein structure, Mechanisms of translation in prokaryotes, Mechanisms of translation in eukaryotes, initiation complex, ribosomes and tRNA, factors, elongation and termination, in vitro translation systems, polycistronic/ monocistronic synthesis, Regulation of translation, RNA instability, inhibitors of translation, stringent response in bacteria.

Post-translational processes: Protein modification, folding, chaperones, transportation; The Signal Hypothesis, protein degradation.

Unit – V **(11 Hrs)**

Regulation of gene expression – Control of gene expression. Positive gene regulation, negative gene regulation and attenuation, using the lac, gal, trp, and ara operons, with emphasis on recent advances. Regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.

Genetic code: Genetic code – properties of genetic code (degenerate, non-overlapping, comma less, universal, non-ambiguous). Codon assignments (Nirenberg and Khorana's work).

Text Books:

Lodish H; A.Berk; S.L. Zipursky; Paul Matsuclaira; D. Baltimore and J Darneel. 2007. Molecular and Cell Biology, 6th edition. W.H. Freeman and Company.

R.F. Weaver, 2007. Molecular Biology McGraw Hill. New York. USA, 4th edition.

B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walter, 2007, Molecular Biology of the Cell, 5th edition. Garland Science Publishers.

References:

Benjamin Lewin, 2007. Gene IX Jones and Bartlett Publishers, Sudbury, Massachusetts.

Benjamin Lewin. (2008) *Genes IX*, Jones and Bartelett Publishers Inc.

Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D. Watson (2004), *Molecular Biology of the Cell*, 4th Edition, Garland Publishing Raff, Keith Roberts, Peter Walter, (2003) *Essential Cell Biology*, 2nd Edition, Garland Publishing

Fred M. Ausubel; Roger Brent; Robert E. Kingston; David D. Moore; John A. Smith

Freifelder. D. 1995. Microbial Genetics, Narosa Publishing House, New Delhi.

J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levin, R. Losick, 2007. Molecular Biology of the Gene, Benjamin Cummings, San Francisco, USA, 6th edition.

J.M. Berg, J.L. Tymoczko, L. Stryer 2008. Biochemistry (5th edition) W.H. Freeman and Company, New York, USA.

Kevin Struhl, 2007. Current Protocols in Molecular Biology. John Wiley and Sons, Inc.

Lewin B. 2002. Genes VIII. Oxford.

Tamarin, R.H. 2001. Principles of Genetics. 7th edition WCB Publishers.

Watson James D., Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick (2004) *Molecular Biology of the Gene*, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc.

Weaver R., (2007) *Molecular Biology*, 4th Edition, McGrew Hill Science.

16MBP08 MICROBIAL GENETICS II Semester

(For students admitted from 2016-17 & onwards)

Objective:

- To make a detailed study on the blue print of life and the information centers called genes.
- To expose the mechanism and function of gene transfer methods.

Unit – I (10 Hrs)

Mendelian principles: Dominance, segregation, independent assortment. Concept of gene: Allele, multiple alleles, pseudoallele. Extensions of Mendelian principles - Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

Unit – II (15 Hrs)

Genetic analysis of bacteria: Importance and uses of mutation analysis. Inheritance in bacteria, Mutation – molecular basis of mutation – types of mutations, lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Spontaneous and induced mutagenesis, isolating mutants, selecting mutants, mutant enrichment. Reversions versus suppression. Carcinogenicity testing. Detection and isolation of mutants. DNA damage and repair. Different types of DNA damages, Nucleotide excision repair, Base excision repair, mismatch repair, recombination repair, SOS operon, Double strand break repair, transcription coupled repair, gene replacements. Cloning genes by complementation. Cloning genes by marker rescue.

Unit – III (13 Hrs)

Gene transfer and mapping by conjugation: Basis of fertility in bacteria. Self-transmissable and mobilizable plasmids. Molecular mechanism of gene transfer by conjugation – genes and proteins involved. Regulation of gene transfer by conjugation. Hfr strains. Hfr transfer and F' transfer.

Gene transfer by transformation and transduction: Natural transformation and competence. Molecular basis of natural transformation – DNA uptake competence systems in gram positive and gram negative bacteria. Regulation of competence in B.subtilis. Importance of natural transformation. Artificially induced competence. Generalized versus specialized transduction - T4 and lambda phage. Homologous and site specific recombination - Models for homologous recombination: The Holliday model, Double strand break repair model. Proteins involved in recombination: RecA, B, C, D, Ruv A, B, C.

Unit – IV (10 Hrs)

Transposons: Discovery of transposition. Classes of bacterial transposons. Regulation of transposition activity. Effects of transposition in bacteria. Genetic requirements for transposition. Assays to analyze transposition events. Molecular mechanisms of transposition – genetic evidence supporting the mechanisms. Conjugative transposons. Transposon mutagenesis.. Yeast Ty-1 transposon.

Unit – V **(12 Hrs)**

Bacteriophage genetics:. Regulation of expression of genes in phages – transcriptional activators, antitermination, Replication and packaging of filamentous phages M13 and f1 – recent advances. Genetic analysis of phages – complementation and recombination tests with phages. Lambda phage – gene and promoter organization. Lambda lytic cyle – regulation of gene expression.

Yeast Genetics: Tetrad analysis, Petite mutants. Neurospora genetics – mutants of Neurospora. Gene conversion. Gene mapping. - mapping with molecular markers, mapping by using somatic cell hybrids.

Text Books:

Hartl, D.L. 1997. Genetics. 4th edition. Jones and Bartlett Publishers.

Klug, W.S. and Cummings. M.R. 2005. Concepts of Genetic. 8th Edition. Prentice Hall.

Maloy, S.R. J.R. Cronan Jr. and D. Freifelder. 2004. Microbial Genetics 2 ed. Jones and Bastlett publishers.

References:

Benjamin Lewin. (2008) *Genes IX*, Jones and Bartelett Publishers Inc.

Brown T., (2007) *Genome 3*, 3rd Edition, Garland Science

James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Larry Snyder and Wendy Champness, 2007. Molecular Genetics of Bacteria. 3rd edition; ASM press.

Nancy Trun and Janine Trempy. 2004. Fundamental Bacterial Genetics by, 1st edition; Blackwell Science Publishers.

Richard Loswick (2004) *Molecular Biology of the Gene*, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc.

Sandy Primrose, Richard Twyman, Bob Old (2001), *Principles of Gene Manipulation*, 6th Edition, Blackwell Science Ltd.

Stanly R. Maloy, John E. Cronan, Jr. & David Freifelder 1987. Microbial Genetics 2nd edition; Narosa Publishing House.

Strachan T. and Read A., (2004), *Human Molecular Genetics*, 3rd Edition, Garland Science.

U.N. Streips and R.E. Yasbin, 2002. Modern Microbial Genetics 2nd edition; Wiley Publishers.

Weaver R., (2007) *Molecular Biology*, 4th Edition, McGrew Hill Science.

Weaver, R.F. 1999. Molecular Biology. International edition. WCB McGraw – Hill.

Weaver, R.F., Hedrick, P.W. 1997. Genetics 3rd edition. Wm. C. Brown publishers.

Wink Michael, Ed., *An introduction to molecular biotechnology*, Wiley-VCH Publications

14MBP09 APPLIED VIROLOGY II Semester

Objective:

- To provide a comprehensive theoritiacl knowledge of animal, plant and bacterial viruses.
- To understand the basic techniques of viral culture.

Unit – I (12 Hrs)

Introduction to virology: Historical introduction to virology, Evolution of viruses, Nomenclature – general techniques in virology – cultivation – Embryonated egg- Tissue culture-enumeration – Characterization of bacterial, animal and plant viruses. Viruses of Fungi and Algae. Insect viruses.

Unit – II (12 Hrs)

Animal Viruses: Classification of animal viruses – structure and replication. Epidemiology, Pathogenesis, Diagnosis and prevention of RNA viruses – Picorna, Orthomyxo, Paramyxo, Toga, Rhabdo, Rota, HIV and other Oncogenic viruses.

Unit – III (12 Hrs)

Animal viruses: structure and replication, Epidemiology, Pathogenesis, diagnosis and prevention of DNA viruses – Pox, Herpes, Hepatitis viruses, viroids, Prions – Viral vaccines, Antiviral approaches – Interferon.

Unit – IV (12 Hrs)

Bacteriophage: classification – replication - single stranded DNA containing viruses. ΦX174, M13, Filamentous phages – Double stranded DNA containing phages – structure and biology of λ and T_4.

Unit – V (12 Hrs)

Plant viruses: classification, structure, mode of transmission and control of RNA viruses – TMV, cow pea mosaic viruses, Brome mosaic viruses – Double stranded DNA virus – Cauliflower mosaic virus, Single stranded DNA viruses – Structure and replication of Geminivirus, Sub viral pathogens, Viroids, satellite viruses and satellite RNA.

Text Books:

Dimmock D.J. and Primrose S.B. 2007. Introduction to modern virology; 6th Edition. Blackwell Science Limited.

Ananthanarayanan, R. and Jayaram Panicker C.K. (2013) *Text book of Microbiology*. 9th Edition University Press, Hyderabad.

Luria S.E.: Darnell J.E., Baltimore D and Campbell A, 1978, General Virology, 3 edition John Wiley and Sons. New York.

References:

- Conrat, H.F., Kimball, P.C. and Levy, J.A. (1994) *Virology*, 3rd Edn, Prentice Hall, New Jersey.
- Dimmock, N.J. and Pimrose, S.B. (1994) *Introduction to Modern Virology*, 4th Edn. Blackwell Scientific Publications, Oxford.
- Finegold, S.M. (2000) *Diagnostic Microbiology*, 10th Edn. C.V. Mosby Company, St. Louis.
- Flint, S.J., Enquist,L.W., Krung,R. Racaniello,VR. And Skalka,A.M. (2000). Principles of Virology,Molecular Biology,pathogenesis and control,ASM Press, Washinton D.C.
- Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Eds) (1994) *Methods for General and Molecular Bacteriology.* ASM Press, Washington, DC.
- Greenwood, D., Slack, R.B. and Peutherer, J.F.(2002) *Medical Microbiology*, 16th Edn. Churchill Livingstone, London.
- Levy, J.A., Fraenkel H.C. and Owens, R.A. 1994; Virology, 3 Edition Prentice Hall, Englewood cliffs: Nes Jersey 07632.
- Maloy SR,Cronan Jr.JE, Freifelder D. (1998). Microbial genetics. Jones and Bartlett publishers.
- Morag, C. and Timbury, M.C. (1994) *Medical Virology*, 10th Edn. Churchill Livingston, London.
- Robert G. Welstar and Allan Garnoll. Encyclopaedia of Virology (1994). Vol. I, II &III Academic Press inc. San Diego, CA 92101. Ed.
- Tom Parker,M., Leslie H. Collier. (1990). Topley &Wilson's Principles of Bacteriology,Virology and Immunity (VIII Edition).
- Topley and Wilson (1995) *Principles of Bacteriology Virology and Immunity*. 9th Edn. Vol I, Edward Arnold, London.

Web sites

1. http:// www.virology.net/garryfavwebaids.html
2. http:// www. virology.net/garryfavwebaids.html≠genaids
3. http:// www.bcm.edu/pedi/infect/dvl/links.htm
4. http://users.ox.ac.uk/-genemed/virology.htm
5. http:// www-micro.msb.le.ac.uk/224/
6. http:// www.cellsalive.com/ecoli.htm
7. http:// www.bact.wise.edu/microtextbook/
8. http:// www. Pitt.edu/-super1/lecture/lec4771/

14MBP10 FERMENTATION AND BIOPROCESS TECHNOLOGY II Semester

Objective:

- To study the basic concepts of fermentation.
- To understand the components and kinetics of Bioprocess.

Unit – I (12 Hrs)

An Introduction on fermentation process - The range of fermentation process – Microbial Biomass, Microbial enzymes, Microbial metabolites and Recombinant products, chronological development - fermentation economics.

Isolation and preservation of industrially important microorganisms: Industrially important microorganisms - Sources of industrially important microbes, Isolation, preservation and improvement of strains. Upstream processing - media for industrial fermentation – characteristics of an ideal production medium – Raw materials –Screening for production media – media formulation – sterilization – (Batch and continuous) – addition of antifoaming agents. Development of inoculum for various fermentation processed upstream processing, Process optimization.

Unit – II (12 Hrs)

Types of fermentation: classification – Basic requirements. Design of a fermentor – factors involved in fermentor design – basic functions – containment, Body construction, individual parts, heat production - gas liquid exchange - mass transfer - oxygen transfer - temperature control, stirring and mixing - Newtonian, non Newtonian fluids - effect of viscosity - scale up - control of temperature, pH. Sterilization of Bioreactors and nutrients, computer application in fermentation technology. Aeration - Theory of oxygen transfer in bubble aeration. Agitation - Functions of agitation. Flow patterns with different types of impellers. Cell recylce – Scale up window. Principal types of fermentors – tower fermentor, cylindro conical, Air lift fermentors, deep jet fermentor, Photobioreactor, membrane bioreactor and micro carrier reactors. Applications, advantages and limitations of each type.

Unit – III (12 Hrs)

The development of inocula for various fermentation process: Fermentation types and culture. Submerged and solid state fermentations. Down stream processing - Recovery of intracellular and extra cellular products - Biomass separation by centrifugation, filtration, flocculation and other recent developments, Cell disintegration - physical, chemical and enzymatic methods. Extraction - solvent, two phase, liquid extraction, whole broth, aqueous multiphase extraction. Purification by different methods, Concentration by precipitation, ultra filtration, reverse osmosis. Drying and crystallization.

Unit – IV (12 Hrs)

Bioprocess Technology – An introduction, Microbial Products – Exo Polysaccharides, Organic acids - Vitamins, Alcoholic beverages - wine and beer, Fermented foods - bread, cheese. Recombinant Products - insulin, interferon and growth hormone, Fermentation products from natural wastes – molasses, starch wastes and cellulosic wastes. Microbial transformations - steroids and sterols, non steroid compounds - pesticides.

Unit – V (12 Hrs)

Enzyme technology: production and recovery of enzymes. (Chitinase, Glucose oxidase, lipase) Enzyme immobilization. Application of enzymes in industries. Use of various types of sensors and biosensors for monitoring environmental parameters (pressure, pH, temperature, DO and DCO2).

Production aspects: flow diagrams, product optimization, and applications of industrial alcohol (ethanol and butanol), antibiotics (cephalosporins, tetracyclines), SCP, microbial polyesters, biosurfactants.

Principles of Validation Process / Method Validation - The concept of ISO Certification. Preparation of SOPs, Validation protocols for methods in Quality Control, Process validation WHO Norms.

Text Books :

Stanbury, P.F., A. Whitaker and Hall S.J. 1995. Principles of fermentation technology. 2nd edition., Pergamon press.

Casida, J.E. 1968: Industrial Microbiology, Wiley Eastern.

Pastel, A.H. 2012; Industrial Microbiology. 2nd edition. Macmillan India Limited.

Cruger and Cruger, Textbook of Industrial Microbiology. 2004

References:

- Belter, P.A., Cussler, E.L. and Hu, W.S., Bioseparation: Down stream processing for Biotechnology, John Wiley and Sons, N.Y.
- Biochemical Engineering and Biotechnology by B. Atkinson & F. Mavituna, The Nature Press, 1982.
- *Bioreactor Design and Product Yield (*1992*)*, BIOTOL series, Butterworths
- Chand, Fermentation Biotechnology: Industrial Perspectives.
- Chisti, Y., Fermentation, Biocatalysis and bioseparation, Encyclopedia of Bioprocess Technology, Vol. 5, John Wiley and Sons, N, Y.
- Demain, A. L. and Soloman INA, 1986. Mammal of Industrial Microbiology and Biotechnology, American society for Microbiology, Washington DC.
- Doran Pauline (1995) *Bioprocess Engineering Principles*, Academic Press.
- Fermentation Biotechnology by O.P. Ward, Open University Press, Milton Keynes, U.K., 1989
- Fermentation Microbiology and Biotechnology by El Mansi & Bryce, Taylor & Francis, London, Philadelphia, 1999.
- Industrial Microbiology: An Introduction by Waites, Morgan, Rockey & Highton, Blackwell Science, 2001.
- Klegerman, M.E and Groves M.J. (1992) *Pharmaceutical Biotechnology:Fundamentals and Essentials*. Interpharm Press Ltd. Buffalo Grove IL
- Komamine A., Misawa M and Dicosmo F Eds. (1991), *Plant cell culture in Japan*.
- Lydersen B., N. a. D' Elia and K. M. Nelson (Eds.) (1993) *Bioprocess Engineering:Systems, Equipment and Facilities*, John Wiley and Sons Inc.
- Marris. P., Scragg, A.H., Standford, A and Fowlew M.W eds. (1986) *Secondary metabolism in plant tissue cultures*. Cambridge Univ. Press, Cambridge
- Microbial Biotechnology: Fundamentals of Applied Microbiology by Glazer & Nikaido , W.H. Freeman and Co., New York, 1995.
- Modern Industrial Microbiology & Biotechnology by N. Okafer, Scientific Publishers, Enfield, USA., 2007.
- Moo-Young M. ed. (1985) *Comprehensive Biotechnology* Vol: III & IV,Pergamon Press. N.Y
- *Operational Modes of Bioreactors*, (1992) BIOTOL series, Butterworths Heinemann.

- Peppler H. J. and D. Perlman (1970) *Microbial Technology* Volume 1 and 2, Academic Press New York.
- Peppler, H. J. and Pearlman, D. 1979. Microbial Technology, Vol 1 ans 2, Academic press.
- Ponkhshe S. (1988) *Management of Intellectual Property*, Bhate and Ponkhshe Prakasham, Pune
- Presscott and Dunn, S., Industrial Microbiology.
- Principles of Fermentation Technology by P.F. Stanbury, W. Whitaker &S.J. Hall, Aditya Books (P) Ltd., New Delhi, 1997.
- Ratledge C and Kristiansen B eds. (2001) *Basic Biotechnology* 2nd Ed. Cambridge Univ. Press. Cambridge
- Reed G. Ed. *Prescott and Dunn's Industrial Microbiology* . 4th Ed., CBS Pub. New Delhi.
- Shuichi and Aiba. Biochemical Engineering. Academic Press. 1982.
- Van Damme E. J. (1984) *Biotechnology of Industrial Antibiotics*, Marcel Dekker Inc. New York.
- Wetter L.R and Canstabel eds. (1982) *Plant Tissue Culture methods*. Natl. Res. Council, Canada
- Wiseman A.(1985) *Topics in Enzyme and Fermentation - Biotechnology*, Vol. 1 and 2, John Wiley and Sons, New York.

Web References

http://www.microbes.info
http://www.fsis.usda.gov/
http://www.cdc.gov/
http://web.indstate.edu/thcme/mwking/
http://lifesciences.asu.edu/text/classesbk.html

14MBP11 ENVIRONMENTAL, AGRICULTURAL AND FOOD MICROBIOLOGY

II Semester

Objective:

- To understand the role of microbes in the environment
- To study the application of microbes in Bioremediation.

Unit- I (10 Hrs)

Aerobiology: Droplet nuclei – aerosol – assessment of air quality – solids, liquids – impingement method. Air borne transmission of microbes. Viruses – bacteria and fungi their disease and prevention measures – carbon dioxide in the atmosphere – global warming – carbon sequestering.

Aquatic Microbiology: Potability of water – Microbial assessment of water quality – water purifications – major water borne diseases and their control measures. Physical, chemical and microbial assessment of water and potability test for water. Colour, pH, alkalinity, acidity, COD, BOD, anions and cations. Microbiological - MPN index presumptive and confirmatory tests. Isolation of dye degrading microbes.

Unit-II (10 Hrs)

Soil Microbiology Microflora of various soil types – Rhizosphere – phyllosphere. Microbial interactions – symbiosis – mutualism – commensalisms – competition – Ammensalism - synergism – parasitism – predation – biogeochemical cycles – carbon – nitrogen – phosphorous – sulphur – soil borne disease and control. Understanding microbial diversity in the environment by culture-dependent approaches and their limitations, and by culture-independent molecular approaches.

Solid waste treatment: Solids waste – characterization – treatment – physical – chemical and biological - aerobic – anaerobic. Solid waste treatment – saccharification, pyrolysis, composting.

Unit-III (10 Hrs)

Liquid waste treatment – eutrophication – primary, secondary and tertiary treatment - trickling activated sludge – oxidation pond – oxidation ditches. Biodegradation and bioaccumulation - bioremediation concepts, microbial and phytoremediation

Positive and negative roles of microbes in environment: Biodegradation of recalcitrant compounds - lignin – pesticides. Bioaccumulation of metals and detoxification. Biopesticides, Biodeterioration of paper. Leather, wood, textiles and metal corrosions.

Unit-IV (10 Hrs)

Agricultural Microbiology - Biofertilizers: Biological nitrogen fixation – Nitrogenase enzyme. Nif genes, symbiotic nitrogen fixation. Rhizobium Frankia, Non-symbiotic – Azotobacter, Azospirillium. VAM-ecto, endo and ectendomycorrrhizae. Rumen microbiology microbial interactions with animals – cultivation of microorganisms by animals for food and food processing. Fungal predation on animals. Plant – Microbe interaction.

Plant Pathogens: Isolation of plant pathogens - Study of Plant diseases - Tobacco mosaic, Bacterial blight of paddy, Red root of sugarcane, Citrus cancer, Downy mildew of bajra, Powdery mildow of cucurbits, Head smut of sorghum, Leaf rust of coffee, Leaf spot of mulberry, Red rot of sugarcane, Root knot of mulberry.

Unit-V **(8 Hrs)**

Food Microbiology: Food fermentations: methods of fermentations and organisms used - Cheese, bread, wine, beer. Contamination, spoilage and preservation of various food products. Food borne diseases, intoxication and food poisoning. Food preservations: principles- methods of preservation-Physical and chemical methods. Food sanitations - GMP-HACCP - Determination of quality of milk sample by methylene blue reductase test, resazurin method, standard plate count. Isolation of yeast and molds from spoiled nuts, fruits and vegetables. Bacteriological examination of specific food (a) Curd (b) Raw meat (c) Fish (d) Ice cream.

Text Books:

Atlas, R.M and Bartha, R. 1997. Microbial Ecology, Fundamentals and applications. 4th edition. An imprint of Adiision Wesley Longman Inc.

Alexander M. 1977. Introduction to Soil Microbiology. John Wiley and Sons New York

Frazier WC and Westhoff DC 1988. Food Microbiology. Tata Mc Graw Hill Pub Comp. New Delhi

References:

- Alexander M 1971. Microbial Ecology. John Wiley and Sons Inc., New York.
- Coyne M.S 1999. Soil Microbiology. An explanatory approach. Delmar publishers.
- Dubey.R.C and D.K.Maheswari, 2002, Practical Microbiology, S.Chand and Company Ltd
- Grant, W.D.P.E Long 1981. Environmental Microbiology. Thomson Litho Ltd.
- Holt J.S,Kreig N.R,Sheath P.H.A,Williams .S.T.[1994] Bergey's Manual of Determinative Bacteriology [9th ed.,] Williams and Wilkins, Baltimore.
- Robinson RK. 1990. Dairy Microbiology. Elsevier Applied Sciences, London
- Stanbury PF, Whittaker A and Hall SJ 1995. Principles of fermentation technology. 2/e Pergamon Press.
- Vasanthakumari .R., 2007, Textbook of Microbiology, BI Publications Pvt Ltd.

Web References

1. www.wikipedia.org/wiki/Food_microbiology
2. www.microbes.info/resources/Food_Microbiology
3. www.bionewsonline.com/1/what_is_food_microbiology.htm
4. www.en.wikipedia.org/wiki/Environmental_microbiology
5. www.microbes.info/resources/Environmental microbiology

14MBP12 Microbiology Practicals II & Viva-Voce II Semester

1. Microbiology of Soil:
   a) Isolation of cellulolytic organisms.
   b) Isolation of phosphate solubilizers.
   c) Isolation of free living nitrogen fixers.
   d) Isolation of symbiotic nitrogen fixers.
   e) Isolation of ammonifiers.
   f) Isolation of denitrifiers.
2. Microbiology of water: Detection of coliforms in water - MPN Technique.
3. Isolation of coliphage from sewage.
4. Microbial Genetics:
   a) Induced mutation (physical and chemical)
   b) Isolation of drug resistant / Auxotropic mutants
   c) Replica plating technique.
   d) Bacterial conjugation
   e) Induction of lac operon
   f) Agar gel separation of DNA.
   g) Plasmid DNA Isolation
5. Extraction of Nucleic acids
6. Pigment Extraction
7. Quality analysis of waste water - pH, turbidity, TDS
8. BOD determination & COD determination
9. Microbial quality analysis of spoiled food.
10. Fermenter – submerged fermentation – continous fermentation. Solid state fermentation.
11. Production of wine.
12. HPLC – Applications.
13. Estimation of Protein - Lowry's method
14. SDS-PAGE for Protein separation and Western blot technique
15. Estimation of DNA and RNA.
16. Separation of proteins by Thin Layer chromatography, Column chromatography

16MBP13 MEDICAL MICROBIOLOGY III Semester

(For students admitted from 2016-17 & onwards)

Objective:

- To impart thorough knowledge about the microbial basis of various diseases
- To study the various diagnosis and prophylactic methods of diseases.

Unit – I **(14 Hrs)**

Systemic Bacteriology: Laboratory diagnosis of Bacterial diseases. Culture and isolation of organisms – Detection of pathogen – specific molecules – serology testing – morphology and cultural characteristics of *Staphylococcus*, Streptococcus, Pneumococcus, Nesseria, Corynebacterium, Mycobacterium, Bacillus, Clastridium, Enterobacteriacaceae, Pseudomonas, Vibrio, Camphylobacter, Spirochetes, Ricketisiae, Chlamydiae, Newer bacteria.

Unit – II **(12 Hrs)**

Viral Infections: General characteristics and classification of viruses – viral infections – Epidemiology – pathogenesis and pathology – Interferon and antiviral agents – Laboratory diagnosis of viral diseases – Pox viruses - Herpes visuses – Arboviruses – Rubella virus – Adenovirus – Rhabdovirus – Hepatitis virus – Retroviruses: HIV, HTLV-I, HTLV – II – Oncogenic viruses.

Unit – III **(09 Hrs)**

Mycology: Structure – Cell wall – Cell membrane – Classification – Morhology – Reproduction – Pathogenesis – Epidemiology – Diagnosis and treatment of fungal infections. Superficial mycosis – *Tinea nigra* - White and Black piedva, Microsporum, Trichophyton – Epidermohphyton. Subcutaneous mycosis. Rhinosporodiasis – Mycetomes – Sporotrichosis - Systemic Mycosis – Cryptococcosis – Histoplasmosis Aspergillosis – Penicillosis – Zycomycosis.

Unit – IV **(13 Hrs)**

Parasitology: Classification of parasites – Morphology and identification – Pathogenesis and clinical findings – laboratory diagnosis – Treatment – Epidemiology of Protozoans: *Giardia lamblia, Trichomonas, Leishamania, Trypanosoma, Entameoba histolytica, Plasmodium, Crytosporidium.* Helminthes – Nematodes – *Ascaris lumbricoides – Ancylostoma duodenale – Wuchereria bancrofti* Cesodes – *Taema saginata – Taenia Solium* - Trematodes – Schistosoma – Medical entomology – Pathogens transmitted by Arthopods – Biology of insects – Bed Bugs – Lice – Housefly - Mosquitoes – Sand fly – tick and Mites.

Unit – V **(12 Hrs)**

Processing of Clinical Specimens: Ground rules for Collection and dispatch of Clinical specimens for microbiological diagnosis – Urine – blood – faecus, Sputum, Pus, CSF and wound exudates – Antibiotic sensitivity tests – Nosocomial infections, Diarrhoea, meningitis and Sexually transmitted diseases. PCR based tests.

Text Books:

Ananthanarayanan, R. and Jayaram Panicker C.K. (2013) *Text book of Microbiology*. 9th Edition University Press, Hyderabad
Chakraborthy, P. 2005. A textbook Microbiology, New central Book Agency Pvt.Ltd, Calcutta.
Jayaram Panicker, C.K. 2006. Text book of Medical Parasitoloty.7th edition. Jaypee Brothers.

References:

Jawetz, E; Melnic, J.K. and Adelberg, E.A. 2012, Medical Microbiology, 26th Edition. Lange Medical Publications, U.S.A.
Balows, A., Hausler. W.J., Ohashi.M. and Turano.A. (Eds) (1988) *Laboratory Diagnosis of Infectious Diseases: Principles and Practice*, Vol 1 Springer-Verlag, New York.
Cappuccino, J. and Sherman, N. (2002) *Microbiology: A Laboratory Manual*, 6th Edn. Pearson Education Publication, New Delhi.
Collee, J.C., Duguid, J.P., Fraser, A.C. and Marimon, B.P. (1996) *Mackie and McCartney Practical Medical Microbiology*, 14th Edn. Churchill Livingstone, London.
Cowan and Steel (1995) *Manual for Identification of Medical Bacteria*, 4th Edn. Cambridge University Press, London.
Dubey, R.C. and Maheshwari, D.K. (2002) *Practical Microbiology*, 1st Edn. S. Chand & Co. Ltd., New Delhi.
Finegold, S.M. (2000) *Diagnostic Microbiology*, 10th Edn. C.V. Mosby Company, St. Louis.
Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Eds) (1994) *Methods for General and Molecular Bacteriology*. ASM Press, Washington, DC.
Holt, J.S., Krieg, N.R., Sneath, P.H.A. and Williams, S.S.T. (1994) *Bergey's Manual of Determinative Bacteriology*, 9th Edn. Williams & Wilkins, Baltimore.
Mackie and McCarthy, 1994. Medical Microbilogy volume _ I and volume –II. Churchill Livingston., 14th edition.

Murray, P.R., Baron, E.J., Jorgensen, J.H., Pfaller, M.A. and Yoke, R.H. (2003) *Manual of Clinical Microbiology* , 8th Edn. Vol 1&2, ASM Press, Washington, D.C.

Slimeld, L.A. and A.T. Rodgers. 1999. Essentials of Diagnostic Microbiology. Delmer Publications.

Web sites:
http:// www.bact.wise.edu/bact330
http:// www.bact.wise.edu/microtextbook/
http:// www.textbook of microbiology.net/
http:// www.microbeworld.org/
http:// www.protocol-online.com
http:// www.microbiologyonline.org.uk/
http:// www.microbes.info/
http:// dmoz.org/science/biology/microbiology
http:// www.biosci.ohio-state.edu/%7Eparasite/home.html
http:// cal.vet.upenn.edu/parasitic/links.htm

14MBP14 IMMUNOTECHNOLOGY III Semester

Objective:

- To study in detail the components of the immune system.
- To learn the immunological basis of infectious diseases, cancer and transplantation.

Unit – I (12 Hrs)

Immunity & Immune system: History and scope of immunology types of immunity . Innate, acquired, Passive and active physiology of immune response. Humoral immunity and cell mediated immunity – Lymphoid organs – Primary and Secondary – Ontogeny and Physiology of immune system.

Unit – II (12 Hrs)

Antigen and Antibody: Antigen –types – Heptanes – Immunoglobulins – structure distribution and function – Molecular biology of Immunoglobulin synthesis – Origin, development and differentiation of T and B lymphocytes. Antibody diversity – Ag – Ab interactions – detection and measurement, agglutination and precipitation – enzyme immunoassays, polyclonal and monoclonal antibodies – Immunoblotting , ELISA.

Unit – III (12 Hrs)

Hypersensitivity and Autoimmune disorders: Complement pathyways – components – classical and alternate pathways – activation – Hypersensitivity – Anaphylaxis cytotoxic reaction. Immune complex deposition and cell mediated hypersensitivity – Auto immunity and idiotypic network – Immunodeficiency diseases.

Unit – IV (12 Hrs)

Immunity to Infectious diseases: Immunity to infectious diseases – Resistance to viral, bacterial and fungi Protozoa and Worms – Immunization with vaccines. Characteristics of a good vaccine methods of vaccine production – classical and modern interleukins – types – sources and their functions.

Unit – V (12 Hrs)

Transplantation Immunology: Cancer and Transplantation immunology – GVH, HVG major Histocompatability complex –structure and functions of class I and class II molecules. Immunopotentiation and Immunosupression – physical, chemical and biological method – introduction to tumor immunity, Tumor antigens. Host immune response to human tumors – immune diagnosis and therapy.

Text Books:

Kuby Immunology (2013) by R.A. Goldsby, T.J. Kindt and B.A. Osborne, 7th Edition. W.H. Freeman and Company, New York. www.whfreeman.com

Ivan M. Roitt and Peter J. Delves (2013) Essential Immunology, 12th Edition. Blackwell Science Ltd. Oxford. http://www.roitt.com/

References:

- Tizard, R.I. 1983. Immunology: An Introduction , Saunders College Publishing, Philadelphia.
- Abbas, A.K., Litchman, A.H., Pober. J.S. (1994) Cellular and Molecular Immunology. Second Edition. W.B.Saunders, USA.
- Benjamini. E; Coico,R:Sunshine. G.,2000. Immunology – A short course. 4th edition. A John Wiley and Sons, Inc., publication.
- C.A. Janeway, P. Travers, M. Walport and M.J. Shlomchik(2001), Immunobiology: The Immune System in Health and Disease. Garland Publishing, USA.
- C.V. Rao, (2002) An Introduction to Immunology. Narosa Publisihng House, India
- Coleman, R.M., Lombard, M.F., and Secard, R.E. 1992. Fundamentals Immunology. 2nd edition. Dubuque, Lowa Wm. C.Brown. publishing Co.
- James T. Barrett. 1974. Textbook of Immunology – An introduction to Immunochemistry and Immunobiology . 2nd edition. The C.V. Mosby Company Saint Louis.
- K. R. Joshi, N.O. Osama (2000) Immunology, Agrobios Ltd, India.
- Peter Wood, (2001).Understanding Immunology University of Manchester, Pearson Education Lts, Essex.
- Stefan E. Kaufmann, Alan Sher and Rafi Ahmed (2002) Immunology of Infectious diseases , ASM Press, USA.

Websites

http://www-immuno.path.cam.ac.uk/-immuno/part1.html
http://www.Iclark.edu/-reiness/immuno/lectures.html
http://www.hhmi.org/biointeractive/immunology/lectures.html
http://www.immuneweb.xxmc.edu.cn/immunology/immunology.html

14MBP15 PRINCIPLES OF GENETIC ENGINEEERING III Semester

Objective:

- To impart thorough knowledge of the basic tools in genetic engineering
- To expose the students to the concepts of genetic recombination, sequencing and gene amplification.

Unit – I (12 Hrs)

Basics of DNA cloning: Simple cloning and cloning using linkers and adaptors. Cloning into various kinds of vectors – plasmids, phages lambda and M13, phagemids, cosmids, P1 phage, PACs, BACs and Yeast vectors - YACs. Insertion vectors, replacement vectors, Shuttle vectors. Selection and screening of clones.

Enzymes involved in DNA cloning process - Restriction enzymes – types – nomenclature – classification – uses. DNA modifying enzymes – nucleases – polymerases – phosphatases – methylases – DNA lgases – ligation.

Unit – II (12 Hrs)

Selection of Recombinants: DNA delivery systems. Selection, screening and analysis of recombinants – Restriction mapping.

Construction of cDNA and genomic DNA libraries: Vectors used in the construction of cDNA versus genomic DNA libraries. Steps and enzymes involved in the construction of cDNA versus genomic DNA libraries. Screening libraries by colony hybridization and colony PCR. Screening expression libraries. Identifying genes in complex genomes by direct selection of cDNA.

Unit – III (12 Hrs)

Methods of DNA and protein analysis: Southern and Northern Blotting. Radiolabelling probes. Isolation and purification of DNA. RFLP analysis. DNA fingerprinting and its application in forensics, in disease diagnosis and in identification of strains. Western Blotting

Protein engineering and proteome analysis: Insertional and deletion mutagenesis. Site directed mutagenesis by conventional and PCR-based methods. Protein arrays and their applications.

Unit – IV (12 Hrs)

Overexpression of recombinant proteins: Overexpression and tagging of recombinant proteins in E.coli, driven by lac, T7 promoters. Expression in B. subtilis.

Transcriptional analysis of gene expression and transcriptomics: Gene expression analysis by Northern Blotting, RT-PCR, EST analysis and the use of reporter genes. Enzymatic and bioluminescent reporters. Reporters used in protein localization and trafficking studies. DNA microarrays (cDNA arrays and oligo arrays), Serial Analysis of Gene Expresion (SAGE).

Unit – V (12 Hrs)

Genome sequencing: DNA sequencing by Maxam Gilbert and Sanger's method – traditional and cycle sequencing. E-PCR. Whole genome shotgun sequencing. Clone-by-clone shotgun sequencing of genome – preparation of BAC/YAC library. Next Generation Sequencing. Comparative genome sequencing of micro-organisms to identify and categorize SNPs. Array CGH.

Polymerase Chain Reaction: Concept of PCR and various thermophilic enzymes used in PCR. Designing primers. Cloning PCR products. Types and Variations in PCR. RAPD fingerprinting of micro-organisms.

Text Books:

Brown, T.A. 2010. Gene Cloning – An Introduction. 6th edition. Chapman and Hall. Sambrook., Maniatis,

Old, R.W. and Primrose, S.B; 2002. Principles of Gene manipulation – An Introduction to genetic engineering. 6th edition. Blackwell Scientific Publications. London.

References:

- James Watson, Tania Baker, Stephen Bell, Alexander Gann, Michael Levine & Richard Losick , 2013, Molecular Biology of the Gene. 7th Edition; CSHL Press.
- Alexander N. Glazer, Hiroshai and Nikaido, 2007. Microbial Biotechnology,
- David P. Clarke. 2005. Molecular Biology by, 1st edition; Elsevier Academic Press.
- Dubey R.C, 2006, Textbook of Biotechnology , S.Chand and Company Ltd, New Delhi, Revised Edition
- Edward Alcamo. 2001. DNA Technology : The Awesome Skill 2nd edition; Hardcourt Academic Press.
- El-Mans, E.M.T and Bryce C.F.A., 2006. Fermentation Microbiology and Biotechnology.
- Glick Pasternak. Principles of Genetic Engineering. WMC Publishers.
- James Watson, Tania Baker, Stephen Bell, Alexander Gann, Michael Levine & Richard Losick , Molecular Biology of the Gene. 6th Edition; CSHL Press.

- Joseph Sambrook & David Russell. 2001. Molecular Cloning: A laboratory manual, 3rd edition; CSHL press.
- Maheshwari. D. K., R.C.Dubey, R.Saravanamuthu, 2010, Industrial Exploitation of Microorganisms, I. K. International Publishing house Pvt Ltd, New Delhi.
- Old, R.W., Primrose S.B., 1993. Principles of Gene Manipulation, An Introduction to Genetic Engineering, Blackwell Science Publications.
- Satyanarayana .U, 2005, Biotechnology, 1st edition published by books and allied (p) Ltd. Kolkata.
- Winnacker, E.C. 1987. From Genes to Clones, Introduction to Gene technology VCH, Weinheim.

Web references

1. www.en.wikipedia.org/wiki/Microbial_genetics
2. www.microbiologyprocedure.com/genetics/microbial-genetics/microbial-genetics.htm
3. www.bestwebbuys.com/Microbiology-N_10038066-books.html
4. www.en.wikipedia.org/wiki/Molecular_biology
5. www.web-books.com/MoBio/

14MBP16 BIOSTATISTICS AND RESEARCH METHODOLOGY III Semester

Objective:

- To learn the basic principles of biostatistics
- To study the tools of statistics applied to microbiological research.

Unit – I (12 Hrs)

Basics in Biostatistics: Definitions – Scope of Biostatistics, statistical methods – kinds of biological data – functions and limitations. Variables in biology, collection of data, classification and tabulation of data –graphical and diagrammatic representation – scale diagrams – Histogram – frequency Polygon – frequency curves – Logarithmic curves.

Unit – II (12 Hrs)

Descriptive statistics: Measures of central tendency -Arithmetic mean, median, mode, geometric mean and Harmonic mean. Measures of dispersion – mean deviation, standard deviation and standard errors.

Unit – III (12 Hrs)

Correlation & Regression analysis: Correlation analysis – types – correlation coefficient – methods of studying correlation – Karl pearsons method only – Regression – simple, linear regression – Regression line equations – arithmetic mean only.

Unit – IV (12 Hrs)

Significance tests& Probability: Basic idea of significance test – Hypothesis testing – level of significance –tests based of student 't' , 'chi' square and goodness of fit. ANOVA. Probability analysis – Types of Probability – Theory of Probability – Theorem of Probability – Additional and Multiplication theorem. Poisson, Binomial and Normal distribution.

Unit – V (12 Hrs)

Research Methodology: Problem selection and Project design – Research process, Research designs - Experimental and non - experimental. Review of literature – Sources of collection – Classification – Processing of data – Presentation of data – graphs and significant figures – errors – editing the final draft: Structure of research project. Preparation of research report. Guidelines for preparing an article - ISSN, ISBN, impact factor, citation index.

Text Books:

Gupta S.P. 2009: Statistical methods, 4th Edition, Sultanchand and Sons.

Palanichamy.S. and Manoharan.M. 1994 – Statistical methods for Biologists (Biostatistics) Palani para Mount Publications.

Gurumani .N., 2006. Research methodology for biological sciences. 1st edition, MJP Publishers. A unit of Tamilnadu Book House, Chennai.

References:

- Bernard Rosner, 1999, Fundamentals of Biostatistics ,Duxbury Press
- Beth Dawson Robert G. Trapp Beth Dawson Robert Trapp, 2004. Basic and Clinical Biostatistics (LANGE Basic Science), McGraw-Hill.
- Harvey Motulsky, 1995, Intuitive Biostatistics, Oxford University Press.
- Jeffrey A. Witmer Myra L. Samuels, 2002. Prentice Hall Statistics for the Life Sciences (3rd Edition)
- Marcello Pagano Kimberlee Gauvreau, 2000. Principles of Biostatistics , 2nd Edition, Brooks Cole
- Nallasivam. V. 1999. Biostatistics.
- Stanton A. Glantz, 2001. Primer of Biostatistics McGraw-Hill

- Wayne W. Daniel, 2006. Biostatistics- A foundation for analysis in the Health Sciences. 7TH edition. Wiley India publication.

Web References

www.anest.ufl.edu/computer/index.html
www.math.yorku.ca/scs/statResource.html# General
www.jegsworks.com/Lessons/index.html
www.bettycjung.net/statsites.html
www.biostat.harvard.edu/links/
www.ped.mod.utah.edu/genpedscrr/Epibio.html

14MBP17A Core Elective - I: PHARMACEUTICAL MICROBIOLOGY

III Semester

Objectives:

1. To understand the chemistry and biochemistry of antimicrobial agents and drugs
2. To learn the pharmacokinetics and techniques in pharmacetical biology

UNIT - I **(12 Hrs)**

Basic Pharmachemistry concepts - Standard periodic table of the chemical elements - Atomic structure: Atom - Ion - Electron - Proton - Neutron - Atomic orbital - Molecular orbital - Chemical element - Valence - Atomic nucleus - Isotope. Bonding : Chemical bond - Ionic bond - Covalent bond - Metallic bond - Hydrogen bond - Intermolecular force - Dipole - Electron pair - Unpaired electron. Chemical formula - Structural formula - Mole - Stoichiometry - Chemical equilibrium - Reversible reaction - Electrophile - Nucleophile - Redox.

UNIT - II **(12 Hrs)**

Microbial pharmaceutics – Mechanism of action of anti - microbials. General properties and drug action of Sulphonamides. Antibacterial chemicals – Bactericidal and bacteriostatic agents. Antibiotics - Penicillin, Chloramphenicol, Tetracyclin. Therapeutical agents against fungal diseases. Antiviral agents. Antiparasitic agents. Therapeutical agents against medically important parasitic diseases. Quality for medicines and formulations - British Pharmacopoeia and Indian Pharmacopoeia.

UNIT - III **(12 Hrs)**

Pharmacokinetics and Pharmacodynamics - Routes of drug administration- volume of distribution – biotransformation – phase I and phase II reactions – bioavailability – excretion of drugs and their metabolites. Drug physical and chemical actions – drug interactions – therapeutic applications of beneficial interactions. Adverse drug reactions. Principles of toxicity, evaluation and determination of LD 50, ED 50 and Therapeutic Index.

UNIT - IV **(12 Hrs)**

Techniques in pharmaceutics – Physical, chemical and biological screening methods to check drug purity. Extraction and purification procedure for drugs. Evaluation of the drug before marketing for drug safety and biomedical potential. Applications of drug evaluation in biological fluids. Indian medicinal plants and trees. Medical importance of magnesium, aluminium, phosphorus, silver, gold and iron.

UNIT - V **`(12 Hrs)**

Advances in Pharmaceutical Biology: Individualization of drug therapy: concept of drug summation, drug synergism, drug antagonism and its types Adverse Drugs Reactions (ADR) and Drug Toxicity (Teratogenecity, carcinogenecity, mutagenecity), Iatrogenic Diseases - Drug Regulation and Development. Novel Drug development strategy. Broad spectrum and narrow spectrum drugs. Drugs for common ailments.

Text Books:

Rang HP, Dale MM, Ritter JM (Eds.). Pharmacology (4th edn.). Churchill Livingstone, New York, 1999.

References

- Gajapathy, D. and Sasikala Amarasurya, 1995. Pharmaceutical chemistry. R.T.Publications, Vellore. 194pp.
- Lakshmi. S. Pharmaceutical chemistry, 1st edition. 1995. Sultan Chand and Sons Publications, New Delhi. 212ppext Books
- Satoskar R.S. and S.D. Bandarkar, 1989, Vol I and II. 11th edition
- Marine Biotechnology Vol I. Pharmaceutical and Bioactive Natural Products (1993) Edited by D.H. Attaway and O.R. Zaborsky, Plenum Press, USA
- Highlights of Marine Natural Products Chemistry (1972-1999). D. J. Faulkner, Natural Products Report, 2000, 17, 1-6
- Marine Pharmacology. D. J. Faulkner, Antonie van Leeuwenhoek, 2000, 77, 135-145
- Biosynthesis of Marine Natural Products: Microorganisms and Macroalgae. B. S. Moore, Natural Products Report, 1999, 16, 653- 674
- Marqquis JK (authour). Contemporary issues in pesticide toxicology and pharmacology. London S Karger, 1986.
- Ghosh MN (Ed.). Fundamentals of experimental pharmacology (2nd edn.). Scientifica book agency, Calcutta, 1984.
- Rang HP, Dale MM, Ritter JM (Eds.). Pharmacology (4th edn.). Churchill Livingstone, New York, 1999.
- Cooper JR, Bloom FE, Roth RH (Eds.). The biochemical basis of neuropharmacology (8th edn.). Oxford University Press, Chennai, 2003.
- Purohit, S.S., 2003. Phamaceutical microbiology. 596.pp

Websites

http://www.chemlin.net/chemistry/pharmaceutical_chemistry.htm
http://www.internetchemie.info/chemistry/pharmaceutical-chemistry.htm
http://web.chem.ucla.edu/~harding/orglinks.html
http://en.wikipedia.org/wiki/H3_Pharmaceutical_Chemistry
http://ibchem.com/IB/ibfiles/options/opt_B/opb.htm

14MBP17B Core Elective - I: GMP, GLP and Quality Control

III Semester

Objectives:

1. To understand the chemistry and biochemistry of antimicrobial agents and drugs
2. To learn the pharmacokinetics and techniques in pharmacetical biology

Unit - I **`(12 Hrs)**

Good manufacturing practices GMP – Quality Control- Factors influencing GMP- Production and documentation- Principles of production and quality control of biologicals.

Unit - II **`(12 Hrs)**

Food Quality- Sanitation in manufacture and trade. Food quality control agencies and their regulation. Hazard analysis and critical control points (HACCP), Plant sanitation- Employee health standard, waste treatment.

Unit - III **`(12 Hrs)**

Good Laboratory Practices - Quality control of laboratory materials and specimens- Preservation of stock cultures- bacteria, fungi, mycoplasma, animal parasites. Quality Control of media and stains, performance of plated media.

Unit - IV **`(12 Hrs)**

Quality Control: in antimicrobial susceptibility testing, Quality control in parasitology. Quality in clinical Analysis- Errors in Analysis- Sources, monitoring and evaluating, Tests and use of Test result. Laboratory audit. Preparation of simulated Quality Control specimens,

Unit - V **`(12 Hrs)**

Quality Control- Internal and external Assessment, Quality improvement, Total Quality Control Programme. Quality Assurance – Attributes, Immunization programme.

Internal Quality Control- Clinical Microbiology Laboratories- Standard operating procedure manuals, Specimens- Equiqments – Biosafety cabinets, Media, Tests_ Biochemical, Staining, Antimicrobial Susceptiblity, Serological Biological Production units.

External Quality Assessment- EQA-Types-Requirement of EQA programme. Organization of EQA, Scoring System in EQA, National External Quality Control assessment.

References:

Rajesh Bhatia, Rattan Lal IchhPujani-Quality Assurance in Microbiology-CBS Publishers & Distributors-New Delhi-First Edition-1995.

NCCLS Manual of SOP

Salle Microbiology

14MBP18 Microbiology Practicals III & Viva-Voce III Semester

1. Medical Microbiology

Diagnostic bacteriology – collection and transport of Clinical Specimens.

Isolation and Identification of Clinically important bacteria from Pus, Sputum, Throat Swab and Urine.- *Staphylococcus*, Streptococcus, Pneumococcus, Mycobacterium, Enterobacteriacaceae, Pseudomonas, Vibrio, Spirochetes

Antibiotic Sensitivity test – 1) Kirby – Bauer method. Determination of MIC.

Mycology - :Isolation and identification from Clinical specimens for *Candida* and Cryptococcus.

2. Immunology

Handling of Laboratory animals – Immunization – Bleeding.

Preparation of Particulate antigens- WIDAL Test

Preparation of Soluble antigens – Freund's adjuvant.

Raising of Polyclonal and Monoclonal (Demonstration) Antibodies in laboratory animals.

Purification of Immunoglobulins.

Immuno diffusion (ouchterlony)

3. Serology

Serodiagnosis of Viruses-ELISA.

Bacteria – WIDAL, VDRL, ASO.

4. Virology

Animal Tissue Culture Laboratory- Equipments- Glassware- Media Preparation for all culture-Passaging of cell culture-CPE.

Embryonated Egg Inoculation.

Cryopreservation

Lyophilization

5. Bioinformatics Practicals:

Sequence Analysis – BLAST

Phylogenetic tree construction using CLLUSTAL W

16rRNA Analysis

Rasmol – Protein structure prediction.

Text Book:

James Cappuccino, Natalie Sherman. Microbiology: A Laboratory Manual. 2013. 10th Edition. Benjamin Cummings Publishers.

References:

- Gerhardt, P.; Murray, R.G.E., Costllow, R.N., Nester, E.W.; Wood, W.A..; Kreig, N.R.; and Philips, G.B., eds. 1981. Manual of methods for general bacteriology, chapters 6-12. Washington, D.C.; American society for Microbiology.
- Benson, Haroid, J. 1990 Microbiological applications. A Laboratory Manual in General Microbiology. W.C. Brown Publishers.
- Clavs, Williams. G. 1989. Understanding Microbes. A Laboratory text book for Microbiology. W.H. Freeman and Company, New York.

- Collins, C.H. and Lyne, Patricia, M.1984. Microbiological Methods. Fifth Edition. Butterworths, London.
- Difco Manual of Dehydrated Culture Media and Reagents. 1984. 10th edition, Detroit, Mich: Difco Laboratories.
- Salle, A.J. 1961. Laboratory Manual on Fundamental Principles of Bacteriology. 7th edition. McGraw Hill Book Company. New York.
- Wilson, M.E., Weisburd, M.H. and Helen Eckel Mizer. 1974. Laboratory Manual and work book in Microbiology. Applications to Patient care. Publishing Co., Inc.; New York.

14MBP21 APPLIED BIOTECHNOLOGY IV Semester

Objective:

- To explain the applications of biotechnological tools
- To study the applications of engineering in plants, animals and environmental aspects.

Unit – I (12 Hrs)

Engineered Products of Commercial Value: Pharmaceutical (medical) – Antibiotics – synthesis of novel antibiotics – improving antibiotic production biopolymers – Engineering of Xanthomonas campestris for inexpensive Xantham gum production. Monoclonal antibodies and their applications. Growth hormones.

Unit – II (12 Hrs)

Engineered Products from Plants: Plant cell culture – plant tissue culture – genetic engineering of plants – plant transformations with Ti plasmid of Agro bacterium tumefaciences. Ti plasmid derived vector systems – Physical methods of transferring genes to plants – vx of reporter genes. Developing plant strains by genetic engineering – insect resistant – virus resistant – Herbicide resistant – stress and senescence tolerant.

Unit – III (12 Hrs)

Engineered Products from animals: Gene technology in animals – animal cell culture – Invitro fertilization – Embryo transfer, Stem cells – Embryonic stem cells – Adult stem cells – uses of stem cells. Development and use of transgenic animals – Transgenic mice – methodology – applications – Transgenic cattle, sheep, goat, pigs, birds, and fish.

Unit – IV (12 Hrs)

Human gene technology: Genetic linkage and gene mapping – RELP analysis. Human gene mean analysis. Human somatic cell gene therapy. Human somatic cell gene therapy. Human cloning – ethical aspects. Gene expression profiling. Gene cascades and molecular pathways – Applications of microarrays.

Unit – V (12 Hrs)

Engineered Products of Environmental values: Use of genetically engineered organisms in biodegradation – biodegradation of plastic, oil and xenobiotic substeances.. Deliberate release of genetically engineered organisms – regulating the use of biotechnology. GMO and impact. IPR – concepts and conditions. Patenting of genes and life forms. Evaluation of life patenting. Biosafety and Bioethics.

Text Book:

Bernard R. Glick and J.Pasternak.2010. Molecular biotechnology: Principles and application of recombinant DNA. 4th Edition. Panima publishing corporation, New Delhi.

Reference:

- Baker KH and Herson DS 1994. Bioremediation. New York.
- Bioremediation by Baker K.H. and Herson. D. S, 1994, Mc Graw Hill Inc.,
- Brock TD and Madigan, 1999. Biology of Microorganisms. Prentice Hall Int. Inc.
- Colin Ratledge and Bjorn Kristiansen. 2008 3rd, Edition, Basic Biotechnology, Publisher: Cambridge University Press
- Ecology and Biotreatment by Ec Eldowney, S. Hardman D.J. and Waite S. 1993. -
- Environmental Microbiology edited by Ralph Mitchell. A John Wiley and Sons. Inc.
- Michel R.(ed). Introduction to Environmental Microbiology. Longman Scientific Technical.

Web References

www.wikipedia.org/wiki/Food_microbiology
www.microbes.info/resources/Food_Microbiology
www.bionewsonline.com/1/what_is_food_microbiology.htm
www.microbiologyprocedure.com/microbiology...dairy/microbiology-in-dairy.htm
www.titanbiotechltd.com/dairy-microbiology.asp -
www.ncbi.nlm.nih.gov ›
www.en.wikipedia.org/wiki/Environmental_microbiology
www.microbes.info/resources/Environmental_Microbiology

CORE ELECTIVE-II

14MBP22A INTRODUCTION TO BIOINFORMATICS , GENOMICS & PROTEOMICS

IV Semester

Objectives:

1. To understand the basics of bioinformatics, proteomics and genomics
2. To gain knowledge on the big data analysis of biological information

Unit I : (12 Hrs)

Biological databases- Overview, modes of database search, mode of data storage (Flat file format, db-tables), flat file formats of GenBank, EMBL, DDBJ, PDB.

Unit II (12 Hrs)

Sequence alignment –Concept of local and global sequence alignment, Pairwise sequence alignment, scoring an alignment, substitution matrices, multiple sequence alignment.

Unit III (12 Hrs)

Phylogenetic analysis- Basic concepts of phylogenetic analysis, rooted/uprooted trees, approaches for phylogenetic tree construction (UPGMA, Neighbour joining, Maximum parsimony, Maximum likelihood). Pathway bioinformatics:

Unit IV (12 Hrs)

Systems Biology: Definition; Hypothesis driven research in systems biology: Wet experiments – Dry experiments: predictions and simulations. Molecular databases. Reductionist approach and Integrative approach.

Annotation procedures for high through-put sequence data- Identification of various genomic elements (protein coding genes, repeat elements, strategies for annotation of whole genome, functional annotation of EST clusters, gene ontology (GO) consortium.

Unit V (12 Hrs)

Structure predictions for nucleic acids and proteins- Approaches for the prediction of RNA secondary and tertiary predictions, energy minimization and base covariance models, Basic approaches for protein structure predictions, comparative modeling, fold recognition/"threading"and ab-initio prediction. Genomics, Proteomics, Metabolomics, transcriptomics, intactomics, Phenomics, localizomics; synthetic biology and systematic biology

Textbooks:

S C Rastogi; Namita Mendiratta and Parag Rastogi. Bioinformatics: Concepts Skills and Applications. 2006. CBS Publishers.

Attwood. Introduction to Bioinformatics: Cell and molecular biology in action series. 1999. Pearson Education.

References:

- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Baxevanis A.D. and Ouellette, Third Edition. John Wiley and Son Inc., 2005.
- Bioinformatics Sequence and Genome Analysis by Mount D.W., CSHL Press, 2004.
- Introduction to Bioinformatics by Tramontano A., Chapman & Hall/CRC, 2007.
- Understanding Bioinformatics by Zvelebil, M. and Baum, Chapman & Hall/CRC, 2008
- David W. Mount, Cold Bioinformatics, 2001. Sequence and Genome Analysis, Spring Harbor Laboratory Press.
- Claverie J-M and C. Notredame, 2003. Bioinformatics for Dummies, Wiley Publishing, Inc.
- Higginns . D and W. Taylor (Eds.) 2000. Bioinformatics. Sequence, Structure and databanks- A Practical Approach by Oxford University Press.
- Baxevanis A.D and B.F. Francis Ouellette (Eds.) Wiley-Interscience, 2001. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins
- Rastogi. S. C, N. Mendiratta and P. Rastogi, 2008. Bioinformatics- Methods and Applications Genomics, Proteomics and Drug Discovery 3rd edition
- Attwood T.K. and D.J. Parry-Smith, 2001. Introduction to Bioinformatics, Pearson Education Asia

CORE ELECTIVE-II

14MBP22B MICROBIAL NANOTECHNOLOGY IV Semester

Objectives:

1. To understand the basics of nanotechnology and types of nanoparticles
2. To understand the major applications of nanotechnology in various fields.

UNIT – I (12 Hrs)

The Journey of biotechnology to nanotechnology. Historical perspectives. Introduction and definition of nanoscience. Opportunities, challenges and principles of nanoscience. Factors affecting the manufacturing process of nano materials – Role of physicists, chemists, medical doctors, engineers, biologists and computer scientists in nanotechnology.

UNIT – II (12 Hrs)

Types of nanomaterials - synthesis and characterization of nanoscale materials. Top down and Bottom up approaches. Microbial synthesis of nanomaterials – Silver, Gold, Platinum, CdS, ZnO, Se, Titania, etc. Characteristics and application of quantum dots, fullernes and CNTs.

UNIT - III (12 Hrs)

Application of semiconductor (metal) nanoparticles – Nanoscience in human disease control, nanomedicine, drug delivery & cancer treatment. Nanoparticles as carrier for genetic material – Nanoscience in agriculture – fertilizers and pesticides. Nanoscience for water treatment and fermentation process. Designer proteins, DNA computing, Biosensors. Nanotoxicology – Risks and Ethics. Nanoscience in India and abroad. Future of nanobiotechnology.

UNIT - IV (12 Hrs)

Nanotechnology for drug development and medical applications. Nanotechnology for drug solubilization and drug delivery. Diagnosis using nanomaterials. Nanotherapy for cancer treatment – Interior artery expansions – Replacing joints with better stuff. - Radioactive tuberene cages in Nuclear medicine.

UNIT - V (12 Hrs)

Cleaner environment with Nanotech. Cleaning the air with Nanotechnology – Nanotechnology for water treatment. Microbial nanoparticles. Nanocarbon ball as deodorizer in ferment process. Biomotors for engineered devices. Possible harm from Nanomaterials. Nanoscience in India – Nanoscience education abroad – Looking at ethics and society.

Text Books:

Niemeyer C. M., C. A. Mirkin. (2004). Nanobiotechnology: Concepts, Applications and Perspectives, Wiley – VCH.

Subbiah Balaji. (2010). Nanobiotechnology, MJP Publishers.

References:

- Carl C. Koch. (2002). Nanostructured Materials: Processing, Properties and Potential Applications, *N*oyes Publications, William Andrew Publishing Norwich, New York, U.S.A.
- David S. Goodsell. (2004). "Bionanotechnology", John Wiley & Sons.
- Duckruix, A. and R. Giege, (1992). Crystallization of Nucleic acids and Proteins. A practical approach, Oxford Umiversity Press, England.
- Paul Dieppe and Paul Calvert. (1983). Crystals and Joint disease, Chapman and Hall Ltd, London.
- Pradeep T. Nano: The Essentials, McGraw – Hill education.
- Richard Brooker and Earl Boysen (2006). Nanotechnology. Wiley Publishing Inc., India. Pp 361.

Web sites:

www.nanobotblogspot.com
www.azonano.com
www.nano.gov
www.forbesnanotech.com
www.foresight.org
www.nanotech-now.com

14CHP19C / 14NDP15C / CLUSTER IDC
14BCP15C / 14ESP17D CLINICAL MICROBIOLOGY-IDC III Semester
(Optional paper for MSc Chemistry, MSc Foods & Nutrition, MSc Biochemistry, & MSc Environmental Science)

Objectives:

1. To understand the basics and techniques in Microbiology
2. To understand the methods in clinical diagnosis of microorganisms.

Unit I (6 Hrs)

Microscopy and staining: Principles-Light microscopy, Dark field, Phase contrast, Fluorescent microscopy-techniques in light microscopy-preparation of specimens for light microscope. Staining reactions-simple, differential, positive and negative staining.

Unit II (8 Hrs)

Culture techniques: Shake culture-enrichment culture and stab culture-agar slant-agar deep-broth culture. Types of media-pure culture techniques. **Bacterial growth:** Growth curve-factors affecting growth-demonstration of growth-batch, continuous and synchronous culture. **Enumeration of Microorganisms:** Enumeration of bacteria and fungi from soil and water, cultural characteristics. Maintenance and preservation of cultures.

Unit III (8 Hrs)

Control of microorganisms by physical and chemical agents: heat, filtration, radiation, chemical agents - Phenolics, alcohols, halogens, heavy metals, quaternary ammonium compounds, aldehydes, chemotherapeutics-basic principles-Antibiotics-penicillin, Erythromycin.

Unit – IV (8 Hrs)

Systemic Bacteriology: Morphology, pathogenesis and laboratory diagnosis of Staphylococcus aureus, Streptococcus pyogenes, Mycobacterium, Clostridium tetani**,** *Escherichia coli, Klebsiella sp., Proteus sp., Salmonella sp., Pseudomonas sp., Shigella sp., Vibrio cholera,* Normal flora of the Human body.

Unit- V (6 Hrs)

Medical virology: Morphology, Pathogenesis and Laboratory diagnosis of Hepatitis – B, Measles, Rabies, HIV.

Text Books

Prescott, Harley, Klien. 199, Microbiology. WCB Publishers. 2nd edition.

Ananthanarayanan, R and Jayaram Panickar, C.K. 2007. Textbook of Microbiology 7th edition. Orient long man Ltd. Chennai

Reference Books:

- Pelzer, Chan and Kreig. Microbiology. Panima Publishers.
- Black, J.G. 1999. Microbiology: Principles and Exploration. 4th edition. Prentice Hall International, Inc.
- Brock, T. D. Madigan, M.T. Martinko, J.M and Parker. J. Biology of Microorganisms. 9th edition. Prentice Hall International, Inc.

- Chakraborthy. 1995. Textbook of Microbiology. New Central Book Agency Pvt. Ltd.
- Shimeld, L.A; Rodgers, A.T., 1999, Essentials of Diagnostic Microbiology. Delmar Publications.

14CHP20C / 14NDP16C / CLUSTER IDC
14BCP16C / 14ESP18D CLINICAL MICROBIOLOGY-IDC III Semester
(Optional paper for MSc Chemistry, MSc Foods & Nutrition, MSc Biochemistry, & MSc Environmental Science)

1. Micrometry
2. Staining methods – Simple staining
3. Differential staining – Gram staining, capsular staining
4. Sterilization methods – Hot air sterilizer – Moist heat – Filtration
5. Motility observation
6. Direct Microscopic count
7. Media Preparation: Liquid and Solid media, Agar deep, Slant and Plates.
8. Pure Culture Techniques – Streak Plate / Pour Plate
9. Identification of clinically important bacteria.
   a) *Escherichia coli*
   b) *Klebsiella sp.,*
   c) *Staphylococcus aureus*
   d) *Streptococcus pyogenes.*
10. Antibiotic sensitivity test.