



Syllabus

For

M.Sc. MICROBIOLOGY (I, II, III & IV SEMESTER COURSE)

W.E.F. - Session 2023 - 2024

P.K.UNIVERSITY SHIVPURI(M.P.)



M.Sc. Microbiology Examination Scheme (2023-24)

Semester	Course Code	Title of the Paper	Credit	L	T	P	T-CCE	T-UE	P-CCE	P-UE	Marks
First	MBASIMB101	Basics in Microbiology and General Bacteriology	4	4	0	0	40	60	0	0	100
	MVIROMB102	Virology and Mycology	4	4	0	0	40	60	0	0	100
	MCELLMB103	Cell biology and Biochemistry	4	4	0	0	40	60	0	0	100
	MBIOIMB104	Bioinstrumentation	4	4	0	0	40	60	0	0	100
	MLABCMB105	Lab course I	2	0	0	4	0	0	20	30	50
	MLABCMB106	Lab course II	2	0	0	4	0	0	20	30	50
		TOTAL	20				160	240	40	60	500
Second	MMICRMB107	Microbial genetics and Molecular Biology	4	4	0	0	40	60	0	0	100
	MIMMUMB108	Immunology	4	4	0	0	40	60	0	0	100
	MMICRMB109	Microbial Physiology and metabolism	4	4	0	0	40	60	0	0	100
	MBIOSMB110	Biostatistics, Computer application and Bioinformatics	4	4	0	0	40	60	0	0	100
	MLABCMB111	Lab course III	2	0	0	4	0	0	20	30	50
	MLABCMB112	Lab course IV	2	0	0	4	0	0	20	30	50
		TOTAL	20				160	240	40	60	500
Third	MMEDIMB201	Medical and Pharmaceutical Microbiology	4	4	0	0	40	60	0	0	100
	MFERMMB202	Fermentation and Microbial Technology	4	4	0	0	40	60	0	0	100
	MRECOMB203	Recombinant DNA Technology	4	4	0	0	40	60	0	0	100
	MENVIMB204	Environmental Microbiology	4	4	0	0	40	60	0	0	100
	MLABCMB205	Lab course V	2	0	0	4	0	0	20	30	50
	MLABCMB206	Lab course VI	2	0	0	4	0	0	20	30	50
		TOTAL	20				160	240	40	60	500
Fourth	MFOODMB207	Food Microbiology	4	4	0	0	40	60	0	0	100
	MMICRMB208	Microbial Biochemistry	4	4	0	0	40	60	0	0	100
	MLABCMB209	Lab course VII	2	0	0	4	0	0	20	30	50
	MDISSBC210	Dissertation	10	0	0		0	0	0	250	250
		TOTAL	20				80	120	20	280	500
		Total marks of all semester	80				560	960	140	460	2000

L – Lecture T- Theory P- Practical CCE- Continuous comprehensive Exam UE- University Exam

UNIT-I

1. Introduction, history and scope of Microbiology.
2. General characteristics and composition of Prokaryotes and Eukaryotes.
3. Classification of Microorganisms: Haekel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese , classification and salient features of bacteria according to Berger's Manual of Determinative Bacteriology.
4. Nomenclature and modern methods of Bacterial taxonomy.

UNIT-II

1. Morphology and ultra structure of bacteria: size, shape, and arrangement of bacteria, ultra structure of bacterial cell wall of eubacteria and archeabacteria. Protoplast and spheroplast formation and L-form.
2. Components external to cell wall: Structure and function of flagella, fimbriae and pilli, capsule-types, composition and function, slime layers, S-layers.
3. Prokaryotic cell membrane and cytoplasmic matrix – cell membrane structure and function of bacteria and archeabacteria, mesosomes, ribosomes, cytoplasmic inclusion bodies (polyhydroxy butyrate, polyphosphate granules, oil droplets, cyanophycin granules) and nucleoid.
4. Bacterial response to external stimulus and bacterial endospores: Chemotaxis and phototaxis structure, formation and germination of bacterial endospore.

UNIT-III

1. Bacterial nutrition: Basic nutritional requirements, growth factors, nutritional categories, physical requirements of bacterial growth.
2. Bacteriological media: types (complex, synthetic, differential, enrichment and selective media) and their uses, culture characteristics of bacteria on different media.
3. Cultivation of bacteria: aerobic and anaerobic culture, pure culture techniques, shaker and still culture, maintenance and preservation of microbial culture.
4. Bacterial growth: growth kinetics, growth curve. Batch, continuous and synchronous culture. Measurement of growth and influence of environmental factors affecting growth.

UNIT-IV

1. General concept of Prokaryotic and Eukaryotic genome. Genome of *E. coli*.
2. Genetic recombination and transformation.
3. Transduction: generalized and specialized transduction, phage conversion.
4. Plasmid: types and their significance. Conjugation and chromosomal mobilization. *E. coli* as model prokaryotes.

UNIT-V

1. Staining methods: fixation, types of dyes, simple staining, differential staining (Gram and Acid-fast staining), staining of specific structures (capsule, flagella and spore staining)
2. Control of microorganisms: Microbial death curve, concept of bio-burden, thermal death time and decimal reduction time. Factors influencing the effectiveness of antimicrobial agents.
3. Control of microorganisms by physical agents: heat (moist and dry), filtration and radiation.
4. Chemical control of microorganisms: Halogens, phenol and other phenolic compounds, heavy metals, alcohols, ethylene oxide and aldehydes.

Reference Books

1. Microbiology; Lansing M Prescott, John P. Harley, Donald A Klein, Sixth edition, McGraw Hill Higher education.
2. General Microbiology; R.Y. Ingraham, J.L. Wheels, M.L. Painter. Thess Macmillan Press Ltd.
3. Brock Biology of Microorganism; M.T, Martinko, J.M. Parker, Prentice-Hall.
4. Microbiology; M.J. Pelczar, E.C.S Chan and N.R. Kreig, Tata MacGraw Hill.
5. Microbial Genetics, S.R. Molloy, J.E. Jr. Cronan and Frreifelder D Jones, Bartiett Publishers.
6. Breed and Buchanan. *Bergey's Manual of Systematic Bacteriology*. 2nd Edition, (Volumes. 1 – 5) (2001 – 2003).
7. General Microbiology, R. Y. Stanier, E. A. Adelberg, J. L. Ingraham, 4th edition, Mac Millan Press, London.
8. Microbiology An introduction by TortoraFunke case.

MVIROMB102: VIROLOGY AND MYCOLOGY

UNIT- I

1. Brief outline on discovery and origin of viruses.
2. General properties of viruses, morphology and ultra-structure of viruses, capsid and their arrangements, types of envelopes and their composition, measurement of viruses.
3. Viral genome; their types and structure, viral related agents-viroids and prions.
4. Classification and general properties of major families of viruses including detail account of their mode of replication.

UNIT-II

1. Cultivation of viruses- in embryonated eggs, experimental animals and cell lines; primary and secondary cell lines, diploid cell culture.
2. Assay of viruses: physical and chemical methods, plaque method, pock counting and end point method.
3. Serological methods: hemagglutination, hemagglutination inhibition, neutralization test, complement fixation, ELISA, RIA.
4. Purification of viruses: gradient centrifuge, electrophoresis, and chromatography.

UNIT-III

1. Plant viruses: recent advance in classification of plant viruses. Structure and pathogenicity of TMV.
2. Transmission of plant viruses with vector (insect, nematodes and fungi) and without vector (contact, seed and pollens). Biochemical changes induced by virus in plant cell.
3. Animal viruses: nomenclature and classification of animal viruses.
4. General idea about Cyanophage, and Mycophage.

UNIT-IV

1. Bacteriophage: classification, morphology and ultra structure.
2. One step growth curve (latent period, eclipse period, and burst of size.)
3. Life cycle: lytic and lysogenic life cycle of bacteriophages.
4. Brief account of M13, Mu, T4, ϕ x174 and lambda phage

UNIT-V

1. Structure, reproduction and classification of fungi, general characteristics of Zygomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes.
2. Cultivation of fungi, culture media for fungal growth, effects of environment on growth, isolation, identification and preservation of fungi.
3. Dimorphic fungi, yeast morphology, general characteristics and reproduction. Lichens, Mycorrhiza, and Actinomycetes.
4. Ecology of fungi: concept of fungistatic, fungicidal.

Reference Books

1. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA
2. An Introduction to viruses, S. B. Biswas and Amita Biswas. Forth edition, Vikas Publishing House PVT LTD New Delhi.
3. Textbook of Microbiology by Ananthnarayanan and Paniker's, eighth edition, Universities Press .
4. Microbiology; Lansing M Prescott, John P. Harley, Donald A Klein, Sixth edition, McGraw Hill Higher education.
5. Introductory Mycology, Alexopoulos, C. Jr : , Second edition, Wiley, New York.

MCELLMB103:CELL BIOLOGY AND BIOCHEMISTRY

UNIT-I

1. Cell: size, shape, types & chemical composition of the cell.
2. Structural organization and function of intracellular organelles of eukaryotic cell: nucleus, mitochondria, golgi body, lysosomes, endoplasmic reticulum, peroxisomes, plastids, chloroplast, vacuole, cytoskeleton.
3. Membrane structure and function: molecular organization of cell membrane, membrane models, mechanisms of intracellular transport.
4. Cellular interaction: differentiation of cell membrane and intracellular communication and Gap junction.

UNIT-II

1. Cell differentiation: general characteristics of cell differentiation and cytoplasmic factors, differential gene action.
2. Cell signaling: cell surface receptors, G-protein, signal transduction pathways.
3. Cell cycle: mitosis and meiosis and their regulation. Programmed cell death and apoptosis.
4. Cancer biology: characteristics of cancer cell, types of cancer, oncogene and tumor markers.

UNIT-III

1. Carbohydrates: structure of sugars, classification, properties, chemical reactions, stereoisomerism and optical isomers of sugars.
2. Structure, properties and function of disaccharides, oligosaccharides, and polysaccharides, carbohydrate derivatives; peptidoglycan, glycoproteins, glycolipids.
3. Lipids: classification, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, sterols and terpenes.
4. Lipids with specific biological functions, micelles and liposomes.

UNIT-IV

1. Amino acids: structure, classification, properties and functions.
2. Proteins: structural and functional proteins, synthesis of peptide bonds. Primary, secondary, tertiary and quaternary structure of proteins. Protein sequencing.
3. Nucleic acids: structure and properties of purines and pyrimidine bases, nucleosides and nucleotides.
4. Basic structure and types of DNA and RNA.

UNIT-V

1. Enzymes: basic concept as a biocatalyst, specificity, active sites, activity unit and iso-enzymes, enzyme classification.
2. Enzyme kinetics- Michaelis-Menton equation for simple enzymes, determination of kinetic parameters.
3. Enzyme inhibition: competitive, noncompetitive and uncompetitive inhibition, allosteric enzymes.
4. Vitamins and cofactors: structure, distribution and biological properties.

Reference books

1. Biochemistry by Donald Voet and Judith G. Voet ,third edition, John Wiley and sons, inc. , U.S.A.
2. Biochemistry by Jeremy M. Berg, John L. Tymoczko and LubertStryer, sixth edition , W. H. Freeman and Company, New York.
3. Molecular Cell Biology , by Harvey Lodish ,Fifth edition , W.H. Freeman and Company, New York
4. Molecular Biology of The Cell by Bruce Alberts, Fourth edition, Garland Science Taylor and Francis Group, U.S.A.
5. Biochemistry by LubertStryer, Fourth edition, W. H. Freeman and Company, New York.
6. Biochemistry by Christopher K. Mathews, K.E. van Holde and Kevin G. Ahern, Third edition, Pearson Education (Singapore) Pte. Ltd., Indian branch, New Delhi
- 7 .Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox.

MBIOIMB104: BIOINSTRUMENTATION

UNIT-I

1. Microscopy: history and principles of microscopy, properties of light, magnification power, resolution limit, resolving power, numerical aperture.
2. Principles and applications of light microscopy, bright field, dark field, phase contrast and fluorescent microscopy. Determination of size of microorganisms by micrometry.
3. Principles and application of electron microscopy- transmission and scanning electron microscopy. Fixation and staining techniques in electron Microscopy.
4. Newer techniques in microscopy- confocal microscopy, scanning probe microscopy (scanning tunneling microscope and atomic force microscope).

UNIT-II

1. Chromatography: Principles, types and applications of partition, paper and thin layer chromatography.
2. Adsorption and Gel filtration chromatography: Principle, matrix, column packing and applications.
3. Affinity, ion exchange, and Gas chromatography: Principle and applications.
4. High performance liquid chromatography (HPLC) and FPLC: Principle, Instrumentation (Reservoirs, pumps, columns) and applications.

UNIT-III

1. Electrophoresis: principle, types and applications of Paper, Starch gel and Agarose gel electrophoresis.
2. Polyacrylamide Gel Electrophoresis: Native PAGE and SDS-PAGE.
3. Isoelectric focusing, Isotachopheresis and gradient gel electrophoresis.
4. Two dimensional gel electrophoresis and pulse field gel electrophoresis.

UNIT-IV

1. Spectroscopy: Laws of absorption, Principles, instrumentation and applications of colorimetry, UV-visible spectroscopy.
2. Principles, instrumentation and applications Infrared and fluorescence Spectroscopy.
3. Principles, instrumentation and applications of NMR and ESR.
4. Principle, instrumentation and applications Mass Spectroscopy (types of ion source, analyzers and detectors), GC-MS, MALDI-TOF.

UNIT-V

1. Centrifugation: Basic principles of centrifugation, differential and density gradient: zonal and isopycnic centrifugation. Sedimentation coefficient, factors affecting sedimentation coefficient.
2. Ultracentrifuges: analytical and preparative with application. Rotors: types and applications.
3. Radioisotope techniques: half life, radioactive decay, radioactive assay methods based on ionization and excitation of gases-Geiger Muller counter, liquid scintillation counter and gamma counter.
4. Autoradiography- principle and applications. Quenching and application of radioisotopes in biological systems.

Reference Books

1. A Biologist Guide to Principles and Techniques of Practical Biochemistry, Wilson and Goulding
2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology, David Frefelder,
3. Microbiology; Lansing M Prescott, John P. Harley, Donald A Klein, Sixth edition, McGraw Hill Higher education.
4. Principles of Instrumental Analysis, Skoog and West.
5. Biological Spectroscopy, Campbell and Dwek.
6. Principles and Techniques of Biochemistry and Molecular Biology, Wilson Keith and Walker John (2005) 6th Edition. Cambridge University Press, New York.

MLABCMB105: LAB COURSE

Practical Exercises

Lab course I (Basics in Microbiology and General Bacteriology & Virology and Mycology)

1. Good Microbiology laboratory practices: Laboratory safety (Dos and Don'ts), hazard from chemicals, handling of cultures and chemicals, disposal of chemicals and cultures.
2. Introduction to different Glass wares used in Microbiology Laboratory.
3. To learn handling of different instruments and Equipments used for culture and Sterilization.
4. To prepare basic liquid (Nutrient broth) and basic solid media (Nutrient Agar and Potato Dextrose Agar) for cultivation of bacteria and fungi.
5. To prepare selective, differential media and enriched media (MacConkey Agar and Blood Agar).
6. To learn pure culture techniques used for isolation and purification of microorganisms.
 - a. Streak plate method.
 - b. Pour plate method.
 - c. Spread plate method.
7. Isolation and Enumeration of microorganisms from Air (plate exposure method), Soil and Water (serial dilution method).
8. To perform different staining methods to study morphological and structural characteristics of bacteria and fungi.
 - a. Gram Staining.
 - b. Acid fast staining.
 - c. Fungal staining (Lacto-phenol cotton blue).
 - d. Spore staining.
 - e. Flagella staining.
 - f. Capsule staining.
 - g. Negative staining.
9. To check motility of bacteria by hanging drop and semi-solid agar methods.
10. To learn culture preservation techniques (Agar slants, stabs and glycerol stocks).
11. To study effect of salt, pH and temperature on microbial growth.
12. Determination of bacterial growth by turbidity measurements and to plot bacterial growth curve.
13. Inoculation and cultivation of viruses in embryonated eggs.
14. Isolation of bacteriophage (coli phages) from sewage.
15. Enumeration of bacteriophage by plaque forming unit method.
16. Determination of one step growth curve of bacteriophage.
17. Isolation cultivation and morphological studies of fungi.
18. Isolation cultivation and morphological studies of Actinomycetes.

MLABCMB105: LAB COURSE II

Practical Exercises

Lab course II (Cell biology and Biochemistry & Bioinstrumentation)

1. To detect the presence of carbohydrate in the given sample by Molish test
2. To detect the presence of reducing sugar in the given sample by Fehling's test
3. To detect the presence of pentose sugar in the given sample by Bial's test
4. To determine the presence of monosaccharide using Anthrone test
5. To detect presence of reducing sugar using Benedict's test.
6. To determine the presence of monosaccharide using Barfoed's reagent
7. To determine the presence of starch in given sample by using iodine solution (starch-iodine test).
8. To determine the presence of ketose sugar by Seliwanoff's reagent in given sample.
9. To determine the presence of protein by Biuret method.
10. To determine the presence of protein by Xanthoprotic test.
11. Quantification of protein contents in given sample by Folin's- Lowry method.
12. To determine Saponification value of given fat sample.
13. Determination of pKa value.
14. To study different stages of mitosis in onion root tip preparations.
15. Verification of Beer-Lambert Law.
16. Determination of absorption maxima of given sample using spectrophotometer.
17. Calibration of an ocular micrometer for different objectives of microscope.
18. Measurement of microorganisms by the use of an ocular micrometer.
19. Separation of given amino acids by paper chromatography.
20. Separation of amino acids by Thin Layer Chromatography.
21. To study microorganisms under dark-field microscope.
22. Separation of sub cellular organelles by differential centrifugation.

MMICRMB107: MICROBIAL GENETICS AND MOLECULAR BIOLOGY

UNIT-I

1. Organization of genetic material in prokaryotes and eukaryotes.
2. Concept of gene, genome, genome size, C-value, and C-value paradox.
3. Nucleic acid as a genetic information carriers; experimental evidence.
4. Gene is a unit of mutation and recombination; molecular basis of mutations, physical and chemical mutagens, spontaneous and induced mutation, selection of mutant.

UNIT-II

1. Structure of DNA, super helicity of DNA, linking number, topological properties and role of topoisomerase. DNA denaturation and renaturation.
2. DNA damage and repair: types of DNA damage (deamination, oxidative damage, alkylation and pyrimidine dimers), repair mechanism; mismatch repair, nucleotide excision repair, recombination repair, SOS repair.
3. DNA replication: general principle, various mode of replication, unwinding of DNA helix, continuous and discontinuous synthesis of leading and lagging strands.
4. Enzymes of DNA replication in prokaryotes and eukaryotes; DNA polymerases, DNA ligase, primase.

UNIT-III

1. Structural features of RNA (rRNA, tRNA, mRNA) and polycistronic and monocistronic RNA.
2. Transcription: general principle and processes of transcription; initiation, elongation and termination, types of RNA polymerases, inhibitors of RNA synthesis.
3. Control of Transcription by interaction between RNA polymerases and promoter region, use of alternate sigma factors, controlled termination; Rho dependent and Rho independent.
4. Post transcriptional modification, maturation and splicing of RNA transcripts, catalytic RNA.

UNIT-IV

1. Genetic code: nature of genetic code, codon, anticodon, wobble hypothesis.
2. Protein synthesis: steps, details of initiation, elongation and termination.
3. Inhibitors of protein synthesis: signal hypothesis.
4. Post translational modification: covalent modification, phosphorylation, glycosylation, methylation. Protein targeting.

UNIT-V

- 1 Regulation of gene expression: operon concept; regulatory and structural gene, operator, promoter, repressor, induction and repression, positive and negative control.
- 2 Lac-operon, ara-BAD operon, trp operon, attenuation, mechanism of regulation of transcription.
- 3 Regulation of gene expression in eukaryotes: Britton and Davidson's model of regulation involve HCP and NHCP and hormones.
- 4 Transposable elements.

Reference Books

1. Genes V by Benjamin Lewin, Oxford University Press, New York.
2. Gene IX, Benjamin Lewin Oxford University Press, New York.
3. Principles of Genetics, Snustad and Simmons, Fourth Edition, John Wiley and Sons, Inc.
4. Molecular Cell Biology, Lodish *et al.*, W. H. Freeman and Company.
5. Genomes by T.A. Brown, John Wiley and sons (Asia)PTE LTD, New York.
6. Principles of Gene Manipulation and Genomics by S.B. Primrose and R. M. Twyman, Seventh edition, Blackwell Publishing, U.K.
7. Cell and Molecular Biology concepts and experiments By Gerald Karp, Third edition, John Wiley and sons, Inc., U.S.A.
8. Chromatin and Gene regulation (2001) Turner Wiley-Blackwell
9. An Introduction to Genetic Analysis, Griffith *et al.*, W. H. Freeman

MIMMUMB108:IMMUNOLOGY

UNIT-I

1. **History of immunology, development of immunology** as discipline.
2. Immune response: mechanism of innate and adaptive immune response.
3. Hematopoiesis: development of immune cells, regulation of hematopoiesis.
4. Structure, composition and types of cells involved in immune response: mononuclear cells, granulocytes, antigen presenting cells, lymphoid cells. Mediators and process of Inflammation.

UNIT-II

1. Anatomical organization of immune system: primary and secondary lymphoid organs: structure and function.
2. Antigens- structure and properties, factors affecting the immunogenicity, properties of B and T- cell epitopes, haptens, mitogens, super antigen, adjuvants.
3. Antibody: structure, properties, types and function of antibodies, antigenic determinants on immunoglobulin; isotypes, allotypes, and idiotypes, molecular mechanism of antibody diversity and class switching.
4. Cell mediated immunity and its mechanism.

UNIT-III

1. Major histocompatibility complex: organization of MHC genes, types and function of MHC molecules, antigen presentation, MHC polymorphism, MHC related diseases.
2. Complement system: components, activation pathways, regulation of activation pathways and role of complement system in immune response.
3. Cytokines: types, structure and functions, cytokines receptors, cytokine regulation of immune receptors.
4. Immune response to infectious diseases: viral infection, bacterial infection, protozoan diseases, helminthes related diseases.

UNIT-IV

1. Hypersensitivity: type I, II, III and types IV hypersensitivity. Immunodeficiency diseases: primary and secondary immunodeficiency.
2. Autoimmunity: organ specific autoimmune diseases, mechanism of autoimmune diseases and therapeutic approaches.
3. Transplantation immunology: immunologic basis of graft rejection, clinical manifestation of graft rejection and clinical transplantation.
4. Cancer immunology: tumor antigen, immune response to tumor, oncogene and induction, cancer immunotherapy.

UNIT-V

1. Vaccines: Active and passive immunization, vaccine schedule, whole organism vaccine, subunit vaccine, vaccine, DNA vaccine, recombinant vaccine, subunit vaccines and anti-idiotypic vaccine.
2. Hybridoma technology: murine monoclonal antibody production, principle of selection, characterization and applications in diagnosis, therapy and basic research.
3. Antibody engineering: Chimeric and Humanized monoclonal antibodies.
4. Antigen- antibody interaction: avidity and affinity measurements, detection of antigen- antibody interaction by precipitation, agglutination, RIA, and ELISA.

Reference Books

1. Kuby Immunology by Kindt TJ, Goldsby RA, Osborne BA, Kuby J: 6th edition. New York. WH Freeman; 2006.
2. Cellular and Molecular Immunology by Abbas AK, Lichtman AH, Pillai S: Saunders Elsevier; 2007.
3. Immunobiology: The immune system in health and disease by JanewayCA, TraversP, Walport M, Shlomchik MJ: 6th edition. New York. Garland Science Publishing; 2005.
4. Medical Microbiology and Immunology by Levinson W, Jawetz E: Lange publication; 2001.
5. Roitt's Essential Immunology by Delves PJ, Martin SJ, Burton DR, Roitt IM; 11th edition. Blackwell Publishing/Oxford Univ. Press; 2006.

MMICRMB109: MICROBIAL PHYSIOLOGY AND METABOLISM

UNIT-I

1. Bioenergetics and metabolism: Basic concepts.
2. First and second law of thermodynamics, concept of free energy, entropy and enthalpy.
3. High energy phosphate compounds, role of ATP, ATP cycle, structural basis of free energy change during hydrolysis of ATP.
4. Biological redox reactions, Biological reducing power and its role in biological system.

UNIT-II

1. Carbohydrate metabolism: glycolysis and its regulation, Feeder pathway of glycolysis and carbohydrate– homo and hetero lactic fermentation, Glycogenesis, Glycogenolysis and regulation, Gluconeogenesis.
2. Pentose phosphate pathway, E-D pathway, Kreb's cycle and glyoxalate pathway.
3. Electron transport system in Mitochondria, Electron carriers and multi enzyme complex I to IV.
4. ATP synthesis: substrate level and oxidative phosphorylation and un-couplers, inhibitors of oxidative phosphorylation.

UNIT-III

1. Photosynthesis: Oxygenic and an-oxygenic microorganisms, structure of chloroplast, light reaction, photolysis of water and photophosphorylation, C3 and C4 pathway of carbon fixation.
2. Nutritional classification of microorganisms, Energy generation in cyanobacteria, green bacteria, purple sulphur bacteria and chemolithotrops.
3. Lipid biosynthesis: Biosynthesis of lipids and fatty acids, triglycerol and phospholipids and their regulation
4. Lipid Metabolism: Degradation of Lipids, oxidation of unsaturated, saturated, even and odd chain fatty acids, ketone bodies.

UNIT-IV

1. Amino acid metabolism: Biosynthetic families of amino acids - Outlines
2. Catabolism of amino acids: Breakdown of amino acids into six common intermediates and urea cycle and relationship with TCA cycle. - Outlines
3. Nucleotide metabolism: Biosynthesis of purines and pyrimidine nucleotides by de novo and salvage pathways.
4. Degradation of Purines and Pyrimidine nucleotides.

UNIT-V

1. Nitrification, denitrification, Nitrate and ammonia assimilation pathways, Nitrogen cycle.
2. Diazotrophs and Biochemistry of nitrogen fixation, Structure of nitrogenase complex.
3. Regulation of nitrogenase complex by oxygen and combined nitrogen sources.
4. Nif genes and their regulation.

Reference Books

1. Biochemistry by Geoffrey L. Zubay. Fourth Edition, Addison-Wesley educational publishers Inc., 2008
2. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox. Fifth Edition, W.H. Freeman and Company; 2008.
3. Microbial lipids edited by C. Ratledge and SG Wilkinson, second edition, Academic Press; 1988.
4. Microbial Physiology by Albert G. Moat and John W. Foster. Third edition, John Wiley and Sons; 2002
5. The Physiology and Biochemistry of Prokaryotes by David White. Second Edition, Oxford University Press; 2000.

**MBIOSMB110:
BIOSTATISTICS, COMPUTER APPLICATION & BIOINFORMATICS**

UNIT-I

1. Definition of statistics and scope of statistics in bio research.
2. Types of sampling methods, survey design, organization and graphical representation of data.
3. Measures of central tendency
4. Measure of dispersion, correlation, calculation of Karl Pearson's coefficient of correlation, theory of multiple correction and property.

UNIT-II

1. Regression Analysis, linear regression, regression equation
2. Hypothesis testing: Types of hypothesis testing: t-test, 2 -test, and F- test.
3. Introduction of Design of Experiment (DOC) and factorial design.
4. Application of SPSS software.

UNIT-III

1. History & development of computer organization of a basic compute. computer application in molecular biology.
2. Number system, computer arithmetic & Boolean algebra.
3. Type of operating systems, DOS, WINDOWS & LINUX. Introduction to MS Office.
4. Basic concept of programming; algorithm, flow charts & introduction to computer languages, basic idea of internet. Use of various software in microbiology.

UNIT-IV

1. Bioinformatics: An overview, introduction and scope of bioinformatics.
2. Databases: Characteristics, categories and types. Literature database (PubMed, LITDB), Disease database (OMIM, Gene Cards, Med line Plus). Information retrieval system (Entrez, SRS).
3. Sequence Database: EMBL, DDBJ, GenBank, UniGen, PIR, SWISS-PROT and TrEMBL. Structure Database: PDB, CATH, DALI, SCOP.
4. Data mining tools: Modelling tools (Rasmol, SPDV, HyperChem), Data submission tools (Bankit, Sequin, Webin, Sukura, Spin, AutoDep).

UNIT-V

1. Algorithms: Classification of algorithms. Sequence Comparison algorithms (Dot matrix). Submission metrics algorithms (PAM, BLOSUM), Tools for sequence alignment (FASTA, BLAST, ORF finding).
2. Gene Prediction: Methods, Gene mapping: DNA sequencing, Sequence alignment optimal algorithms (Smith- Waterman algorithm, Needleman – Wunsch algorithm). Tools for Genome analysis (COGs, Map Viewer, GEO).
3. Phylogenetic analysis: Phylogenetic trees. Methods of phylogenetic evaluation. Prediction tools (Phylip, GenScan, Pfam, Modeler)
4. Proteomics: Proteome analysis, Tools for Protein sequence analysis and proteomics (PSI- BLAST, CD search, CDART), structure analysis (Cn3D, CD search).

References Books

1. Sampling Techniques, Cochran W.G., Wiley eastern Ltd, New Delhi.
2. Fundamentals of statistics, Goon, Gupta and Dasgupta, World Press, Kolkata.
3. Statistical methods, Gupta S.P., Sultanchand& Sons.
4. Fundamentals of Biostatistics; Irfan Ali Khan and AtiyaKhanum, 2nd Edition. Ukaaz Publications, Hyderabad.
5. Bioinformatics: Databases, Tools and Algorithms, by OrpitaBosu, SimminderKaurThukral, OXFORD University Press.
6. Bioinformatics: Sequence and Genome Analysis by D.W. Mount , second edition, Cold Spring Harbor Laboratory Press
7. Bioinformatics : Methods and Application by S.C. Rastogi, N. Mendira, P. Rastogi, Third edition , PHI Learning Private Limited
8. Introduction to Bioinformatics by Teresa. K. Attwood and David J. Parry- Smith, Low Price edition, Pearson Education

MLABCMB111: LAB COURSE III

Practical Exercises

LAB COURSE-III (MICROBIAL GENETICS AND MOLECULAR BIOLOGY & IMMUNOLOGY)

1. To induce mutation by UV radiations and to exhibit DNA repair by photo reactivation.
2. To isolate and produce UV induced auxotrophic mutants by replica plating method.
3. Demonstration of genetic recombination in bacteria by conjugation.
4. To perform Ames test for detecting carcinogen or mutagen.
5. Quantification of DNA by DPA method.
6. Quantification of RNA by Orsinol method
7. To check purity and quantity of DNA by Spectrophometric method.
8. To isolate genomic DNA from Gram positive and Gram Negative bacteria.
9. To isolate total RNA and mRNA from bacteria
10. To perform SDS-PAGE for separation of proteins in given sample.
11. To prepare soluble antigen by different methods.
12. To demonstrate various routes of immunization in mice.
13. To prepare serum and plasma from blood.
14. To precipitate immunoglobulins by ammonium sulphate and to determine total protein contents.
15. To determine Blood group and Rh factor by slide agglutination test
16. To determine Total Leukocyte Count (TLC) for given blood sample
17. To determine Differential Leukocyte Count (DLC) for given blood sample using Leishman stain.
18. To perform Widalagglutination test (slide and tube) for diagnosis of typhoid.
19. To perform Ouchterlony double diffusion test for detection of antigen and antibody reaction and to demonstrate relationship between antigens.
20. To perform Radial immuno-diffusion test for detection of antigen and antibody reaction and for quantification of antigens.
21. To perform immune-electrophoresis for separation of antigens and for detection of antigen and antibody reaction
22. To perform Rocket immuno-electrophoresis for detection of antigen and antibody reaction
23. To perform ELISA for assay of antibodies in serum sample against given antigen.

MLABCMB112:LAB COURSE IV

Practical Exercises

Lab course - IV (Microbial Physiology and Metabolism & Biostatistics, Computer Application and Bioinformatics)

1. To study catalase activity of given microbial culture.
2. To study oxidase activity of given microbial culture.
3. To study ability of microorganisms to hydrolyse casein
4. To demonstrate phenylalanine deaminase activity of given bacterial culture.
5. To demonstrate L-lysine decarboxylase activity of bacterial culture.
6. To demonstrate carbohydrate metabolism (oxidation and fermentation of Glucose) in microorganisms
7. To demonstrate Fat hydrolysis (lipase activity) by bacteria
8. To study ability of microorganisms to hydrolyze gelatin
9. To demonstrate degradation of sulphur containing amino acids by bacteria
10. Representation of statistical data by
 1. Histogram
 2. O give curves
 3. Pie diagrams
11. Collection of data using different sampling methods
12. Determination of Averages or Central tendencies (Mean, Mode, Median)
13. Determination of measures of dispersion (Mean deviation, Standard deviation and Coefficient of variation, Quartile deviation)
14. Application of Tests of significance (Chi-Square test, student t-test, Standard error)
15. Applications of computers in biology using MS-office (MS-Word, Excel, Power point)
16. To access scientific data from Literature data bases (PUBMED, LITDB, Medline)
17. To access nucleic acid databases for retrieval of gene sequence.
18. To access protein databases for retrieval of amino acid sequence of target protein.
19. To perform pair wise sequence alignment using Dot matrix.
20. To perform multiple sequence alignment using BLAST.
21. To perform multiple sequence alignment using CLUSTAL-W and to find conserved sequences using JAL view.
22. To prepare Phylogenetic tree and Cladogram using CLUSTAL-W
23. 3D protein structure prediction and structure refinement using Swiss-PDB viewer

MMEDIMB201: MEDICAL AND PHARMACEUTICAL MICROBIOLOGY

UNIT-I

1. Infection: types of infection, sources of infection, reservoirs and vehicles of infection, predisposing factors.
2. Host-parasite relationship governing the infection and establishment of disease, factors affecting virulence.
3. Normal microflora of human body: normal flora of skin, respiratory, gastrointestinal, genital tract, role of resident flora, concept of probiotics.
4. Mode of spread of infection; Respiratory, skin, wound & burn infection, venereal infections, alimentary tract infection, blood born infection and nosocomial infection.

UNIT-II

1. Infections caused by Gram positive cocci and Gram negative cocci: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *Staphylococcus*, *Streptococcus* and *Neisseria* (meningitis, gonorrhoea)
2. Infections caused by Gram negative bacteria of family Enterobacteriaceae: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *E. coli*, *Klebsiella*, *Proteus*, *Pseudomonas*, *Shigella dysenteriae* and *Salmonella typhi*.
3. Infection caused by Gram Positive bacilli: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *Corynebacterium diphtheriae*, *Bacillus anthracis*, *Clostridium tetani*, *Vibrio cholerae*.
4. Disease caused by acid-fast bacteria and intracellular bacteria: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *Mycobacterium tuberculosis*, *Mycobacterium leprae*, *Rickettsia* and *Chlamydia*.

UNIT-III

Morphology, pathogenesis, immune response, diagnosis and prevention of

1. Pox viruses (Variola, Vaccinia, Small pox) Herpes Simplex type I and type II, Picorna viruses (Enteroviruses and Polio viruses).
2. Paramyxoviruses (Rubella virus and Parainfluenza viruses), Orthomyxoviruses (Measles & Mumps viruses).
3. Hepatitis viruses (Type A, B, C, D, E), Arboviruses (Alpha virus and Flaviviruses), Rhabdoviruses (Rabies virus).
4. Oncogenic viruses, HIV virus.

UNIT-IV

1. Important protozoal diseases: Route of entry, Life Cycles, Immunity, disease produced, diagnosis & prophylaxis of *Plasmodium vivax*, *P. falciparum*, *P. malariae* (Malaria), *Entamoebahistolytica* & *Entamoeba coli* (amoebiasis),
2. Route of entry, Life Cycles, Immunity, disease produced, diagnosis & prophylaxis of *Leishmania*, *Trypanosoma* and *Toxoplasma*.
3. Fungal infections: description & classification of pathogenic fungi, Infection caused by dermatophytes (Microsporum, Trichophyton & Epidermatophyton)
4. Definition, Causative agent, Source of infection, Epidemiology, Symptomatology & Diagnosis of Candidiasis, Aspergillosis and Histoplasmosis.

UNIT-V

1. Antimicrobial agents: History, Antibiotics, Antifungal and Antivirals (common drugs, their spectrum and mode of action)
2. Methodologies for testing of antibacterial, antifungal, and antiviral drugs (*in vivo* and *in vitro* infectivity models), mechanism drug resistance.
3. Preclinical development: Safety profile of drugs (Pyrogenicity, Toxicity –hepato, - nephro, -cardio and neurotoxicity), Toxicological evaluation of drug (LD50, Acute, subacute and chronic toxicity), Mutagenicity (Ames test, micronucleus test) and Carcinogenicity.
4. Clinical studies: Phase I, phase II, phase III and phase IV of clinical trials –Objectives, Conduct of trials, Outcome of trials.

Reference Books

1. Textbook of Microbiology by Ananthnarayanan and Paniker's, eighth edition, Universities Press.
2. Brock Biology of Microorganisms, M.T, Madigan, J.M. Martinko and J. Parker, Ninth edition, Prentice Hall, Upper Saddle River, NJ.
3. Microbiology: An introduction, G.J. Tortora, B.R. Funke and C.L. Funke.
4. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA
5. An Introduction to viruses, S. B. Biswas and Amita Biswas. Forth edition, Vikas Publishing House PVT LTD New Delhi.
6. Medical Microbiology; Jawetz, Melnick, & Adelberg's, Fifth edition, MacGrow Hills
7. Medical Bacteriology, Medical Mycology and AIDS; N.C.Dey, T.K. Dey and D. Sinha, New Central Book Agency (P) Ltd.
8. Principles of Therapeutics, Burn J. H., Blackwell Scientific Pub. O. Ltd. Oxford.
9. Principles of Drug Action, The Basis of Pharmacology, Goldstein A., Aronow L., and Kalman S. M., Harper international edition New York.
10. Manfred A. Holliger, (2008), *Introduction to pharmacology*, 3rd Ed., CRC Press

MFERMMB202: FERMENTATION AND MICROBIAL TECHNOLOGY

UNIT-I

1. Industrially important strains of bacteria, fungi, and actinomycetes. Novel microbes for future industry.
2. Isolation and screening of the industrially important strain from diverse ecosystem.
3. Method of strain improvement, mutagenesis, strain breeding by protoplast fusion, sexual and para sexual recombination.
4. Fermentation technology: principles of fermentation. Fermenter and bioreactors: monitoring and control of parameters, designing, operation and application.

UNIT-II

1. Downstream processing: filtration of fermentation broths recovery of biological products by distillation, superficial fluid extraction.
2. Detection, analysis and quality control of fermentation products and raw materials.
3. Industrial production of alcohols: vinegar, wine and alcohol.
4. Industrial production of solvents-glycerol, acetone, and butanol.

UNIT-III

1. Industrial production of citric acid and glutamic acid.
2. Microbial production of enzyme of industrial important: amylase and proteases.
3. Methods of whole cell immobilization, enzyme immobilization and application.
4. Industrial production of antibiotics, penicillin and streptomycin.

UNIT-IV

1. Hygiene and safety in fermentation industries.
2. Microbial production of Vitamin B2 and B12.
3. Microbial production of Interferon, Insulin, flavours and fragrances.
4. Bioelectronics: Biochips and biosensors.

UNIT-V

1. Microbial production of vaccines.
2. Microbial production of polymers : Dextran and xanthan.
3. Microbial transformations: Steroid biotransformation
4. Intellectual property rights (IPR) and protection (IPP)

Reference Books:

1. Principles of Fermentation Technology by Stanbury, P.F., Whitaker A. and Hall. 1995. Butterworth Heinemann
2. Biotechnology - A Text Book of Industrial Microbiology by Cruger.
3. Fermentation Biotechnology: Industrial Perspectives by Chand.
4. Biochemical Engineering Fundamentals by Bailey and Ollis, Tata McGraw Hill, N.Y.
5. Biotechnology. Volume 3. Edited by H. J. Rehm and G. Reed. VerlagChemie. 1983.

MRECOMB203: RECOMBINANT DNA TECHNOLOGY

UNIT-I

1. Enzymes used in DNA technology: Restriction and modification enzymes, nucleases, polymerases, ligase, kinases and phosphatases. Linkers and adapters.
2. Cloning vectors: Plasmids, Phages (Lamda and M13) Phagmids, Cosmids and Expression vectors.
3. Cloning vectors for Yeast (shuttle vector and YAC) and cloning vector for animal cells: SV 40, Vaccinia and Retroviruses.
4. Cloning techniques: DNA isolation (Bacteria, Fungi, Plant and animal), Insert preparation, Ligation, Transformation methods (chemical methods, Electroporation and microinjection), Transfection.

UNIT-II

1. Genomic and cDNA library.
2. Screening of clones from libraries: Expression based screening, Interaction based screening.
3. Gene Expression: Expression vectors, factors affecting expression of cloned gene in *E. coli*.
4. Mutagenesis: Site directed mutagenesis, Transposon mutagenesis.

UNIT-III

1. DNA Sequencing: Sangers method, Maxmam Gilbert method, Thermocycle sequencing and Pyrosequencing
2. Principles of hybridization and hybridization based techniques: Colony, plaque, *in-situ* Hybridization, Southern, Northern, Western blotting.
3. Oligonucleotide synthesis, Restriction mapping, S1 nuclease and RNase mapping.
4. Polymerase Chain Reaction (PCR): Principle, Types and variants of PCR (Touch-Down PCR, Hot start PCR, Inverse PCR, RT-PCR, multiplex PCR, nested PCR), Real time PCR.

UNIT IV

1. Molecular typing: RFLP (Ribotyping, IS based), RAPD, AFLP, VNTR, SNP, Whole genome sequence: GIS
2. Promoter characterization: promoter analysis through reporter genes, electrophoretic mobility, shift assay, DNA foot-printing & DNA fingerprinting.
3. Transgenic animals: Strategies and methods.
4. Construction of knockout mutants.

UNIT-V

1. Applications of Recombinant DNA Technology in Medicine, Molecular diagnostics, recombinant and DNA vaccines.
2. Gene therapy: somatic and germ line gene therapy.
3. Applications of Recombinant DNA Technology in Agriculture and Industry.
4. Biosafety & ethical considerations for GMOs.

Reference Books

1. Molecular Biotechnology. Glick BR, Pasternak JJ. ASM Press Washington D.C.
2. Principles of Gene Manipulation. Old and Primrose. Blackwell Scientific Publication.
3. Gene Cloning. T. A. Brown, Blackwell Publishing.
4. Molecular cloning- A laboratory manual, Sambrook, Fritsch and Miniatis, Cold Spring Harber Laboratory Press.
5. Molecular Biotechnology 2nd Edition by S.B. Primrose. Blackwell Scientific Publishers, Oxford.
6. Genetic Engineering and Introduction to Gene Analysis and Exploitation in Eukaryotes by S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford.
7. PCR Technology - Principles and Applications for DNA Amplification by Henry A. Erlich (Ed.), Stockton Press.
8. Genes and Genomes: A Changing Perspective; Maxine Singer and Paul Berg. University Science Books, Mill Valley, CA, 1991

MENVIMB204: ENVIRONMENTAL MICROBIOLOGY

UNIT-I

1. Microbial ecology: basic concepts, types and microbial habitats, factors affecting microbial population.
2. Microbial interactions: competition, commensalism, parasitism, mutualism, commensalisms, synergism.
3. Population ecology: characteristics of population, population growth curves (r and k selection) population regulation.
4. Conservation and management of microbial diversity: biodeterioration and biodegradation.

UNIT-II

1. Microbiology of air: microorganism of air, enumeration of air micro flora.
2. Significance of air micro flora.
3. Brief account of air borne transmission of bacteria, fungi, pollens and viruses.
4. Air borne diseases and their prevention.

UNIT-III

1. Soil microbiology: microflora of soil: soil microorganisms associated with plants: rhizosphere, mycorrhizae.
2. Role of microorganisms in organic matter decomposition (cellulose, hemi cellulose, lignin).
3. Bioleaching; introduction, application of bacterial leaching techniques, properties of bioleaching.
4. Microbial degradation of xenobiotics, petroleum and oil spills in environmental decay behaviours and degradative plasmid.

UNIT-IV

1. Water microbiology: aquatic microorganisms; fresh water and sea water microflora. Microorganisms and water quality, water pollution.
2. Water purity test and indicator organisms, method used in environmental studies –BOD, COD, DO.
3. Common water born disease and their control measure.
4. Water purification: flocculation, chlorination and purification.

UNIT-V

1. Microbiology of waste water and effluent treatments, aerobic process: primary, secondary and tertiary treatment: trickle filter, oxidation ponds and stabilization ponds, principle of aerobic digestion.
2. Bioremediation of contaminations.
3. Extremophiles –acidophilic, alkalophilic, thermophilic microbes with adaptation and application in ecosystem.
4. Microbial biofilms: physiology, morphology, biochemistry of microbial biofilms, mechanism of microbial adherence, beneficial and harmful role of biofilms.

Reference Books

1. Microbial Ecology: Fundamentals and applications, Ronald M. Atlas, fourth edition, An imprint of Addison Wesley Longman. Inc, California
2. Environmental chemistry, A.K. De, Wiley Eastern Ltd., New Delhi
3. Environmental Science, Physical Principles and applications; Egbert Boeker *et. al.*
4. Comprehensive Biotechnology, vol.4, M. Moo-Young (Ed-in-chief), Pergamon Press, Oxford.
5. Wastewater Treatment for Pollution Control By Soli J Arceivala, Second Edition, Tata McGraw- Hill Publishing Company Limited.
6. Environmental Biotechnology Theory and Application by Gareth M. Evans and Judith C. Furlong, John Wiley and Sons, LTD, U.S.A.
7. Ecology and Environment by P.D. Sharma, Rastogi Publications, New Delhi, India
8. Environmental Sciences earth as a living planet by Daniel K. Botkin and Edward A. Keller, Third edition, John Wiley and Sons, LTD, U.S.A.

MLABCMB205: Lab course V(MEDICAL AND PHARMACEUTICAL MICROBIOLOGY & FERMENTATION AND MICROBIAL TECHNOLOGY)

1. To prepare various basic, selective, enrichment and enriched media used for isolation of medically important bacteria from clinical samples.
2. To perform various biochemical tests (IMVIC, oxidase, catalase, urea utilization test, sugar utilization and H₂S production on TSI agar slant) used for identification of medically important bacteria.
3. To perform sugar fermentation tests used for identification of medically important bacteria.
4. Preparation of transport media for different clinical samples.
5. Demonstration normal microbial flora of skin, mouth and throat
6. Isolation and identification of *Staphylococcal* species using suitable media, staining techniques and biochemical tests.
7. Isolation and identification of *Staphylococcal* species using suitable media, staining techniques and biochemical tests.
8. Identification of bacterial species belonging to Enterobacteriaceae family using suitable biochemical tests (*E. coli*, *Proteus*, *Pseudomonas*, , *Klebsiella*)
9. Isolation and identification of enteric fever causing bacteria (*Salmonella typhi*) using suitable media and biochemical tests.
10. Isolation and identification of *Bacillus* species using suitable media, staining techniques and biochemical tests.
11. Microbiological analysis of urine specimens.
12. Microbiological analysis of sputum specimens
13. Isolation of dermatophytes and their identification based on colony morphology and microscopic characteristics.
14. To determine antibiotic sensitivity for Gram negative and Gram positive bacteria by disc diffusion method
15. To determine Minimal Inhibitory Concentration (MIC) and Minimal Bactericidal concentration of an antibiotic for test bacteria.
16. To study antibiotic resistance in bacteria
17. Determination of thermal death point (TDP) of an Organism
18. Determination of thermal death time (TDT) of an Organism
19. Isolation of amylase producing microorganisms from Soil
20. Isolation of cellulase and pectinase producing microorganisms from vegetable and fruit waste.
21. Isolation of lipase producing microorganisms from butter.
22. To isolate antibiotic producing microorganisms form soil
23. To isolate *Penicillium* species producing penicillin.
8. Production of penicillin and to evaluate it activity.
24. To demonstrate handling and sterilization of Fermenter.
25. Production of wine from grapes.
26. To demonstrate strain improvement of industrially important bacteria or yeast by mutagenesis and selection of improved strains.

MLABCMB206: Lab course VI (RECOMBINANT DNA TECHNOLOGY & ENVIRONMENTAL MICROBIOLOGY)

1. Preparation of LB broth, LB Agar with antibiotic for culture and maintenance of Host *E. coli* and *E.coli* with plasmid vector.
2. Isolation of plasmid DNA (or plasmid vector DNA).
3. Restriction digestion of given DNA with suitable restriction enzymes.
4. Ligation of insert (gene) and vector DNA.
5. Preparation of competent cells.
6. Transformation of host *E. coli* with recombinant DNA and selection of recombinants.
7. To perform PCR for amplification of target DNA segment (or gene).
8. Determination of Total Dissolve Solids (TDS) of given water sample.
9. Determination of chemical oxygen demand (COD) of given water sample.
10. Determination of Dissolved oxygen (DO) of given water sample.
11. Determination of BOD of given water sample.
12. Determination of total bacterial population by standard plate count technique.
13. Determination of the most probable number (MPN) of coliform bacteria in water
14. Microbiological analysis of water by membrane filter method.
15. Microbiological analysis of air for presence of pathogenic microorganisms in air.
16. Microbiological analysis of water for presence of pathogenic microorganisms.

MFOODMB207: FOOD MICROBIOLOGY

UNIT I

1. Microorganisms important in food microbiology: molds, yeast and bacteria –general characteristics, classification and importance.
2. Principles of food preservation, preservation by use of high temperature, low temperature, drying and desiccation.
3. Chemical preservatives and additives.
4. Preservation by radiation.

UNIT II

1. Factors influencing microbial growth in food: Extrinsic and intrinsic factors.
2. Microbial spoilage of food. Chemical changes caused by the microorganisms during spoilage.
3. Spoilage of fish, meat, poultry, eggs, fruits and vegetables.
4. Detection of spoilage and characterization.

UNIT III

1. Classification of food borne diseases.
2. Food borne infections: *Brucella*, *Bacillus cereus*, *Clostridium perfringens*, *Yersinia enterocolitica* and *Escherichia*, *Salmonella* spp.
3. Food intoxication: Staphylococcal intoxication, Clostridial poisoning (*Clostridium Botulinum*).
4. Food adulteration and prevailing food standards in India.

UNIT IV

1. Microbiology of Milk: Sources of microorganisms in milk and types of microorganisms in milk.
2. Microbiological examination of milk (standard plate count, direct microscopic count, reductase, and phosphatase test).
3. Dehydration and pasteurization of milk.
4. Dairy products from microorganisms: Butter, yoghurt and cheese.

UNIT V

1. Microorganisms as source of food: Single Cell Protein (SCP)
2. Mushrooms and food value of mushrooms
3. Food conversions: Lactic acid conversions, soyabean conversions and Bakery
4. Microbiological estimation of food: Sample collection, preparation and analysis techniques

Reference Books:

1. Food science By Norman N. Potler, Joseph H. Hotchkiss. Fourth edition, CBS Publishers and Distributors, New Delhi
2. Food Microbiology , by William C. Frazier and Dennis C. Westhoff, Fourth edition, Tata McGraw-Hill Publishing Company Limited, New Delhi
3. Modern Food Microbiology by James M. Jay, Fourth Edition, CBS Publishers and Distributors, New Delhi.

MLABCMB207: Lab course
FOOD MICROBIOLOGY

1. Detection of adulterants in spices, pulses, sugar, tea.
2. Detection of adulterants in milk and milk products.
3. Detection of arsenic by microbiological methods.
4. Detection of nicotinic acid by bioassay.
5. Detection of number of bacteria in milk by SPC.
6. Determination of quality of milk sample by methylene blue reductase test.
7. To demonstrate role of yeast in bread-making.
8. Isolation of microorganisms from spoiled food.
9. Isolation of pathogenic microorganisms from food.

MMICRMB208: MICROBIAL BIOCHEMISTRY

UNIT I

1. Classification of Microorganisms: Basis of microbial classification, Haekel three kingdom, Whittaker's five kingdom concept.
2. Morphology and fine structure of eubacteria and archeobacteria cell wall, cytoplasmic membrane and other organelles.
3. Pure culture techniques and preservation methods.
4. Preparation of Culture media, microbial staining.

UNIT II

1. Microbial Growth: Bacterial growth curve, Mathematical expression, measurement of Growth and factors affecting growth
2. Microbial Nutrition: Nutritional classification of Microorganisms, common nutritional requirements, mode of nutrition, transport of nutrients across the bacterial membrane
3. Oxygen toxicity: Study of catalase, peroxidase, superoxide dismutase, mechanism of oxygen toxicity.
4. Sterilization: Physical and chemical methods

UNIT III

1. Structure and morphology of Bacteriophage, Lytic and lysogenic cycle.
2. Life cycle of DNA Viruses: SV 40, RNA Viruses: Retroviruses
3. Cynobacteria : General account and their importance
4. Virus: Types, Isolation, cultivation, identification and viral replication.

UNIT IV

1. Infection and disease, types of Infection, Mechanism of pathogenicity
2. Bacterial Diseases: Staphylococcal and Clostridial food poisoning, Salmonellosis Shigellosis
3. Fungal diseases: Histoplasmosis , Aspergillosis
4. Viral diseases: Chicken pox, Hepatitis B, and Poliomyelitis

UNIT V

1. Mycoplasmas and diseases caused by them
2. Bacterial Recombination: Transformation, Conjugation, Transduction, Plasmids and transposons
3. Chemotherapeutic agents: Classification of antibiotics, Broad spectrum antibiotics, Antibiotics from prokaryotes
4. Anti-fungal and antiviral antibiotics, mode of action of antibiotics and resistance to antibiotics

Practical Exercises

1. Preparation of liquid and solid media for growth of microorganisms.
2. Isolation and maintenance of organisms by plating, streaking and serial dilution methods. Slants and stab cultures. Storage of microorganisms. Isolation of pure cultures from soil and water.

4. Growth; Growth curve; Measurement of bacteria population by turbidometry and serial dilution methods. Effect of temperature, pH and carbon and nitrogen sources on growth.
5. Microscopic examination of bacteria, Yeast and molds and study of organisms by Gram stain, Acid fast stain and staining for spores.
6. Study of mutations by Ames test.
7. Assay of antibiotics and demonstration of antibiotic resistance.
8. Analysis of water for portability and determination of MPN.
9. Bacterial transformation.
10. Biochemical characterization of selected microbes.
11. One step growth curve of coliphage.

Reference Books

1. General Microbiology, R.Y. Ingraham, J.L. Wheelis, M.L. and Painter, P.R. The MacMillan Press Ltd.
2. Brock Biology of Microorganism, M.T. Martinko, J.M. and Parker, J. Prentice-Hall.
3. Microbiology, Pelzar, M.J., Chan , E.C.S. and Kreig, N.R., Tata McGraw Hill.
4. Microbial Genetics, Maloy , S.R., Cronan, J.E.Jr and Freifelder, D. Jones, Bartlett Publishers.
5. Microbiology-a Laboratory Manual,cappuccino, J.G. and Sherman, N. Addison Weseley.
6. Microbiological Applications, (A Laboratory Manual in General Microbiology) Benson, H.J. WCB: Wm C. Brown Publishers

MLABCBC209: LAB COURSE

MDISSMB210: DISSERTATION