(2)

Syllabus

For

M.Sc. Microbiology

(Four Semester Course)

Academic Session

July (2015-2017)

Jiwaji University, Gwalior

M.Sc. Microbiology, Choice Based Credit System

(Four Semester Course: Internal Assessment 40 and External Assessment 60)

Course Structure and Scheme of Examination-2015

SEMESTER I

Code	Course	C/E/S	L	P	Credit	Marks
MB 101	Basics in Microbiology and General Bacteriology	Core	3	0	3	100
MB 102	Virology and Mycology	Core	3	0	3	100
MB 103	Cell biology and Biochemistry	Core	3	0	3	100
MB 104	Bioinstrumentation	Core	3	0	3	100
MB 105	Practical Course Based on Theory Course 101 & 102	Core	0	3	3	100
MB 106	Practical Course Based on Theory Course 103 & 104	Core	0	3	3	100
MB -107	Assignment/Personality development	Core			1	50
MB -108	Seminar-I	Core			1	50
MB -109	Comprehensive viva-voce exam	Virtual credit			4	100

Total Credit Value: #20 + 4 (Virtual credit)

SEMESTER II

Code	Course	C/E/S	L	P	Credit	Marks
MB 201	Microbial genetics and Molecular Biology	Core	3	0	3	100
MB 202	Immunology	Core	3	0	3	100
MB 203	Microbial Physiology and Metabolism	Core	3	0	3	100
MB 204	Biostatistics, Computer application and Bioinformatics	Core	3	0	3	100
MB 205	Practical Course Based on Theory Course 201 & 202	Core	0	3	3	100
MB 206	Practical Course Based on Theory Course 203 & 204	Core	0	3	3	100
MB 207	Assignment/Personality development	Core			1	50
MB 208	Seminar-II	Core			1	50
MB 209	Comprehensive viva-voce exam	Virtual credit			4	100

Total Credit Value: #20 + 4 (Virtual credit)

SEMESTER III

Code	Course	C/E/S	L	P	Credit	Marks
MB 301	Medical and Pharmaceutical Microbiology	Core	3	0	3	100
MB 302	Fermentation and Microbial Technology	Core	3	0	3	100
MB 303	Major Elective I: Recombinant DNA Technology	Elective C	3	0	3	100
MB 304	Major Elective II: Environmental Microbiology	Elective G	3	0	3*	100
MB 305	Practical Course I	Core	0	3	3	100
MB 306	Practical Course II	Core	0	3	3	100
MB 307	Assignment/Personality development	Core			1	50
MB 308	Seminar-III	Core			1	50
MB 309	Comprehensive viva-voce exam	Virtual credit			4	100

Total Credit Value: #20 + 4 (Virtual credit)

SEMESTER IV

Code	Course	C/E/S	L	P	Credit	Marks
MB 401	Food Microbiology	Core	3	0	3	100
MB 402	Major Elective I: Agriculture Microbiology	Elective C/G	3	0	3*	100
MB 403	Practical Course I	Core	0	2	2	100
MB 404	Project/ Dissertation work	Core			12	400
MB 405	Comprehensive viva-voce exam	Virtual credit			4	100

Total Credit Value: #20 + 4 (Virtual credit)

*** 03 elective credits may be obtained from other departments/faculties/Institutes.**

- **Minimum credits be earned for the award of degree-**

96 Credit (Valid credits - 80 + Virtual Credits - 16)

- **Minimum credits for promotion to next semester - 12 valid credits/semester**
- **Two typed/ computerised bound copies of the dissertation shall be submitted to the University during the final M.Sc. at least fifteen days before the commencement of the final examination.**
- **Field work/ industrial training and group discussions accomplished with the bound copy of report are necessary for evaluation.**
- **Subjects offered may change from time to time depending on the availability of expertise.**

Note: *Lecture (L): 1Hr = 1 Credit, Tutorial (T): 2 Hr = 1 Credit and Practical (P)/ Field work: 2Hr = 1 Credit per week in a semester for 16 – 18 weeks of academic work.*

MB: 101 (Core) BASICS IN MICROBIOLOGY AND BACTERIOLOGY

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 archeobacteria. 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 archeobacteria, mesosomes,ribosomes, cytoplasmic inclusion bodies (polyhydroxy butyrate, polyphosphate granules, oil droplets, cynophycin 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, Mc Graw 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. Microbiololgy; 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 roduction by Tortora Funke case.

MB: 102 (Core) 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 pathgenicity of TMV.
2. Transmission of plant viruses with vector (insect, nematods 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, Ø x174 and lamda phage

UNIT-V

1. Structure, reproduction and classification of fungi, general characteristics of Zygomycetes, Ascomycetes, Basidiomycetes, and Duteromycetes.

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, Micorrhiza, and Actinomycetes.

4. Ecology of fungi: concept of fungistatis, 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, Mc Graw Hill Higher education.
5. Introductory Mycology, Alexopoulos, C.Jr : , Second edition, Wiley, New York.

MB: 103 (Core) 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,golgibody, 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 appoptosis.
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 isoenzymes, 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 Lubert Stryer, 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 Lubert Stryer, 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.

MB: 104 (Core) BIOINSTUMENTATION

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 micrometery.
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, Isotachophoresis and gradient gel eletrophoresis.
4. Two dimentional 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 isopycinic 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, Mc Graw 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.

MB: 105 (Core) Lab course I (Basics in Microbiology and 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 (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 plague 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

MB: 106 (Core) 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 Seliwanof'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

MB: 201 (Core) 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 diamers.), 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 polimerases, 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, represser , 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, Grifiths *et al.,* W. H. Freeman

MB: 202 (Core) 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 involve 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, superantigen, adjuvants.

3. Antibody: stucture, properties, types and function of antibodies, antigenic determinants on immunoglobulin; isotypes, allotypes, and idiotypes.

4. Molecular mechanism of antibody diversity and class switching.

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-idiotype vaccine.

2. Hybridoma technology: murine monoclonal antibody production, principle of selection, characterization and applications in diagnosis, therapy and basis 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 Janeway CA,Travers P,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.

MB: 203 (Core) MICROBIAL PHYSIOLOGIES 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 heterolactic fermentation, Glycogenesis, Glycogenolysis and regulation, Gluconeogenesis.

2 Pentose phosphate pathway, E-D pathway, Kreb's cycle and glyoxalate pathway.

3. Electron transport system in Mitrochondria, Electron cariers and multienzyme 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.

2. Catabolism of amino acids: Breakdown of aminoacids into six common intermediates and urea cycle and relationship with TCA cycle.

3. Nucleotide metabolism: Biosynthesis of purines and pyrimidines nucleotides by de novo and salvage pathways.

4. Degradation of Purines and Pyrimidines 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 UniversityPress; 2000.

MB: 204 (Core) 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 computer.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, GeneCards, MedlinePlus). Information retrival 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 submition 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 Atiya Khanum, 2nd Edition. Ukaaz Publications, Hydrabad.

5. Bioinformatics: Databases, Tools and Algorithms, by Orpita Bosu, Simminder Kaur Thukral, 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

205: LAB COURSE-I (Core) (MICROBIAL GENETICS AND MOLECULAR BIOLOGY & IMMUNOLOGY)

1. To induce mutation by UV raditions 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 Spectrophometeric 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 from 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 Widal agglutionation 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 Redial 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.

206: Lab course - II (Core) (Microbial Physiology and Biostatistics, Computer Application and Bioinformatics)

1. To study catalase activity of given microbial culture.

2. To study oxidase activity of given microbial culture. s

3. To study ability of microorganisms to hydrolyse casein

4. To demonstrate phenlalanine 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. Ogive 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

MB: 301 (Core) 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, gonorrhea)

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,Clostrodium 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 Polioviruses).

2. Paramyxo viruses (Rubulavirus and Parainfluenza viruses), Orthomyxoviruses (Measles & Mumps viruses).

3. Hepatitis viruses (Type A, B, C, D, E), Arboviruses (Alphavirus and Flaviviruses), Rhabdo viruses (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), *Entamoeba histolytica* & *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: Histroy, 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 (Pyrogenecity, Toxicity –hepato, - nephro, -cardio and neurotoxicity), Toxicological evaluation of drug (LD_{50}, Acute, subacute and chronic toxicity), Mutagenecity (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 Ajency (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. Mannfred A. Holliger, (2008), *Introduction to pharmacology*, 3rd Ed., CRC Press

MB: 302 (Core) FERMENTATION AND MICROBIAL TECHNOLGOY

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 row 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. Verlag Chemie. 1983.

MB: 303 (Elective C) RECOMBINANT DNA TECHNOLOGIES

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. Screening of clones from libraries: Expression based screening, Interaction based screening.

2. Gene Expression: Expression vectors, factors affecting expression of cloned gene in *E.coli.*

3. Mutagenesis: Site directed mutagenesis, Transposon mutagenesis.

4. Principles of hybridizations and hybridization based techniques: Colony, plaque, Southern, Northern, Western and southwestern blotting, *in situ* hybridizations.

UNIT-III

1. DNA Sequencing: Sangers method, Maxmam Gilbert method, Thermocycle sequencing and Pyrosequencing

2. Principles of hybridization and hybridization based techniques: Colony, plaque, Southern, Northern, *in-situ* Hybridization.

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

MB: 304 (Elective G) 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 leaching techniques, properties of bioleaching.

4. Microbial degradation of xenobiotics , petroleum and oil spilles 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, biochemisty of microbial biofilms, mechanism of microbial adherence, beneficial and harmful role of biofilms.

Reference Books

1. Microbial Ecology: Fundamentals and applications, Ronals M, Atlas, fourth edition, Animprint of Addison Wesley Longman. Inc, California
2. Environemental chemistry, A.K. De, Wiley Eastern Ltd., New Delhi
3. Environemtal Science, Physical Principles and applications; Egbert Boeker *et. al.*
4. Comprehensive Biotechnology. vol.4, M.moo-young (Ed-in-chief). Pergmon 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.

MB: 305 Lab course I (Core) (MEDICAL AND PHARMACEUTICAL MICROBIOLOGY and RECOMBINANT DNA TECHNOLOGIES)

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 (IMVC, 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 Enterobacteriaceace family using suitable biochemical tests (*E.coli, Proteus, Pseudomonas, , Klebsiella*)
9. Isolation and identification of enteric fever causing bacteria (*Salmoella 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 dermatophytes and their identification based on colony morphology and microscopic characterisctics.
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. Preparation of LB broth, LB Agar with antibiotic for culture and maintenance of Host *E.coli* and *E.coli* with plasmid vector
18. Isolation of plasmid DNA (or plasmid vector DNA)
19. Restriction digestion of given DNA with suitable restriction enzymes.
20. Ligation of insert (gene) and vector DNA
21. Preparation of competent cells
22. Transformation of host *E.coli* with recombinant DNA and selection of recombinants.
23. To perform PCR for amplification of target DNA segment (or gene)

MB: 306 Lab course II (Core) (FERMENTATION AND MICROBIAL TECHNOLGOY & ENVIRONMENTAL MICROBIOLOGY

1. Determination of thermal death point (TDP) of an Organism
2. Determination of thermal death time (TDT) of an Organism
3. Isolation of amylase producing microorganisms form Soil
4. Isolation of cellulase and pectinase producing microorganisms from vegetable and fruit waste.
5. Isolation of lipase producing microorganisms from butter.
6. To isolate antibiotic producing microorganisms form soil
7. To isolate *Penicillium* species producing penicillin.
8. Production of penicillin and to evaluate it activity
9. To demonstrate handling and sterilization of Fermentor
10. Production of wine from grapes
11. To demonstrate strain improvement of industrially important bacteria or yeast by mutagenesis and selection of improved strains.
12. Determination of Total Dissolve Solids (TDS) of given water sample
13. Determination of chemical oxygen demand (COD) of given water sample
14. Determination of Dissolved oxygen (DO) of given water sample
15. Determination of BOD of given water sample
16. Determination of total bacterial population by standard plate count technique
17. Determination of the most probable number (MPN) of coliform bacteria in water
18. Microbiological analysis of water by membrane filter method
19. Microbiological analysis of air for presence of pathogenic microorganisms in air
20. Microbiological analysis of water for presence of pathogenic microorganisms

MB: 401 (Core) 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 dessication.

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, Bacilllus 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.

MB: 402 (Elective C/G) AGRICULTURAL MICROBIOLOGY

UNIT I

1. Microorganisms of soil

2. Rhizosphere and phyllosphere microflora

3.Brief account of Microbial interactions: antagonism, symbiosis, mutualism, commensalisms, synergism and parasitism.

4. Nutrient cycle : Carbon cycle , nitrogen cycle, phosphorous cycle and sulphur cycle.

UNIT II

1. Role of enzymes and toxins in pathogenesis.

2. Fungal diseases of plants: Rusts of wheat, linseeds; late blight of potato; red rot of sugarcane.

3. Bacterial diseases of plats : Citrus canker, blight of rice

4. Viral diseases of plants : Leaf curl of Papaya, vein clearing of lady's finger

UNIT III

1. Physical and chemical control of plant diseases.

2. Bacterial control of insect pests : *Bacillus thuringiensis* as bacterial insecticide

3. Viral control of insect pests : Nuclear polyhedrosis visuses (NPV) and cytoplasmic polyhedrosis viruses (CPV)

4. Fungal control of insect pests : Entomopathogenic fungi : *Metarhinium anisopliae, Beauveria bassiana, Verticillium lecani, Hirsutella thompsoni*

UNIT IV

1. Storage fungi : Categories of storage fungi, conditions during storage in relation to damage of seeds, harmful effects

2. Mycotoxins and their effect on human being.

3. General idea about quarantine

4. Production of biogas and alcohol from agricultural wastes

UNIT V

1. Biofertilizers : Types, production and application

2. Mycorryzae : Types and their application in agriculture and forestry.

3. Vermicomposting

4. Reclamation of waste agricultural land by microorganisms

Reference Books

1. Soil Microbiology by Prof. N.S. Subba Rao, Fourth edition, Oxford and IBH Publishing CO. PVT., LTD., New Delhi

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

3. Modern Soil Microbiology, Dirk J, Elas V, Trevors JT, Wellington, EMH (1997) Marcel Dekker INC, New York.

MB: 403 Lab course (Core) (FOOD MICROBIOLOGYM AND AGRICULTURE MICROBIOLOGY)

1. Detection of adulterants in spicies, pulses, sugar, tea.
2. Detection of adulterants in milk and milk products
3. Detection of arsenic by microbiolgical 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 spoilage microorganisms from food
9. Isolation of pathogenic microorganisms from food
10. To study viral diseases in plants
11. To study bacterial and fungal diseases in plants
12. Isolation of rhizobia from root nodules of leguminous plants
13. Testing of nodulation ability of rhizobia.
14. Inoculation of seeds with rhizobia.
15. To study pesticidal activity of *Bacillus thuringiensis*.
16. Isolation of VAM spores from soil
17. Isolation of *Azotobacter* species from soil
18. Isolation of microorganisms from rhizosphere.

MB:403 (Core)	Lab course
MB:404 (Core)	Project work of 3-4 months duration