SHRI GOVIND GURU UNIVERSITY, GODHRA
THIRD YEAR B.Sc SYLLABUS WITH EFFECT FROM JUNE 2018
B.Sc SEMESTER-V MICROBIOLOGY

For each theory paper

Total lecture hours: 48 h **Credit : 4**
For each semester Practicals: 24 h **Credit : 2**

MB.301: Microbial Molecular Biology and Genetics

1 Microbial Genetics: Gene Structure, Replication, and Expression No. of Hours: 12

A. DNA as Genetic Material, The Flow of Genetic Information
B. Structure of DNA: A, B, Z., DNA Replication : Patterns of DNA synthesis, replication machinery, proof reading, termination of replication, replication of linear chromosome
C. Gene Structure : protein coding genes, tRNA and rRNA genes
D. Transcription in prokaryotes , how it differs from transcription in eucaryotes
E. The Genetic Code, Translation : initiation, elongation and termination, introduction to chaperones

2 Microbial Genetics: Regulation of Gene Expression No. of Hours: 12

A. Levels of Regulation of Gene Expression , The Discovery of Gene Regulation
B. Regulation of Transcription Initiation: induction and repression of enzyme synthesis, Lactose operon and tryptophan operon
C. Regulation of Transcription Elongation : Attenuation of *trp* operon
D. Regulation at the Level of Translation : riboswitch, antisense RNA
E. Global Regulatory Systems, Quorum sensing in *V.fisheri*

3 Microbial Genetics: Mechanisms of Genetic Variation No. of Hours: 12
A. Mutations: spontaneous and induced mutation: chemical mutagens: base analogs; intercalating agents, DNA modifying agent; physical mutagenic agent: UV, X-ray. Detection and Isolation of Mutants: auxotrophic mutants, Ames test.
B. DNA Repair: Excision, direct, mismatch, recombination, SOS.
C. Transposable Elements
D. Bacterial Plasmids

4. Creating Genetic Variability: No. of Hours: 12
A. Bacterial Conjugation
B. DNA Transformation
C. Transduction
D. Molecular mechanism of lysogeny in lambda phage
E. Mapping the Genome; Interrupted Mating Experiment, Cotransduction Experiment**.**

MB 302: IMMUNOLOGY

Unit 1 INTRODUCTION TO IMMUNITY No. of Hours: 12
A. Concept of Innate and Adaptive immunity

B. Immune Cells and Organs **:** Outline of blood constituents, Structure, Functions ; Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT

C. Antigens : Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; adjuvants, Antigens occurring in bacterial cell, Concept of immunohaematology: blood group antigens and the blood group.

D. Antibodies: Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); Clonal selection, Monoclonal antibodies

Unit 2 Generation of Immune Response **No. of Hours: 12**

A. Primary and Secondary Immune Response

B. Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response

C. Major Histocompatibility Complex **:** Organization of MHC locus; Structure and Functions of MHC molecules; Antigen processing and presentation

D. Immunotolerance

Unit 3 Complement System and Immunological Techniques **No. of Hours: 12**

A. Mechanism of antigen-antibody reactions (zone phenomenon); Measurement of cell mediated immune response (CMI)

B. Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement Activation

C. Principles of: Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluoresence, RIA,RAST, Flow cytometry, Immunoelectron microscopy, skin tests

Unit 4 Immunological Disorders **No. of Hours: 12**

A. Autoimmunity

B. Hypersensitivity

C. Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD;

D. Types of tumors, tumor Antigens, causes and therapy for cancers.

E. Transplantation immunity

Mb 303:Bioprocess Technology

Unit I. Introduction to Bioprocess **No. of Hours: 12**

A. Concept of fermentation and changing phases in industrial microbiology, Stages in development of fermentation process (component parts), Characteristics of an industrially ideal organism

B. Range of fermentation products.

C. Screening of industrially important organisms: Primary screening of amylase, organic acid, antibiotics and amino acid producers; Introduction to secondary screening

D. Isolation of industrially important microbial strains, Sources of industrially important microbes , methods for their isolation, preservation and maintenance of industrial strains

Unit II. Fermentation media and fermentation economics **No. of Hours: 12**

A. Principles of media formulation, Media ingredients: Water, carbon sources, nitrogen sources, minerals, growth factors, buffers, precursors, inducers, inhibitors, antifoam agents
B. Sterilization of media: Use of high-pressure steam: Principle, batch and continuous sterilization process
C. Sterilization by use of filtration: Principle, types of filters, sterilization of animal cell media and air
D. Inoculum development: General principles for development of seed culture

Unit III. Bioreactor Design **No. of Hours: 12**

A. Essential features of a bioreactor (basic functions), Body construction: Devices for aeration and agitation, pH, temperature, foam and dissolved oxygen
B. Types of bioreactors-Laboratory, pilot- scale and production fermenters, constantly stirred tank , Stirred tank Bioreactor,
C. Bioreactors for special fermentation: Airlift, Tower fermentors & Biocatalytic Reactors
D. Down-stream processing **:** Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying

Unit IV. Modes of Operations & Control parameters **No. of Hours: 12**

A. Modes of Operations: Open and closed fermentation, surface culture fermentation, submerged culture (batch, fed-batch & continuous) fermentation, solid substrate fermentation
B. Introduction to fermentation economics, strain improvement
C. Operating parameters and their control: Aseptic operation, mass transfer of oxygen, KLa value, foam, pH & temperature
D. Enzyme immobilization: methods and applications

MB. 304: Agriculture microbiology

Unit 1. Role of Microorganisms in Soil Fertility **No. of Hours: 12**

A. Role of nitrogen fixers, nitrifying, ammonifying, denitrifying, phosphate solubilizing
B. Biofertilization, Phytostimulation **:** Plant growth promoting bacteria, biofertilizers – symbiotic (*Bradyrhizobium*, *Rhizobium*, *Frankia*), Non Symbiotic (*Azospirillum*, *Azotobacter*, Mycorrhizae, MHBs, Phosphate solubilizers, algae), Novel combination of microbes as biofertilizers, PGPRs, methods of application advantages and disadvantages, constrains in use, benefits of use
C. Rhizosphere, Mycorrhiza
D. Entomopathogenic fungi

Unit 2. Plant Pathology **No. of Hours: 12**

A. Types of plant pathogens
B. Mode of entry of plant pathogen in to plant host
C. General symptoms of plant diseases
D. Transmission and control of plant diseases

Unit 3. Stages in development of a disease **No. of Hours: 12**

A. Infection, invasion, colonization, dissemination of pathogens and perennation
B. Concepts of constitutive defence mechanisms in plants, inducible structural defences (histological cork layer, abscission layer, tyloses, gums),

C. Inducible biochemical defences [hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts].
D. Biological control of plant pathogens and nematodes : Microbial pesticides, organisms having potential of use advantages and disadvantages

UNIT 4: **Microbes In Sustainable Agriculture** **No. of Hours: 12**
A. Microbial Activity in Soil and Green House Gases: Carbon dioxide, methane, nitrous oxide, nitric oxide – production and control
B. Secondary Agriculture Biotechnology: Biotech feed, Silage, Biomanure, biogas, biofuels
C. GM crops : transgenic plants- Bt crops, golden rice, ice minus bacteria, herbicide resistance
D. Transgenic farm animals.

MB 305: Geomicrobiology

Unit 1. Microbial biodiversity **No. of Hours: 12**

A. What is biodiversity?
B. Origin of life, evolution and origin of biodiversity
B. Evolutionary tree of microorganisms
C. Value of biodiversity, microbial biodiversity as index of environmental change

Unit II. Methods of Assessing Biodiversity **No. of Hours: 12**

A. Microscopic methods
B. Cultural methods
C. Molecular and genomic methods: Molecular context of microbial diversity, importance of DNA and rRNA sequence comparison, determination of GC content
D. Non-molecular methods for geomicrobially important microorganisms

Unit III. Geomicrobial Interactions **No. of Hours: 12**

A. Biogenesis of minerals: Natural origin of metal sulphides, principles of metal sulphide formation and laboratory evidences.
B. Biodegradation of minerals , Biobeneficiation,
C. Biooxidation of metal sulphides ,. Bioleaching of metals and Acid mine drainage,
D. Bioaugmentation, biosorption, bioremediation

Unit IV. Geomicrobiology of Fossil Fuel **No. of Hours: 12**

1. Natural fossil fuels, MEOR, microbes in petrol degradation, microbes and shale oil
2. Geomicrobiology of methane
3. Role of microbes in peat formation and conversion
4. Role of microbes in coal formation and desulphurization

PRACTICALS OF SEMESTER FIVE

1. Preparation of Master and Replica Plates: auxotrophic mutants
2. Study physical (UV) mutagens on bacterial cells: lac mutants

3. Study survival curve of bacteria after exposure to ultraviolet (UV) light
4. Gradient plate technique for isolation of streptomycin resistant mutants
5. Identification of human blood groups.
6. Perform Total Leukocyte Count of the given blood sample.
7. Perform Differential Leukocyte Count of the given blood sample.
8. Separate serum from the blood sample (demonstration).
9. Perform immunodiffusion by Ouchterlony method.
10. Perform DOT ELISA.(demo)
11. Study cell immobilization by sodium alginate method and MBRT test.
12. Primary screening of amylase producing bacteria, antibiotic producing bacteria (crowded plate technique), organic acid producing bacteria.
13. Plant specimens or photographs of diseased plants: wilt, rust, mildew, blight, smut, ergot, angular leaf spot, canker of citrus
14.Isolation of X*anthomonas citri* from canker leaf.
15.Isolation of phosphate solubilising bacteria

References :

1) Principles Of Microbiology , Atlas R.M.
2) Microbiology Marjorie Kelly Cowan
3) Microbiology Gerard J. Tortora
4) Microbe Hunters: The Classic Book On The Major Discoveries Of The Microscopic World Paul De Kruif
5) Foundations In Microbiology Kathleen Park Talaro
6) General Microbiology , Roger Y. Stanier Macmillan, 1987
7) Michael J. Pelczar Jr. Chan Ecs And Krieg Nr (2004) Microbiology , 5th Edition. Tata Mcgraw Hill.
8) Instructor's Manual To Accompany Elements Of Microbiology By Michael J. Pelczar
9) Prescott's Microbiology, Eighth Edition Reviewed By Joanne J. Dobbins Joanne M. Willey , Linda M. Sherwood , And Christopher J. Woolverton . 2011. Mcgraw-Hill Higher Education, New York, Ny.
10) Black Jg (2008), Microbiology : Principles And Explorations 7th Edition, Prentice Hall.
11) Medigan Mt And Martinko Jm (2014), Brock Biology Of Microorganisms, 14th Edition. Parker J. Prentice Hall International Inc
12) Cappuccino J And Sherman N (2010) Microbiology: A Laboratory Manual, 9th Edition. Pearson Education Limited
13) Stanbury P F, Whitaker A, And Hall S J, (1995). ***Principles Of Fermentationtechnology***, 2nd Edn, Pergamon Press, London, Uk
14) Waites M J, And Morgam N L,(2002). ***Industrial Microbiology: An Introduction*** Blackwell Science
15) Crueger W And Crueger A, (2000), ***Biotechnology: A Text Book Of Industrial Microbiology***, 2nd Edn, Panima Publishing Corporation, New Delhi, India
16. Trevan M D, Boffey S, Goulding K H, And Standury S, (Eds), (1987), ***Biotechnology: The Biological Principles***, Tata Mcgraw-Hill, New Delhi, India
17. Casida L E, Jr. (1968). ***Industrial Microbiology***, Wiley Eastern Ltd, New Delhi,India

Alexander M, (1977), ***Introduction To Soil Microbiology***, 2nd Edn, Wiley Eastern Ltd.
18. Subbarao N S, (1993), ***Biofertilizers In Agriculture And Forestry***, 3rd Edn, Oxford And Ibh.
19. Mehrotra R And Aggarwal A, (2003), ***Plant Pathology***, 2nd Edn, Tata Mcgraw-Hill Publisher

SEMESTER FIVE MICROBIOLOGY EXAMINATION PATTERN OF PRACTICAL MARKS 70

DAY 1.

A. Genetics (15 marks)

1. Preparation of Master and Replica Plates: auxotrophic mutants
2. Study physical (UV) mutagens on bacterial cells: lac mutants
3. Study survival curve of bacteria after exposure to ultraviolet (UV) light
4. Gradient plate technique for isolation of streptomycin resistant mutants

B. General exercise (15 marks)

1. Isolation of X*anthomonas citri* from canker leaf.
2. Isolation of phosphate solubilising bacteria
3. Study cell immobilization by sodium alginate method and MBRT test.
4. Primary screening of amylase producing bacteria, antibiotic producing bacteria (crowded plate technique), organic acid producing bacteria.

F. Certified Journal, slide box, record book (must for appearing the examination) **(5 marks)**

Day 2.

C. Immunology (15 marks)

1.Identification of human blood groups.
2. Perform Total Leukocyte Count of the given blood sample.
3. Perform Differential Leukocyte Count of the given blood sample.
4. Separate serum from the blood sample (demonstration).
5. Perform immunodiffusion by Ouchterlony method.

Day 3:

D. Spotting **(10 marks)**
E. Viva voce **(10 marks)**

B.Sc SEMESTER-VI (Microbiology)

MB 307 : Recombinant DNA Technology

Unit 1 Introduction to Genetic Engineering **No. of Hours: 12**

A. Milestones in genetic engineering and biotechnology

B. Molecular Cloning- Tools and Strategies

Cloning Tools; Restriction modification systems: Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases

C. Cloning Vectors: Definition and Properties- Plasmid vectors: pBR322 and pUC series Bacteriophage lambda and M13 based vectors, Cosmids, BACs, YACs, Use of linkers and adaptors

D. Expression vectors: An introduction to prokaryotic and eukaryotic expression vectors

Unit 2 Methods in Molecular Cloning **No. of Hours: 12**

A. Transformation of DNA: Chemical method, Electroporation,

B. Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral mediated delivery, *Agrobacterium* - mediated delivery

C. DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern – blotting techniques, dot blot, DNA microarray analysis, SDS-PAGE and Western blotting.

Unit 3. DNA Amplification and DNA sequencing **No. of Hours: 12**

A. PCR: Basics of PCR, RT-PCR, Real-Time PCR

B. Sanger's method of DNA Sequencing: traditional and automated sequencing Primer walking and shotgun sequencing

C. Construction and Screening of Genomic and cDNA libraries , Preparation and uses

D. Screening of libraries: Colony hybridization and colony PCR, Chromosome walking and chromosome jumping

Unit 4. Applications of Recombinant DNA Technology **No. of Hours: 12**

Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - cotton, brinjal, Gene therapy, recombinant vaccines, protein engineering and site directed mutagensis

SUGGESTED READING

1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA
3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
4. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
5. Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
6. Brown TA. (2007). Genomes-3. Garland Science Publishers
7. Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.

MB. 308. Advances In Microbiology (Susan R Barnum, Vikas Publishing house)

Unit 1 : Microbial biotechnology: Commercial production No. of hours 12

A. Single cell protein, Mushroom cultivation
B. Primary metabolite - enzymes: amylase; vitamins, citric acid, lysine
C. Secondary metabolite - antibiotics: penicillin; steroid biotransformation
D. Biofuel, Bioplastics, Biopolymers.

Unit 2. Plant, animal and marine biotechnology No. of hours 12

A. Plant tissue culture and its applications : micropropagation , callus, somatic embryogenesis, somaclonal variations, germplasma, plants as bioreactors
B. Animal biotechnology: microinjection, embryonic stem cell gene transfer, retrovirus and gene transfer
C. Marine biotechnology: Introduction to aquaculture, algal products, fuel from algae
D. Introduction to nano biotechnology, biosensors.

Unit 3. Microbial Genomics (Prescott's Microbiology) No. of hours 12
A. Introduction, Determining DNA Sequences, Whole-Genome Shotgun Sequencing
B. Introduction to Bioinformatics
C. Introduction to Functional Genomics, Comparative Genomics, Environmental Genomics

D. Proteomics

Unit 4. Forensics and DNA Profiling No. of hours 12

A. Satellite DNA : repetitive DNA, microsatellites, minisatellites, macrosatellites
B. VNTRS
C. Technical considerations, PCR, Digital DNA typing
D. Frye test, DNA database

References:
1. Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
2. Stanbury P F, Whitaker A, and Hall S J, (1995). ***Principles of FermentationTechnology***, 2nd edn, Pergamon Press, London, UK
3. Waites M J, and Morgam N L,(2002). ***Industrial Microbiology: An Introduction*** Blackwell Science
4. Crueger W and Crueger A, (2000), ***Biotechnology: A Text Book of Industrial Microbiology***, 2nd edn, Panima Publishing Corporation, New Delhi, India
5. Trevan M D, Boffey S, Goulding K H, and Standury S, (eds), (1987), ***Biotechnology: The Biological Principles***, Tata McGraw-Hill, New Delhi, India
6. Casida L E, Jr. (1968). ***Industrial Microbiology***, Wiley Eastern Ltd, New Delhi,India
Alexander M, (1977), ***Introduction to Soil Microbiology***, 2nd edn, WileyEastern Ltd.
7. Biotechnology. An introduction ,Susan R Barnum, Vikas Publishing House.

MB 309. **Medical Microbiology**

Unit 1. Pathogenicity of Microorganisms **No. of hours 12**

A. Host-Parasite Relationships , infectious disease process, types of infections
B. Pathogenesis of Viral Diseases , Overview of Bacterial and viral Pathogenesis :
C. Pathogenicity : Invasivness : structures and secretions,; Toxigenicity
D. Host Defense Against Microbial Invasion : physical and chemical barriers first line and second line of defence; phagocytosis, interferons.

Unit 2. Antimicrobial Chemotherapy **No. of hours 12**

A. General Characteristics of Antimicrobial Drugs
B. Determining the Level of Antimicrobial Activity : **Disk Diffusion Tests, MIC,** Factors Influencing Antimicrobial Drug Effectiveness
C. Antibacterial Drugs Inhibitors of cell wall synthesis- cephalosporin, vancomycin; protein synthesis inhibitors, metabolic antagonistic, nucleic acid synthesis inhibitors,
D. Drug Resistance : MDR, XDR, MRSA, NDM-1, introduction to Antifungal Drugs: Mechanism of action of Amphotericin B, Griseofulvin , Antiviral Drugs: Mechanism of action of Amantadine, Acyclovir, Azidothymidine , Antiprotozoan Drugs

Unit 3. Clinical Microbiology and Epidemiology **No. of Hours: 12**

A. **Normal microflora of the human body and host pathogen interaction**
Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract
B. Clinical specimens , collection, handling , transport, Identification of Microorganisms from Specimens : microscopy, growth and biochemical characters, **Rapid Methods of Identification**, bacteriophage typing, Clinical immunology: principle of the tests and its use -(ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).
C. **The Epidemiology of Infectious Disease (Prescott's viii edition)** **No. of hours 12**
Epidemiological Terminology , John Snow—The First Epidemiologist , Measuring infectious disease frequency: The Epidemiologist's Tools, patterns of infectious disease in a population, Nosocomial Infections
D. Infectious disease cycle Control and prevention of Epidemics : Immunizations and herd immunity.

Unit 4. Human Diseases Caused by bacteria, fungi, protest, viruses and prions
No. of Hours: 12

List of diseases of various organ systems and their causative agents of the following diseases with Symptoms, mode of transmission, prophylaxis and control
A. Viral diseases : Dengue, AIDS, Influenza , Ebola, Chikungunya, Japanese Encephalitis
B. Protozoan diseases : Malaria, Kala-azar
C.Fungal diseases : Cutaneous mycoses: Tinea pedis (Athlete's foot), Systemic mycoses: Histoplasmosis, Opportunistic mycoses: Candidiasis
D. **Bacterial Diseases**:

- Respiratory diseases *: Mycobacterium tuberculosis,*
- Gastrointestinal Diseases: *Escherichia coli*, *Salmonella typhi*, *Vibrio cholerae*, *Helicobacter pylori*
- Others: *Bacillus anthracis*, *Clostridium tetani*, *Treponema pallidum*, *Rye's syndrome.*

SUGGESTED READING

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition

MB 310. **Instrumentation and Biotechniques**

Unit 1 Chromatography **No. of Hours: 12**

Principles and applications of: paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ion exchange chromatography and affinity chromatography, GLC, HPLC.

Unit 2 Electrophoresis **No. of Hours: 12**

Principle and applications of : native polyacrylamide gel electrophoresis, SDS-polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

Unit 3 Spectrophotometry **No. of Hours: 12**

Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry.

Unit 4 Centrifugation **No. of Hours: 12**

Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation.

SUGGESTED READINGS

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 9thEd., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.

MB 311 **Microbial Quality Control in Food and Pharmaceutical Industries**

Unit 1 Microbiological Laboratory and Safe Practices No. of Hours: 12
Good laboratory practices - Good laboratory practices, Good microbiological practices Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL- 1, BSL-2, BSL-3. Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration, principles of blood bank

Unit 2 Determining Microbes in Food / Pharmaceutical Samples No. of Hours: 12
Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products
Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

Unit 3 Pathogenic Microorganisms of Importance in Food & Water No. of Hours: 12
Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay)

Unit 4 HACCP for Food Safety and Microbial Standards No. of Hours: 12
Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water

SUGGESTED READING
1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press
2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
3. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer
4. Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

SEMESTER VI : PRACTICAL
1. Fermentative production of amylase and its activity check by iodometric method
2. Demonstration of recovery of crude protein / amylase from fermentation broth either by salting out (ammonium sulfate) or by using isopropyl alcohol
3. Use of enzyme as analytical tool: Glucose estimation by GOD-POD method
4. Study of antibiogram (using multidisk)
5. Physical and chemical analysis of urine
6. Estimation of blood urea by diacetyl monoxime method (DAM)

7. Study of permanent slides of Insect vectors: Female anopheles mosquito, head louse, tick, flea, mite.
8. Study of permanent slides of microorganisms: Actinomycetes, yeast, bacteroids, acid-fast bacilli, spirochetes, *Streptococcus pneumoniae*, *Clostridium tetani* and *Plasmodium vivax*

9. Identify bacteria (*E. coli, Salmonella, Pseudomonas, Staphylococcus, Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
10. Demonstration of characterization of Gram-negative bacteria based on biochemical reactions using rapid identification kit
11. Separation of mixtures of amino acids by paper / thin layer chromatography.
12. Determination of λmax for an unknown sample and calculation of extinction coefficient.
13. Separation of components of a given mixture using a laboratory scale centrifuge.
14. Determination of MIC of streptomycin

15. LAL Test for endotoxins (demo)

16. Study of bacterial flora of skin by swab method
17. Bioassay of penicillin by diffusion method
18. Sterility testing of pharmaceutical test
19. Fermentative production of amylase and its activity check by iodometric method

SUGGESTED READINGS

- Prescott L, Harley J P, and Klein D A, (2008), ***Microbiology***, 7th edn. Wm C.Brown - McGraw Hill, Dubuque, IA
- Atlas R M, (1997), ***Principles of Microbiology***. 2nd edn, Wm. C. Brown Pub.,Iowa, USA.
- Stanbury P F, Whitaker A, and Hall S J, (1995). ***Principles of Fermentation Technology***, 2nd edition, Pergamon Press, London, UK
- Waites M J, and Morgam N L,(2002). ***Industrial Microbiology: An Introduction*** Blackwell Science
- Crueger W and Crueger A, (2000), ***Biotechnology: A Text Book of IndustrialMicrobiology***, 2nd edn, Panima Publishing Corporation, New Delhi, India
- Trevan M D, Boffey S, Goulding K H, and Standury S, (eds), (1987),***Biotechnology: The Biological Principles***, Tata McGraw-Hill, New Delhi, India
- Casida L E, Jr. (1968). ***Industrial Microbiology***, Wiley Eastern Ltd, New Delhi, India
- Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
- Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3rd edition. Blackwell Science, Oxford.
- Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
- Rangaswami G. (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hall of India Pvt. Ltd., New Delhi.
- Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.

SEMESTER SIX MICROBIOLOGY EXAMINATION PATTERN OF PRACTICAL MARKS 70

Day 1.

A. . Identify bacteria (any three of *E. coli, Salmonella, Pseudomonas, Staphylococcus, Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests **(20 marks)**

B. Medical microbiology (15 marks)

1. Use of enzyme as analytical tool: Glucose estimation by GOD-POD method
2. Study of antibiogram (using multidisk)
3. Physical and chemical analysis of urine
4. Estimation of blood urea by diacetyl monoxime method (DAM)
5. Study of bacterial flora of skin by swab method

F. Certified Journal, slide box and record book (must for appearing the examination (5 marks)

Day 2.

C. Microbial Quality Control in Food and Pharmaceutical Industries 15marks

1. Separation of mixtures of amino acids by paper / thin layer chromatography.
2. Determination of λmax for an unknown sample and calculation of extinction coefficient.
3. Determination of MIC of streptomycin
4. Bioassay of penicillin by diffusion method
5. Sterility testing of pharmaceutical test
6. Fermentative production of amylase and its activity check by iodometric method

Day 3:

D. Spotting **(10 marks)**
E. Viva voce **(10 marks)**
