

B.Sc MICROBIOLOGY (CBCS STRUCTURE) SEMESTER III

MB 201: THE VIROLOGY AND MYCOLOGY (15 LECTURES EACH)

TOTAL HOURS: 60

CREDITS: 4

1. The Viruses: Introduction and General Characteristics

1. Early developments of Virology , General Properties of Viruses , The Structure of Viruses : Capsid symmetry, enveloped and non-enveloped viruses
2. Virus Reproduction
3. Isolation and cultivation of viruses
4. Virus Purification and Assays
5. Principles of Virus Taxonomy , Classification and nomenclature of different groups of viruses

2. Viral Diversity :

1. Introduction to Virulent Bacteriophages with special reference to T4
2. Introduction to temperate Bacteriophages with special reference to Lambda phage
3. Introduction to Animal Viruses : Retroviruses
4. Introduction to plant virus :TMV
5. Importance of virus- human and plant diseases, vaccines, Use of viral vectors in cloning and expression, Gene therapy and Phage display

3. The *Fungi (Eumycota)*

- a. Morphology of fungi: thallus, hyphae –mycellium structure , hyphal modification
- b. Nutrition and Metabolism
 - i. Culture media used for fungal cultivation
 - ii. Preservation of fungal cultures.
- c. Reproduction : asexual, sexual, vegetative methods, parasexual cycle.
- d. Importance of fungi: medical - mycosis and mycotoxins and economical importance

4. Classification of fungi

- a. Criteria used for classification of fungi

b. General characters, structure, habitat, reproduction, importance of

- i. Chytridiomycetes
- ii. Zygomycetes and Glomeromycetes
- iii. Ascomycetes
- iv. Basidiomycetes

MB 202: ENVIRONMENTAL MICROBIOLOGY (15 LECTURES EACH)**TOTAL HOURS: 60****CREDITS: 4****Unit I. Microbiology of air**

- i. Sources of microbes in air
- ii. Sampling of air
- iii. Control of air microflora and its importance
- iv. Air borne diseases

Unit II. Microbiology of Soil

1. Physicochemical characteristics of soil, soil as a culture medium, soil flora
2. Methods of studying soil micro flora:
 - i. Direct microscopic method, agar plate technique, and buried slide method
 - ii. Use of Winogradsky column in studying microbial diversity in soil
3. Microbial interactions in soil : Neutral, positive and negative associations
4. Biogeochemical cycles:

i. Nitrogen cycle	iv. Iron cycle
ii. Sulfur cycle	v. Phosphorus cycle
iii. Carbon cycle, humus and its significance	

Unit III. Microbiology of Water

1. Understanding of : Freshwater Environments , marine environments , Hydrothermal Vents and Cold Seeps
 2. Sources of Water contamination
 3. Water Purification : *individual and municipal*
2. Microbial indicators of faecal pollution
 - i. Coliforms as indicator, need for differentiation
 - ii. Methods of differentiation: IMViC test and Elevated temperature test
 - iii. Microbial indicators other than coliforms
3. Nuisance organisms in water: Slime forming bacteria, iron and sulfur bacteria and algae
4. Bacteriological examination of drinking water
 - i. Sampling
 - ii. Quantitative analysis: Standard plate count
 - iii. Qualitative analysis: Multiple tube fermentation method (presumptive, confirm and completed test), MPN, membrane filter technique, defined substrate test, P-A (Presence-Absence) test

Unit IV. Microbiology of Wastewater, Waste management

1. BOD, COD and TOD as indicators of strength of wastewater, pollution problems due to disposal of untreated wastewater
2. Methods of wastewater treatment: solid/sludge and liquid waste

i. Primary Treatment ,	iv. Septic Tanks,
ii. Secondary Treatment ,	v. Landfills, composting, vermiculture
iii. Tertiary Treatment ,	

References:

- Willey MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein's Microbiology by. 9th Ed., McGrawHill
 - Foundations in microbiology Kathleen Park Talaro
 - General microbiology Roger Y. Stanier Macmillan, 1987
 - Microbiology by Michael J. Pelczar
 - Instructor's manual to accompany elements of microbiology by [Michael J. Pelczar](#)
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- Prescott's microbiology, eighth 2011. Mcgraw-hill higher education, New york,.
 - Pepper, Ian L., and Scot E. Dowd. "Aeromicrobiology." Environmental Microbiology. N.p.: Academic Press, 2009. 83-101. Print
 - Fundamentals of Microbiology, **Frobisher, Martin; etc.**, Published by W.B. Saunders Company

MB 203 PRACTICALS**TOTAL HOURS: 60****CREDITS: 2****THE VIROLOGY AND MYCOLOGY:**

1. To study structure of important animal viruses (rhabdo, influenza, paramyxo, Hepatitis B & retroviruses) using electron micrographs
2. To study structure of important plant viruses (caulimo, gemini, tobacco ring spot, cucumber mosaic & alpha-alpha mosaic viruses) using electron micrographs
3. To study structure of important bacterial viruses (λ , T4 & ϕ X174) using electron micrographs
4. Isolation and enumeration of bacteriophages from water/sewage sample using double agar layer technique
5. Study of cytopathic effects using photographs
6. Study of the vegetative and reproductive structures of following genera through temporary and permanent slides: Alternaria, Helminthosporium, Neurospora, Puccinia
7. Slide cultivation method of fungi-molds.

ENVIRONMENTAL MICROBIOLOGY

8. Study of microbial quality of air by Koch's impregnation method For Enumeration of gram negative bacteria mac conkey Agar medium, blood agar media for Streptococci and for fungi PDA Agar medium plates
9. Direct microscopic method (buried slide) for studying soil fungal flora
10. Isolation of Rhizobium, Azotobacter, actinomycetes.
11. Quantitative analysis of water: Standard plate count of water
12. Qualitative analysis of water: Detection of faecal coliforms
13. Multiple tube test for water analysis
14. BOD of water

SCHEME OF PRACTICAL EXAMINATION SEMESTER THREE

		First day
I.	Virology/ mycology	20 marks
II.	Air/water/soil	20 marks
III.	Journals /slide box	10 marks
		Second day
IV.	Spotting	10 marks
		Third day
V.	Viva	10 marks
		Total 70 marks

B.Sc MICROBIOLOGY (CBCS STRUCTURE) SEMESTER IV**MB 204: MICROBIAL PHYSIOLOGY:METABOLISM (15 LECTURES EACH)****TOTAL HOURS: 60****CREDITS: 4****Unit I Bioenergetics**

1. First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy and Entropy and mathematical relationship among them, Standard free energy, O/R potential, emf.
2. Energy rich compounds and role in metabolism
3. An Overview of Metabolism
4. Oxidation-Reduction Reactions, Electron Carriers, and Electron Transport Systems
5. Electron Transport and Oxidative Phosphorylation: chemiosmosis, inhibitors.

Unit II. Enzymes and Regulation

1. Structure of enzyme, Classification of enzymes, Mechanism of action of enzymes, Definitions of terms – enzyme unit, specific activity and turnover number
2. Vitamins
3. Factors affecting enzyme activity: substrate, enzyme, ions, pH, temperature
4. Significance of hyperbolic, double reciprocal plots of enzyme activity, Km, and allosteric mechanism
5. Enzyme inhibition: competitive and non-competitive
6. The Nature and Significance of Metabolic Regulation, Metabolic Channelling

Unit III. Metabolism: Energy Release and Conservation

1. Chemoorganotrophic Fueling Processes
2. Aerobic Respiration , anaerobic respiration, fermentation
3. Sugar degradation pathways i.e. EMP, Pasteur effect , ED, Pentose phosphate pathway, TCA cycle
4. Lipid Catabolism
5. Protein and Amino Acid Catabolism
6. Chemolithotrophy : Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction)
7. Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria

Unit IV. Metabolism: The Use of Energy in Biosynthesis

- i. Principles Governing Biosynthesis
- ii. The Precursor Metabolites

- iii. The Fixation of CO₂ by Autotrophs
- iv. Synthesis of Sugars and Polysaccharides
- v. Synthesis of Amino Acids
- vi. Synthesis of Purines, Pyrimidines, and Nucleotides
- vii. Lipid Synthesis

SUGGESTED READING

- Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
 - Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
 - Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
 - Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
 - Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company,
 - Willey MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein's Microbiology by. 9th Ed., McGrawHill
 - Voet D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons
 - Foundations in microbiology Kathleen Park Talaro
 - General microbiology Roger Y. Stanier Macmillan, 1987
 - Microbiology by Michael J. Pelczar
 - Instructor's manual to accompany elements of microbiology by [Michael J. Pelczar](#)
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- Prescott's microbiology, eighth 2011. Mcgraw-hill higher education, New york,.

MB 205: MICROBIOLOGY OF FOOD AND MILK (15 LECTURES EACH)

TOTAL HOURS: 60

CREDITS: 4

Unit I. Microorganism Growth in Foods

1. Factors influencing growth of microbes in food - Intrinsic Factors, Extrinsic Factors
2. Microbial Growth : Food Spoilage – vegetables, fruits, milk, poultry, meat, canned foods
3. Changes caused by micro-organisms during spoilage of food and milk (breakdown of proteins, carbohydrates, fats and other constituents)
4. Controlling Food Spoilage : Removal of Microorganisms, Low Temperature, High Temperature, Pasteurization, Water Availability, Chemical-Based Preservation, Radiation Thermobacteriology, Biopreservatives, Microbial Product-Based Inhibition esp. Bacteriocins,

Unit II. Food borne diseases

1. Food borne intoxication
2. Detection of Food-Borne Pathogens :
 - i. Fluorescent antibody, enzyme linked, immunoassays (ELISAs), and radioimmunoassay techniques, Molecular techniques
 - ii. Standard plate count, dye reduction method :MBRT; phosphatase test, detection of coliforms, spore formers, anaerobes: roll tube, reduced culture media methods, MPN

Unit III. Starter Cultures

1. Microbiology of Fermented Foods
2. Fermented Milk products
3. Cheese types and production
4. Microorganisms as Foods

Unit IV. Trends in food microbiology

1. Introduction to Hurdle concept and Predictive Microbiology, Minimal Processing, Genetically Modified Foods
2. Probiotics, prebiotics, symbiotics and health benefits.
3. Rapid methods of detection of food borne pathogens.
4. Food Amendments

Recommended Readings

1. Frazier William C and Westhoff, Dennis C.2004. Food Microbiology, TMH, New Delhi
2. Jay, James M.2000. Modern Food Microbiology, CBS Publication, New Delhi 3
3. Garbutt, John.1997. Essentials of Food Microbiology, Arnold, London
4. Pelczar MJ, Chan E.C.S and Krieg, Noel R.2007. Microbiology, 5th Ed., TMH, New Delhi.
5. Banwart G.J. 1979 . Basic Food Microbiology ,AVI Publishing.
6. Adams M.R. and Moss M.O. 2000. Food Microbiology IInd Edition ,The Royal Society.
7. Tortorello M.L. and Gendel S.M. 1999. Food Microbiology and Analytical Methods,CRC Press. (DC I)
8. Prescott’s microbiology, eighth 2011. Mcgraw-hill higher education, New york,.
9. Microbiology by Michael J. Pelczar

MB 206: PRACTICALS**TOTAL HOURS: 60****CREDITS: 2****MICROBIAL PHYSIOLOGY: METABOLISM**

1. Effect of heavy metals on growth of bacteria
2. Estimation of sugars by Nelson somogy's methods
3. Estimation of proteins by Lowry's method
4. Estimation of vitamin C by redox titration using iodine solution
5. Estimation of amylase activity by Nelson's methods
6. Study of Km and V max of amylase

MICROBIOLOGY OF FOOD AND MILK:

7. Standard Plate Count of food
8. Detection of anaerobes- sulphite reducers clostridial spores in food/milk sample
9. MBRT test of milk
10. Phosphatase test of milk
11. Detection of fecal coliforms in milk
12. Detection of acid fast bacteria by staining
13. Enumeration of coliforms MPN of milk
14. IMViC test to differentiate faecal and non faecal coliforms

SCHEME OF PRACTICAL EXAMINATION SEMESTER FOUR**First day:**

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| I. | Microbial metabolism | 20 marks |
| II. | Food/milk microbial analysis | 20 marks |
| III. | Journal /slides | 10 marks |

Second day

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| IV. | Spotting | 10 marks |
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Third day

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| V. | Viva | 10 marks |
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Total marks 70**Pattern of theory question paper (university exam)****Section One:**

- Objective questions (30 marks) from all four units (ie. OMR i.e optical mark reading)

Section Two:

- Four questions, each of 10 marks.
- Each question from each of the unit.
