

B.Sc. First Year Semester – I

Paper -MCB-111. Fundamentals of Microbiology

Unit: I History of Microbiology (10)

1. Definition and concepts
1. Discovery of microorganisms: Contribution of Antony Van Leeuwenhoek.
2. Spontaneous generation theory :Aristotles view, Charles Darwin view.
Controversy over spontaneous generation
3. Recognition of the microbial role in diseases: Koch's postulates,
Koch's direct stimulation theory, Aseptic surgery
4. Discovery of microbial effects on organic and inorganic matter.
5. Recognition of the microbial role in fermentation: Contribution of Louis Pasteur
Stahls theory of fermentation,
6. Pure culture concept
7. Patenting of microorganisms : contribution of Louis Pasteur and
AnandChakraborty

Unit: II Microscopy(10)

1. Introduction of Magnification, resolving power, depth of focus, focal length,
numerical aperture.
1. Electron Microscope: (SEM and TEM).
2. Phase contrast microscope.
3. Dark field microscope.
4. Fluorescence Microscope.
5. Atomic Force Microscope

Unit: III Taxonomy of microorganisms. (10)

1. Taxonomic rank.
2. Major characteristics used in taxonomy (Morphological, Physiological,
Immunological, Metabolic).Compositions of proteins, Composition of nucleic acids,
Nucleic acids hybridization, Nucleic acid sequencing, 16S rDNA.
3. Classification system
4. Numerical taxonomy.
5. Bergey's manual of systematicBacteriology, General characteristics enlisting all
parts with major characters and examples in brief.

Unit: IV General characteristics of Microorganisms (10)

1. Fungi
2. Actinomycetes
3. Algae
4. Mycoplasma
5. Rickettsia.
6. Archaeobacteria
7. Protozoa

Unit : V Tutorials, Seminars and Assignments (05 Periods)

B.Sc. First Year (CBCS)
Paper – MCB-112-Microbial Techniques

Unit- I: Sterilization – contribution of (10)

Richard J. Petri : Petriplates and their types

Schroeder and Dusch : Cotton plug

C. Salomonsen : Hot air oven

Wire loop: Introduction, diameter, Connors transfer loop, Roux and Yersin, Platinum needle.

Agar : Discovery, introduction, structure, classification of agar and agar gels. Uses of agar.

Agar slant apparatus : Introduction, diagram and angles used in slant preparation.

Incubators : Types of incubator (Anaerobic incubator, Perfusion incubator, Pocket incubator, Thermal gradient incubator)

Pasteurizer: Beer pasteurizing apparatus.

Autoclave :

Hot air oven

Radiations : (Gamma rays, X rays, Ultra violet rays)

Unit II: Sterilization and Disinfection (10)

- a. Sterilization- introduction
- b. Definition and concept: Disinfection, Germicide, Antiseptics, Bacteriostatic, Bactericidal
- b. Chemical sterilizing agents (Spectrum, Mode of action, Application, Limitations)
Phenolic, Alcohols, Halogens, Heavy metals, Quaternary ammonium Compounds, Aldehydes.
- c. Sterilization using gases (Spectrum, Mode of action, Application, Limitations) : Sulfur dioxide, Ethylene oxide and Beta propiolactone
- d. Evaluation of disinfectants : Phenol coefficient

Unit -III Pure Culture Techniques (10)

A. Development of pure culture

- B. Single Cell Isolation
- C. Methods for isolation of pure culture -
Streak plate method, Pour plate method, Spread plate methods
- D. Handling of pathogenic microorganisms
- E. Methods for disposal of microbial wastes
- F. Techniques for enumeration of microorganisms
Cell count by Direct Microscopic Count, Colony count
Measurement of turbidity, Measurement of cell mass

Cultivation of microorganisms

- A. Properties of a good culture medium.
- B. Definition and concept
 - a. Living media : Embryonated chicken eggs, Tissue culture & Animals
 - b. Non living media : Natural, Semi-synthetic & Synthetic
- C. Types of culture media on the basis of their specific use w.r.t. role of media ingredients (with examples)

Selective ,Differential, Enriched , Enrichment, Assay , Minimal , Maintenance and Transport media

- D. Role of Buffers in culture media.
- E. Media used for cultivation of bacteria, fungi, actinomycetes, yeasts, algae and photosynthetic bacteria (at least two)
- F. Techniques for cultivation of anaerobes : John H. Brewer Instrument and Anaerobic Jar closure assembly
- G. Method for detecting microscopic organisms using bacteriophage : Kent J. Voorhees Apparatus.
- H. Measurement of gas production by Wilkins et al method.

Unit IV – Stains and Staining (10)

- A. Fundamentals of microbial staining
 - a. Definition : stain, dye, chromogen, chromophore, auxochrome,
 - b. Types of stains: Acidic, basic
 - c. Staining reagent: Primary stain, Secondary stain, Mordant and Decolorizer
 - d. Fixation of Smear: Physical and Chemical methods
Physicochemical basis of staining.
- B. Staining methods
 - a. Staining (Principle, application and methodology)
Monochrome staining and Negative staining
 - b. Differential staining (Principle, application and methodology)
Gram's staining and Acid fast staining
 - c. Structural/ Special staining procedures
Cell wall, Capsule, Spore, Flagella, Metachromatic granule,
 - d. Staining of Fungi.
 - c. Micrometry
 - d. Hanging drop technique
 - e. Microscopic photograph

Unit : V Tutorials, Seminars and Assignments (05 Periods)

B.Sc. First Year (CBCS)
Paper - MCB-211 .Microbial Chemistry

Unit- I : Basic of atoms and molecules (10)

I. Concepts of Atom, Molecule, pH, Acids, Bases, Buffer, Solvent, Solute, Types of solutions (hypotonic, hypertonic, isotonic) and redox potential
II. Types of Isomers and their importance in biology.
III. Types of bonds and their importance: Electrovalent, covalent, non-covalent, Ester, Phospho-diester, Thio-ester, Peptide, Glycosides

Unit II : Amino acids and Proteins (10)

Amino Acids: Definition, General structure and features of amino acids, amphoteric nature, List of 20 amino acids. Classification of amino acids: based on R-group, Uncommon amino acids and their functions.

Proteins: Definition. Classification of Proteins, Primary, secondary, tertiary, quaternary structures of proteins (outline). Biological significance of proteins. Classification of Proteins, Primary, secondary, tertiary, quaternary structures of proteins . Biological significance of proteins

Unit - III : Carbohydrates (10)

a) Definition and Classification. b) Monosaccharides, Triose, Tetrose, Pentose, Hexose (Examples and structures). c) Disaccharides: Glycoside Linkage (Lactose, Maltose and Sucrose). d) Oligosaccharides: Trisaccharides (Structure of raffinose).
e) Polysaccharides: Homo and heteropolysaccharides, structure of (Starch, Cellulose, Hyluronoc acid), Biological Significance of carbohydrates.

Unit IV : Lipids and Nucleic acids (10)

Definition and Classification. Types of Lipids: Simple lipids-Triglycerides.

Conjugated Lipids- Phospholipids, Phosphatidic acid, and Cholesterol.

Biological importance of Lipids.

Purine , pyrimidine bases , Ribose and Deoxyribose sugars, phosphodiester bonds, m-RNA, t-RNA and r-RNA.

Unit V Tutorials, Seminars and Assignments (05 Periods)

Paper MCB-212- Bacterial Cytology and Virology

Unit- 1: Bacterial morphology and outer ultra structures of cell. (10)

1. Cytology of a typical bacterial cell. Prokaryotic and Eukaryotic cell structure.
2. Morphology – size and arrangement of bacterial cells.
3. Structure, chemical composition and functions of:
 - i. Capsule and slime layer
 - ii. Flagella : Arrangement, Structure, mechanism of flagellar movement, Chemotaxis, phototaxis, Magnetotaxis.
 - iii. Pili
 - iv. Cell wall : Gram positive and Gram negative bacteria
 - v. Cell membrane /Unit membrane

Unit – 2: Bacterial morphology and inner ultra structures of cell. (10)

- i. Bacterial Endospores: Structure, Formation and Germination process
 - ii. Ribosomes.
 - iii. Nuclear material
 - iv. Mesosomes
 - v. Reserved food material: Nitrogenous, Non-nitrogenous (Starch and Glycogen, Poly beta hydroxy butyric acid), polyphosphate, Sulfur granules.
4. Bacterial cell division: Binary fission

Unit -3: Viral Morphology and Genomic structure (10)

1. Introduction and General characteristics
2. Discovery and Early development of Virology
3. Virions, Viroids, Virusoids, Prions.
4. Structure of viruses: Size, Shape, Proteins, Capsids and capsomers.
 - i) The structure of filamentous viruses and nucleoproteins
 - ii) The structure of isometric viruses (tetrahedron, cube, octahedron, dodecahedron, icosahedrons)
 - iii) Enveloped (membrane bound) viruses
 - iv) Viruses with head-tail morphology
5. Viral genomes
 - i) Positive-Sense Single stranded RNA Viruses
 - ii) Negative-Sense Single stranded RNA Viruses
 - iii) Double-Stranded RNA Viruses
 - iv) Retroviruses
 - v) Double-Stranded DNA Viruses
 - vi) Single-Stranded DNA Viruses

Unit - 4: Classification, Multiplication, Cultivation and Impact of viruses (10)

1. Classification: ICTV (International Committee on Taxonomy of Viruses), Baltimore and LHT System)
 2. Multiplication: Lytic cycle in Animal and Bacteria
 3. Lysogeny
 4. Cultivation of Viruses: Egg inoculation and Tissue culture
 5. List of common viral diseases with causative agents and important symptoms in plants, animals and human beings.
 6. Emerging human viruses (Brief)
 - i. H1N1 Influenza Virus (Swine Flu)
 - ii. Avian Influenza (Bird Flu)
 - iii. Ebola Hemorrhagic Fever (Ebola virus disease)
 - iv. Chikungunya Virus
 - v. Severe acute respiratory syndrome (SARS)
 - vi. Nipah virus disease
 - vii. Zika virus infection
 7. Viruses and cancer
 8. Viruses used in Recombinant DNA technology
- Unit V** : Tutorials, Seminars and Assignments (05 Periods)

**B.Sc. First Year
MICROBIOLOGY**

Lab Course 1MCB -121

1. Microscopy- Different parts of compound microscope. Use and care of compound microscope
2. Preparation of Standard Operating Procedures (SOPs) for common microbiology laboratory instruments: Introduction to Laboratory equipments, Construction, Operation and utility of laboratory equipments.
 - a) Autoclave
 - b) Hot air oven
 - c) Incubator
 - d) pH meter
 - e) Centrifuge
 - f) Colorimeter/Spectrophotometer
 - g) Anaerobic jar
 - h) Seitz filter
 - i) Laminar air flow
3. Disinfection & discarding techniques in laboratory
4. Introduction of : Wire loop, Agar , Agar slant apparatus , Incubators, Pasteurizer, Autoclave , Hot air oven, Radiations
5. Staining
 - a. Simple staining: Monochrome, Negative
 - b. Differential : Gram's staining
 - c. Structural staining:
 - i. Cell wall staining (Chance's method)
 - ii. Capsule staining (Maneval's method)
 - iii. Spore staining (Schaeffer and Fultons's method)
6. Hanging drop technique.
7. Measurement of size of cells by micrometry
8. Preparation of buffers- Citrate and phosphate buffer
9. Study tour to related laboratories /industries

**B.Sc. First Year
MICROBIOLOGY**

Lab Course 2MCB-221

1. Cleaning and sterilization of glassware: Preparative procedures for glasswares before sterilization.
2. Study of aseptic techniques: Preparation of cotton plugs for test tubes and pipettes, wrapping of petriplates and pipettes, Methods of inoculum transfer .
3. Preparation of Media: Nutrient broth, Nutrient Agar, MacConkey's broth and agar, Sabouraud's Agar.
4. Study of bacterial growth curve
5. Study of methods of isolation of bacteria from mixed cultures:
 - i) Streak plate technique
 - ii) Spread plate technique
 - iii) Pour plate technique
6. Morphological , Cultural characterization of isolates.
7. Effect of pH, Temperature & UV on bacterial growth
8. Isolation of Bacteria and Fungi from soil
 - a) Preparation of serial dilutions.
 - b) Spread plate and pour plate techniques
11. Qualitative tests for:
 - I. Carbohydrates- Benedict's test
 - II. Proteins- Biuret Test
 - III. Nucleic acids- DNA-Diphenyl amine test and RNA- Orcinol test

Books Recommended for Theory & Practical of B.Sc.I, SEM I & II

1. General Microbiology by Hans G. Schlegel.
2. General Microbiology by R.Y. Stayner.
3. Fundamentals of Microbiology by Crabtree, & Martin Frobisher.
4. Fundamentals of Bacteriology by A.J. Salle
5. A text of Microbiology by Dubey RC and Maheswari DK (2012).
6. Geeta Sumbali and Mehrotra RS (2009). Principles of Microbiology.
7. General Microbiology volume 1 and 2 by Powar CB and Dagainawala H F.
8. Microbiology by Pelczar TR M J Chan ECS and Kreig N R.
9. Robert F Boyd (1984). General microbiology.
10. Microbiology by Prescott L M, J P Harley and D A Klein.
11. Introduction to Microbiology by Ingraham J.L. and Ingraham C.A
12. History of Microbiology & Microbiological Methods by A.B. Solunke, V.S. Hamde, R.S. Awasthi & P.R. Thorat.
13. General Microbiology by Hans G. Schlegel.

14. Air Microbiology an environment & Health Prospective by S.C. Aithal, P.S. Wakte & A.V. Manwar.
15. Water Microbiology by S.C. Aithal, & N. Kulkarni.
16. General Microbiology by R.Y. Stayner.
17. A text of Microbiology by Dubey RC and Maheswari DK.
18. Manual of Methods for Pure Culture Study by A.B. Solunke, V.S. Hamde, R.S. Awasthi & P.S. Wakte.
19. Text Book of Microbial Chemistry and Physiology by P.H.Kumbhare & U.V.Thool Rajani Prakashan, Nagpur.
20. Text Book of Applied Microbiology by P.H.Kumbhare & U.V.Thool, Rajani Prakashan, Nagpur.
21. General Virology by Luria S.E.
22. A textbook of Fungi and Viruses by Dubey H.C.
23. Alcamo Fundamentals of Microbiology
24. Experiments in Microbiology by Aneja K.R.
25. Introduction to Microbial Techniques by Gunasekaran,
26. Elementary Microbiology by Modi H.A.
27. Handbook of Media, Stain and Reagents in Microbiology by Deshmukh A.M.,
28. Biology of Microorganisms by Brock T.D. and Madigan M.T.
29. Biochemistry by J.L. Jain
30. Biochemistry by Zubay
31. Principles of Biochemistry by Nelson David L and Cox Michael M. Lehninger.
32. Disinfectants and Disinfection by A.G. Young
33. Filtration by F.E. Vey
34. Biological Stains by H.J. Conn.