

# Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science

B.Sc First year Syllabus

Semester Pattern effective from June 2009

**Subject: Microbiology**

Sr.No	Semester / Annual	Paper No	Title of paper	Total periods/ week	Total period	Total Marks
1	<b>I</b>	I	Introductory Microbiology	03	45	60
		II	Fundamentals of Microbiology			
2	<b>II</b>	III	Basic Microbiology	03	45	60
		IV	General Microbiology and Biochemistry			
3	Practical ( Annual pattern)	V (Practical)	Practical's based on theory paper I, II, III, IV.	04	45	60

The syllabus is based on six (3x2) theory periods and 4 practical periods per batch per week.

Candidates are required to pass separately in theory and practical examination.

**Marks distribution:**

- 1) Theory exam : 50 marks ( for each paper)
- 2) Internal evaluation : 10 marks ( Mid term Exam: 5, Home assignment : 5 )

**Note:** B.Sc. First year practical includes studies of growth of microorganisms and life activities of microorganisms. These studies need two consecutive days for completion of practicals.

## Semester I

### **Paper I: Introductory Microbiology**

**Maximum Marks: 60**

**Periods: 45**

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#### **Unit I: Introduction and Scope of Microbiology**

**11**

- 1.1 Scope of Microbiology
  - a) Definition and concept
  - b) Types of Microorganisms
  - c) Distribution of Microorganisms in nature.
- 1.2 Role of microorganisms in
  - a) Agriculture
  - b) Human and animal health
  - c) Industries
  - d) Food processing

(Beneficial and harmful role of Micro-organisms with suitable examples)

#### **Unit II: History of Microbiology.**

**11**

- 2.1 Historical developments in microbiology.
  - a) Early observation of microorganisms
  - b) Controversy over spontaneous generation - Contribution of different scientists
  - c) Recognition of microbial role in diseases - Koch's postulates and contribution of Louis Pasteur, Edward Jenner.
  - d) Recognition of microbial role in fermentation.
  - e) Discovery of microbial effect on organic and inorganic matter.
  - f) Discovery of pure culture concept
  - g) Aseptic surgery.

### **Unit III: Microscopy.**

**12**

- 3.1 Introduction
  - a) Definition: Magnification, Resolving power, Depth of focus, Focal length, Angular aperture, Numerical aperture.
  - b) Objectives: Low, High, Oil immersion.
  - c) Oculars: Function
  - d) Condensers: Abbe, Cardioid, Parabolic and their functions.
- 3.2 Principle, Construction using ray diagram and applications of
  - a) Compound Microscope
  - b) Electron Microscope  
(Scanning Electron Microscope and Transmission Electron Microscope)
  - c) Introduction to Phase Contrast Microscope, Dark field Microscope, Fluorescent Microscope in brief.

### **Unit IV: Stains and Staining**

**11**

- 4.1 Definition: Stain, Dye, Acidic stain, Basic stain, Auxochrome, Chromophore, Mordent, Chromogen, Leuco compound, Natural stain, Flurochrome, Decolourising agent and Counter stain.
- 4.2 Theories of Staining
- 4.3 Principles, Mechanism, Procedure and Observation of
  - a) Simple staining: Monochrome staining, Negative staining
  - b) Differential staining: Gram's staining and Acid Fast staining
  - c) Structural staining: Cell wall staining, Capsule staining, Spore staining, Flagella staining (PKG Method), Reserve food Material staining (PHB, Metachromatic granule Staining).

## **Paper II: Fundamentals of Microbiology.**

**Maximum Marks: 60**

**Periods: 45**

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### **Unit I: General characteristics of Microorganisms. 11**

- 1.1 General Characters and Structure (In Brief) of
  - a) Archeabacteria
  - b) Microalgae
  - c) Fungi
  - d) Actinomycetes
  - e) Protozoa
- 1.2 Ultra structure of Animal virus- HIV, Bacterial Virus (□), Plant Virus –TMV  
(Brief account with labeled figures).

### **Unit II: Pure culture techniques and Cultivation of bacteria. 12**

- 2.1 Pure culture Techniques.
  - a) Definition and Significance of Streak plate, Pour plate, Spread plate.
  - b) Single Cell isolation.
- 2.2 Cultivation of Bacteria
  - a) Media used, Properties of good culture media.
  - b) Definition, Concept, Use and Types of different culture media.
  - c) Synthetic, Non-synthetic, Natural, Selective, Differential, Enriched, Enrichment, Assay, Minimal, Maintenance and Transport Medium.
  - d) Buffers in culture medium.
- 2.3 Cultivation of anaerobes. (Any two methods)

### **Unit III: Control of Microbial growth (Chemical agent). 11**

- 3.1 Definition of Sterilization, Disinfection, Antiseptic, Germicide, Sanitizer, Fungicide, Viricide, Bacteriostatic and Bactericidal agent.

### 3.2 Chemical Disinfectants

a) Characterization of ideal disinfectant

b) Chemical Agent

i) Phenol and Phenolic compounds

ii) Alcohols

iii) Halogens

iv) Heavy metals and their Compounds (Hg, Au, Ag)

v) Quaternary Ammonium Compounds

vi) Aldehydes

vii) Gaseous sterilizing Agents: Formaldehyde, Ethylene Oxide,  $\beta$  -  
Propiolactone.

viii) Soaps

ix) Surfactants and Synthetic detergents

3.3 Evaluation of Disinfectant (Phenol Co efficient).

## **Unit IV: Control of Microbial growth (Physical agent).**

**11**

4.1 Microbial death concept.

4.2 Sterilization by Physical Agent

a) Heat: Moist Heat, Dry heat, Boiling, Tyndallization, Pasteurisation, Steam under pressure (Autoclave) Incineration, Hot air Oven.

b) Radiations: Ionising and Nonionising radiations.

c) Filtration and Types of filters (Bacteriological)

## Semester II

### Paper III: Basic Microbiology

**Maximum Marks: 60**

**Periods: 45**

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**Unit I: Eukaryotic and Prokaryotic cell morphology. 7**

Bacterial morphology, animal and plant cell structure.

Differentiation between Eukaryotic and Prokaryotic cell.

**Unit II: Bacterial Morphology and Ultra structure. 14**

1.1 Cytology of typical bacterial cell

- a) Morphology - size and arrangement of bacterial cell.
- b) Structure, Chemical composition and function of following: -
  - i) Capsule and slime layer
  - ii) Cell wall: Gram positive and Gram negative bacteria
  - iii) Unit membrane
  - iv) Flagella: Arrangement, Mechanism of Flagellar movement, Chemotaxis, Phototaxis, Magnetotaxis
  - v) Pili.
  - vi) Ribosomes
  - vii) Nuclear material Mesosome, Plasmid
  - viii) Endospore- Types, Sporulating bacteria, Architecture of Endospore, Sporulation process, Germination process
  - ix) Reserve Food material poly- $\beta$  hydroxy butyric acid granules, Glycogen, Poly phosphate granules and sulfur granules

**Unit III: Growth 12**

3.1 Bacterial Growth

- a) Concept of Growth

- b) Definition
- c) Bacterial Growth Curve
- d) Phases of Growth
- e) Diauxic Growth
- f) Synchronous Growth
- g) Continuous Culture
- h) Measurement of bacterial Growth

### 3.2 Bacterial Cell division.

Binary fission.

## **Unit: IV Effect of Environmental factors on Microorganisms.**

**12**

### 4.1 Effect of Environmental factors on Microorganisms

- a) Temperature
- b) PH
- c) Nutrient concentration
- d) Oxygen
- e) Osmotic Pressure
- f) Hydrostatic pressure
- g) Surface Tension
- h) Heavy metals
- i) Radiation

## **Paper IV: General Microbiology and Biochemistry**

**Maximum Marks: 60**

**Periods: 45**

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### **Unit I: Biochemistry of Macromolecules**

**Periods: 12**

- 1.1 Carbohydrates
  - a) Definition and classification
  - b) Triose, Pentose, Hexose (Examples and Structure)
  - c) Disaccharides: - Glycoside linkage (Lactose, Maltose and Sucrose)
  - d) Oligosaccharides: - Trisaccharides (Structure of Raffinose)
  - e) Polysaccharides: - Homo and Heteropolysaccharides Structure (Starch, Cellulose, Mucopolysaccharides)
  - f) Biological Significance of carbohydrates
- 1.2 Lipids
  - a) Definition and classification
  - b) Types of lipids
    - i) Simple Lipids: - Triglycerides
    - ii) Conjugated Lipids: - Phosphatidic Acid, Phospholipids and Cholesterol
  - c) Biological importance of Lipids
- 1.3 Nucleic Acids
  - a) Nucleosides and Nucleotides, Ribose, Deoxyribose sugars
  - b) DNA: - Properties, Structure and Functions
  - c) RNA: - Properties, Structure, Function
- 1.4 Proteins
  - a) Definition and classification
  - b) List of 20 amino acids
  - c) Peptide bonds
  - d) Biological Significance of proteins

**Unit II: Nutrition****11 periods**

- 2.1 Microbial nutrition
  - a) Concept
  - b) Common nutritional requirements
  - c) Energy sources
  - d) C, H, N, O, P, S, Micronutrients, Growth factors, Water etc.
  - e) Nutritional categories of microorganisms on the basis of carbon and energy source.

**Unit III: Uptake of nutrients (In brief)****11 Periods**

- a) Passive diffusion
- b) Facilitated diffusion
- c) Active transport mechanism.
- d) Group translocation
- e) Uptake of amino acids and sugars (as examples)

**Unit IV: Classification of Microorganisms.****11 Periods**

- 4.1 Microbial Classification and Nomenclature
  - a) Taxonomic Groups
  - b) Goals of classification
- 4.2 General Methods of classifying Bacteria
  - a) Intuitive Method
  - b) Numerical Taxonomy
  - c) Genetic Relatedness.
- 4.3 Nomenclature
- 4.4 Introduction to Bergey's Manual (9<sup>th</sup> Edition)

## **B.Sc. First Year**

### **Practical Paper V (Theory Based)**

**Maximum Marks - 60**

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Practical syllabus requires four periods per batch per week for 2 consecutive days. B.Sc First year practical includes studies of growth of microorganisms and life activities of microorganisms. These studies needs two consecutive days for completion of practicals.

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#### **1) Microscopy**

- i. Different parts of compound microscope.
- ii. Use and care of compound microscope.

#### **2) Construction, Operation and utility of laboratory equipments.**

Autoclave

- i. Hot air oven
- ii. Incubator
- iii. pH meter
- iv. High speed centrifuge
- v. Colorimeter/Spectrophotometer
- vi. Anaerobic jar
- vii. Bacterial filters
- viii. Laminar airflow

#### **3) Staining**

- i. Simple staining: Monochrome, Negative
- ii. Differential: Gram's staining
- iii. Structural staining:
  - a) Capsule staining: Maneval's Method
  - b) Cell wall staining: Chance's method
  - c) Endospore staining: Schaefer and Fulton's Method
  - d) PHB staining: Burdon's method

- 5) **Micrometry**
- 6) **Preparation of culture media**
  - i. Nutrient broth and Agar
  - ii. Mac Conkey's Broth and Agar
  - iii. Sugar Media
- 7) **Isolation of bacteria from mixed culture**
  - i. Streak plate method
  - ii. Spread plate method
  - iii. Pour plate method
- 8) **Effect of physical and chemical agents on growth of bacteria**
  - i. pH
  - ii. Temperature
  - iii. Heavy metal ions (Oligodynamic Action)
  - iv. U.V. rays
  - v. Antibiotics
- 9) **Qualitative tests for**
  - a. Carbohydrates: Benedict's test
  - b. Protein: Biuret test
  - c. Nucleic acid: Diphenylamine test (DPA) for DNA and Orcinol test for RNA.
- 10) **Demonstration of Yeast, Fungi, Actinomycetes, Algae and Protozoa.**
- 11) **Study of Bacterial Growth curve.**
- 12) **Hanging drop technique.**

## Reference Books

1. Bisen P.S., Varma K . : Handbook of Microbiology CBS Publishers and Distributors, Delhi.  
Introduction to viruse : Vikas Publishing House Pvt. Ltd., New Delhi.
2. Dubey H.C.: A textbook of fungi and Viruses, Vikas Publishing House Pvt. Ltd. Delhi.
3. Dubey R.C. and D.K. Maheshwary, A textbook of Microbiology S chand and Co. New Delhi.
6. Frobisher, Hinsdill, Crabtee, Goodheart : Fundamentals of microbiology: W.B.Saunders Company, U.S.A, Toppan Company Ltd., Japan.
7. Luria: General Virology
8. Modi H.A.: Elementary Microbiology (Fundamentals of Microbiology) Vol. II Ekta Prakashan, Nadiad, Gujrat and I.
9. Parasher Y.K.: Modern Microbiology: Campas Books International, New Delhi
10. Pelczar Michael J., Jr./E.C.S. Chan, Elements of Microbiology: McGraw, Hill International Book Company, New Delhi.
11. Pelczar Michael J ., Jr. E.C.S Chan, Noel R.Krieg : Microbiology : Concepts and applications- McGraw Hill Inc.
12. Pelczar Michael J., Reid R.D. and Chan E.C.S.: Microbiology, Tata McGraw hill publishing Co. Ltd., New Delhi.
13. Powar C.B.and Daginawala H.F.: General microbiology Vol I and II Himalaya publishing house Bombay.
14. Prescott L.M., Harley J.P., and Klein Donald A.: Microbiology, W.M.C., Brown publishers
15. Purohit S.S. : Microbiology : Fundamentals and Applications : Agro-Botanical publishers, Bikaner, India.
16. R.A. Atlas: Microbiology - Fundamentals and Applications McMilan.
17. Singh R.P., Microbiology Kalyani Publication
18. Stanier Roger Y., Adelberg Edward A., Ingraham John L., General microbiology, Prentice-Hall, Englewood Cliffs, New Jersey. Publishing Co. Ltd., New Delhi.
19. Tauro P, Kapoor K.K., yadav K.S.: introduction to Microbiology: Wiley Eastern Ltd., New Delhi.
20. Tortora G.J. Funke B. and Case Christine L: Microbiology: an Introduction: The Benjamin Publishing Co. New York.
22. Yadav Manju, Microbiology Discovary Publishing House, New Delhi Microbiology, Times Mirror/mosby College Publication.
23. Gunasekarn : Introduction to Microbial techniques.
24. Handbook of microbiological media - Himedia.
25. Dubey, Maheshwari: Practical Microbiology.