

# MICROBIOLOGY

## B.Sc.III Semester- V

### Environmental Microbiology and Bioinstrumentation

The examination shall comprise of two theory papers, one in each semester and one practical in each Semester. Each theory paper will be of 3 hours duration and carry 80 marks. The internal assessment will carry 20 marks. The following syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper have been divided into 6 units. There shall be one question on each unit, will internal choice and for each of 12 marks and one compulsory question covering all the syllabus of semester V(8 marks).

#### Unit-I : Microbial Associations and Air Microbiology

**A. Microbial Associations:** Definition and examples of positive(Mutualism, Commensalism, Synergism), negative (Antagonism, Competition, Parasitism ) and neutral association.

#### B. Air Microbiology

- a) The atmosphere and its layers.
- b) Different types of microorganisms in air.
- c) Techniques for microbiological analysis of air:
  - i) Solid impingement devices
  - ii) Liquid impingement devices.
- d) Airborne diseases: Etiology, symptoms and prevention.
- e) Control of microorganisms in air.

#### Unit-II : Microbiology of Soil.

- a) Microorganisms in soil.
- b) Rhizosphere.
- c) Decomposition of plant and animal residues in soil.
- d) Definition, formation, function and microbiology of humus and compost.
- e) Biological Nitrogen fixation : Type of nitrogen fixing microorganisms, factors affecting and mechanism of symbiotic and non-symbiotic nitrogen fixation. Process of nodulation, nitrogenase complex, recombinant DNA and nitrogen fixation, legume inoculants.
- f) Cycles of elements in nature :
  - i) Carbon cycle : CO<sub>2</sub> fixation, organic carbon degradation.
  - ii) Nitrogen cycle : Proteolysis, amino acid degradation, Nitrification, Denitrification, Degradation of nucleic acids.
  - iii) Sulphur cycle
  - iv) Phosphorus cycle.
  - v) Biofertilizers, biological pest control.

#### Unit III : Water Microbiology

- a) Planktons : Definition, types, factors affecting growth of planktons, methods of enumeration, beneficial and harmful activities of planktons.
- b) Control of plankton problems
- c) Eutrophication and its control.

## **Unit IV : Assessment of Water Quality and Treatment**

### **Bacteriological analysis of water:**

- i) Significance of bacteriological analysis of water.
- ii) Collection and handling of water sample from various sources.
- iii) Indicators of excretal pollution.
- iv) Multiple tube dilution technique, MPN.
- v) IMViC classification of coliform.
- vi) Membrane filter technique for coliform and faecal Streptococci.
- vii) ICMR and WHO Bacteriological standards of drinking water.

### **Unit V: A) Water Treatment**

- a) Self purification of water : Various zones and factors responsible for self purification.
- b) Treatment of water : Aeration, Coagulation, Flocculation, Sedimentation and Filtration.
- c) Slow and Rapid sand filters : Construction, mechanism of filtration, differences.
- d) Methods of chlorination : Plain, super chlorination, ammoniachlorine treatment, Break-point chlorination

### **B)Waste Water Treatment**

- a) Aims of sewage treatment, composition of sewage.
- b) Municipal sewage treatment plant.
- c) Preliminary treatment (seiving and Grit chamber)
- d) Primary treatment(sedimentation)
- e) Secondary treatment (Aerobic)
  - i) Trickling filter
  - ii) Activated sludge process
  - iii) Oxidation pond
- f) Anaerobic sludge digestion
- g) Domestic sewage treatment by septic tank and Imhoff tank.
- h) Concept of COD,BOD.
- i) Outline of bio-gas production

### **Unit VI: Bio-Instrumentation**

- a) Spectroscopy- Definition, Principle, types (UV&IR) & its applications.
- b) Electrophoresis- Definition, Principle, types (Paper&Gel) & its applications.
- c) Chromatography- Definition, Principle, types (Paper&TLC) & its applications.
- d) I sotopic Tracer Techniques - Definition, Principle & applications.

### **Microbiology Practicals.**

1. Bacteriological analysis of water and Waste Water.
  - a) Standard plate Count.
  - b) Multiple tube dilution technique (MPN for Coliform)
    - i) Presumptive test ii) Confirmatory test iii) Completed test.
  - c) IMViC test for coliform
  - d) Multiple tube dilution technique for faecal strepto cocci.
  - e) Membrane filter technique for coliforms & faecal streptococci.
  - f) BOD estimation.

- g) Isolation of Bacteriophage from Sewage.
- h) Determination of Chlorine demand and residual chlorine.

## **2. Study of Soil Microbiology**

- a) Enumeration of Soil microorganisms.
  - b) Isolation of Azotobacter from Soil.
  - c) Isolation of Rhizobium from Soil
  - d) Isolation of Antibiotic producers from soil
3. Effect of Ultra-violet/Filtration on micro-organism present in water
4. Separation of amino acids and sugars by paper chromatography.

### **List of Reference Books:**

1. Introduction to Soil Microbiology : Alexander Martin
2. Soil Microbiology : Subbaroa N.S.
3. Introduction to environmental Microbiology: Mitchell, Ralph
4. Sewage & Waste treatment : Hammer
5. Water Pollution : Zajic J.E.
6. Water Pollution Microbiology : Mitchell R.
7. Air Pollution : Perlins H.L.
8. Aquatic Microbiology : Stainer & Shewan
9. Introduction to Waste Water Treatment processes: Ramalhr R.S.

## **Industrial Fermentation, Food Microbiology and Metabolism**

### **B.SC. FINAL (SEMESTER-VI) MICROBIOLOGY**

The examination shall comprise of two theory papers, one in each semester and one practical in each Semester. Each theory paper will be of 3 hours duration and carry 80 marks. The internal assessment will carry 20 marks. The following syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper have been divided into 6 units. There shall be one question on each unit, will internal choice and for each of 12 marks and one compulsory question covering all the syllabus of semester VI(8 marks).

#### **Unit- I : Fermentation in General.**

- a) Definition and scope of Industrial microbiology and biotechnology.
- b) Important classes of industrial microorganisms.
- c) Fermentation :- Definition and types ( batch and continuous, aerobic and anaerobic, surface and submerged fermentations )
- d) Production strains
  - e) Screening :- Definition, Primary screening ( crowded plate technique, auxanography, enrichment culture technique, use of indicator dyes ), secondary screening.
  - f) Scale up process :- Definition and significance.
  - g) Inoculum buildup : Spore and vegetative inoculum.
  - h) General layout of fermentation plant :- Fermentation equipment and its uses.
  - i) Raw materials: - Composition and uses. Saccharine, starch, cellulose raw materials, hydrocarbon and vegetable oils, nitrogenous material ( corn steep liquor).
  - j) Antifoam agents.
  - k) Sterilization of media :- Batch and continuous sterilization.
  - l) Detection and assay of fermentation products.

#### **Unit- II : Industrial Productions I:**

Microorganisms, raw material, inoculum buildup, fermentation conditions, recovery, uses and mechanism of the following products.

- a) Ethyl-alcohol : From molasses and waste sulphite liquor.
- b) Beer.
- c) Wine ( Red table and White table ).
- d) Acetone- Butanol from corn.
- e) Citric acid
- f) Vinegar- Fring's process

#### **Unit- III : Industrial Productions II:**

- a) Baker's yeast : From molasses, Definition of compressed and active dry yeast.
- b) Single cell protein : From bacteria.

- c) Penicillin.
- d) Amylase : Bacterial and fungal.
- e) Vitamin B12.

#### **Unit-IV : Microbiology of Milk**

- a) Definition
- b) Composition and types of milk.
- c) Sources of microorganisms in Milk.
- d) Types of microorganisms in milk.
- e) Pasteurization of milk : LHT, HTST, UHT. Phosphatase test.
- f) Grades of milk.
- g) Concentrated milk and milk powder.
- h) Preparation of fermented milk products, butter and cheese.

#### **Unit-V : Food Microbiology**

- a) Sources of contamination of fresh food.
- b) Microbial spoilage of foods.
- c) Preservation of foods :- Low and high temperature, dehydration, high osmotic pressure, chemical preservation, radiations and canning.
- d) Fermented foods : Idli, pickles and sauerkraut.
- e) Food poisoning : Food infection and food intoxication.
- f) Indicators of food contamination as per WHO.

#### **Unit VI : Enzymology and Metabolism**

##### **A Enzymology :**

- a) Nature and Definition.
- b) Classification and nomenclature of enzymes.
- c) Terminologies used in enzymology :- Enzyme, active site, substrate, co-enzyme, cofactors, prosthetic group, apoenzyme, activation energy, isoenzyme, allosteric enzyme, inhibitors, immobilized enzymes.

##### **B Metabolism :**

- a) General strategies of metabolism.
- b) EMP pathway, TCA cycle.
- c) Oxidative phosphorylation and Electron transport chain

#### **Microbiology Practicals:**

##### **1. A) Microbiological Examination of milk:**

- a) Plate count
- b) Methylene blue reduction test (MBRT)
- c) Phosphatase test
- d) Test for coliform bacteria
- e) Estimation of fats in milk
- f) Milk testing for Adulteration

##### **B) Demonstration of microbes in Curd.**

2. A) Laboratory scale production, recovery and quantitative estimation of following products:  
 a) Ethyl alcohol. b) Citric Acid c) Amylase  
 B) Immobilisation of Yeast.  
 C) Production of Curd/ Pickle/ Cheese by microorganisms  
 D) Production of wine from grapes/ other raw material
4. Microbiological Examination of Vegetables, fruits and Fast Foods by  
 a) Plate Count  
 b) Test for Coliform bacteria.  
 c) Yeast & Molds.

**Distribution of marks for Microbiology Practical Examination:**

Major Experiment	- 15 marks
Minor Experiment	- 10 Marks
Viva Voce	- 10 marks
Spotting	- 10 marks
Laboratory Journals	- 05 Marks
<b>Total</b>	<b>- 50 marks</b>

**List of Reference Books for 6S Microbiology:**

1. Food Microbiology : Fazier W.C. & Westhoff D.C.
2. Fermented Foods (Vol.7) : Rose A.A.
3. Industrial Microbiology : Prescott S.C. & Dunn C.G.
4. Industrial Microbiology : Miller B.M. & W. Litsky
5. Industrial Microbiology : A.H. Patel
6. Microbial Technology : Pepler H.J. (Vol. I & II)
7. Industrial Microbiology : Casida L.E.
8. Principles of Fermentation : Stanbury, Peter F. & Technology Allan. Whitaker
9. Outlines of Dairy Bacteriology : Sukumar De
10. Modern Food Microbiology : Jay, Mames M.
11. Principles of Industrial : Rhodes & Fletcher. Microbiology
12. Industrial Fermentation : Under Kofler & Hick. Vol. I & II
13. Dairy Microbiology : Foster Etal
14. Industrial Microbiology : Rose

**BOOKS RECOMMENDED FOR PRACTICALS :**

1. Microbes in Action : Seely, Wander Mark, Taraporewala, Bombay.
2. Manual of Microbiological : A.J. Salle, Methods
3. Microbiological Methods : Collins
4. Difco Manual.