DEPARTMENT OF MICROBIOLOGY

B. Sc. III Semester-V syllabus
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 has 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: 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.

B) Microbial Associations and Air Microbiology A. Microbial Associations: Definition and examples of positive (Mutualism, Commensalism, Synergism), negative (Antagonism, Competition, Parasitism) and neutral association. b) Control of plankton problems c) Eutrophication and its control.

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_2 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. g) Domestic sewage treatment by septic tank and Imhoff tank. h) Concept of COD, BOD. i) Outline of bio-gas production

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 fecal 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, ammonia chlorine treatment, Break-point chlorination.

B) Waste Water Treatment: a) Aims of sewage treatment, composition of sewage. b) Municipal sewage treatment plant. c) Preliminary treatment (sieving 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.

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) Isotopic 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 fecal streptococci.
    e) Membrane filter technique for coliforms & fecal 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.

Distribution of practical marks:

1. Major Experiment - 15 marks
2. Minor Experiment - 10 Marks
3. Viva Voce - 10 marks
4. Spotting - 10 marks
5. Laboratory Journals - 05 Marks ———————————— Total - 50 marks

List of Reference Books:

THEORY:

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: Stainner & Shewan
9. Introduction to Waste Water Treatment processes: Ramalhr R.S.

B. Sc. III Semester-VI syllabus

Industrial Fermentation, Food Microbiology and Metabolism

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 has 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, starchy, 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, inoculums 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) 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, holo enzyme, Apo enzyme, 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) Phosphatases 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) Immobilization of Yeast.

C) Production of Curd/ Pickle/ Cheese by microorganisms

D) Production of wine from grapes/ other raw material

3. 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:

1. Major Experiment - 15 marks
2. Minor Experiment - 10 Marks
3. Viva Voce - 10 marks
4. Spotting - 10 marks
5. Laboratory Journals - 05 Marks ———————— Total - 50 marks

List of Reference Books:

THEORY:

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: Pepller H.J. (Vol. I & II)
7. Industrial Microbiology: Casida L.E.
8. Principles of Fermentation: Stanbury, Peter F. & Technology Allan. Whitaker
9. Outlines of Diary 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. Mannual of Microbiological: A.J. Salle, Methods
3. Microbiological Methods: Collins
4. Difco Mannual.