# B. Sc.

# INDUSTRIAL MICROBIOLOGY

(Anil Prakash)

(DR. SHIKHA BANSAL)

(NIDHI NARULA)

(Saba Ali)

# SCHEME OF EXAMINATION

| | | Max. Marks | Min. Marks | Total |
|---|---|---|---|---|
| **B.Sc. Ist Year** | Paper- I-Theory | 42 ½ | 14 | |
| | CCE | 2 ½ + 5 | 1 + 2 | |
| | Paper-II-Theory | 42 ½ | 14 | |
| | CCE | 2 ½ + 5 | 1 + 2 | |
| | Practical | 50 | 17 | **150** |
| **B. Sc. IInd Year** | Paper- I-Theory | 42 ½ | 14 | |
| | CCE | 2 ½ + 5 | 1 + 2 | |
| | Paper-II-Theory | 42 ½ | 14 | |
| | CCE | 2 ½ + 5 | 1 + 2 | |
| | Practical | 50 | 17 | **150** |
| **B.Sc. IIIrd Year** | Paper- I-Theory | 42 ½ | 14 | |
| | CCE | 2 ½ + 5 | 1 + 2 | |
| | Paper-II-Theory | 42 ½ | 14 | |
| | CCE | 2 ½ + 5 | 1 + 2 | |
| | Practical | 50 | 17 | **150** |

(DR SHIKHA BANSAL)

## B. Sc. I, II, and III Year

### PRACTICAL SCHEME

| | | |
|---|---|---|
| Major- Any One | - | 10 |
| Minor-Any Two | - | (5+5) |
| Spotting | - | 10 |
| *Viva voce* | - | 10 |
| Sessional/Record | - | 10 |
| **TOTAL** | - | **50** |

(DR SHIKHA BANSAL)

# B. Sc.

# INDUSTRIAL MICROBIOLOGY

## (I - Year)

## B. Sc. I Year

### (INDUSTRIAL MICROBIOLOGY)

**MM 42 ½**

### PAPER-101 FUNDAMENTALS OF INDUSTRIAL MICROBIOLOGY & TECHNIQUES

**UNIT – I : HISTORY AND SCOPE :-**

History:- Spontaneous generation and Biogenesis; scope and application of Microbiology in human welfare; Development of Microbiology:- Contribution of A. V. Leeuwenhock. Alexander Fleming, Louis Pasteur, Robert Koch and Edward Jenner;

**UNIT- II : DIVERSITY OF MICROBIAL WORLD A :-**

Three kingdom and Whittaker's five kingdom system of classification.

General Characteristics and structure of Eubacteria- Morphology, structures external and internal to cell wall.

Bacteria with unusual Properties:- Archaeobacteria, Cyanobacteria, Mycoplasma and Actinomycetes.

**UNIT- III : DIVERSITY OF MICROBIAL WORLD B :-**

Introduction to Fungi: Classification, general characteristics, reproduction and economic importance.

Introduction to Virus, Classification, general characteristics, structure and reproduction: T4, TMV, Pox Virus, Prions, Virions, Virusoid and Viriods

**UNIT-IV: MICROBIAL TECHNIQUES :-**

Microscopy: History, Principle, Construction and Application of Bright field Microscopy, Dark field Microscopy, Phase contrast, Fluorescent Microscopy and electron Microscopy, sofware in microscopy.

Instrumentation: Principle, construction and application of Autoclave, Hot air oven, incubator, B. O. D. incubator, laminar Air Flow, Colorimeter, Spectrophotometer, pH meter, centrifugation and chromatography(TLC)

**UNIT-V : MICROBIOLOGICAL METHODS :-**

Media Preparation; Concept of sterilization and disinfection; types of culture; Pure culture techniques; Nature of dyes,physical and chemical theories of staining, principle, procedure and

application of simple staining,negative staining, differential staining.Enrichment culture and micromanipulator; Maintenance and preservation of pure cultures.

**List of recommended books:**


1. Microbiology- Pelczar, Chan and Kreig. Ingrahm
2. General Microbiology- Stainier, Ingharam, Wheelis and Painter.
3. Biology of Microorganisms Brook and Madigan.
4. Fundamental Principles of Bacteriology, - A.J. Salle.
5. Introduction to Microbiology, - Ingraham and Ingraham.
6. Tools and techniques In microbiology by Nath and Upadhyay
7. Powar C. B. and H. F. Daginawala (2003). General Microbiology Vol. 2; Himalaya Publishing House.
8. Dubey R. C. and D, K. Maheshwari (2004). A Text book of Microbiology, 1st Edition; S.Chand and Company Ltd.
9. H. C. Dube (2005) A Textbook of Fungi, Vikas Publishing House.
10. Aneja, K. R. Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Cultivation; New Age International, New Delhi.
11. Atlas R. M. Microbiology – Fundamentals and Applications, Mac Millan Publishing Company, New York.

# B. Sc. I – Year

## (INDUSTRIAL MICROBIOLOGY)

### Paper – 102 MICROBIAL BIOCHEMISTRY AND IMMUNOLOGY

**UNIT – I: CARBOHYDRATES :-**

Classification; Chemical structure and properties of monosaccharides, oligosaccharides and polysaccharides.

**UNIT – II: LIPIDS AND NUCLEIC ACID :-**

Saturated and unsaturated fatty acids; structure, classification, properties and functions of lipids.

Structure and properties of purines and pyrimidines, structure and types of nucleic acids.

**UNIT – III: PROTEINS :-**

Structure, classification and properties of amino acids, classification and properties of proteins, primary, secondary and tertiary structures of proteins.

**UNIT– IV : ENZYMES :-**

Classification of enzymes, coenzymes and cofactors, mechanism of enzyme action, competitive and non competitive inhibitions, allosteric regulation of enzymes, isoenzymes, factors affecting enzyme action.

**UNIT– V :- IMMUNOLOGY**

History & Scope of immunology, antigens- types of antigens, antigenic determination, determinants of antigenicity. Antibodies- nature, function, structure of immunoglobulin, types of Ig and abnormal immunoglobulins. Production of vaccines & Monoclonal antibodies. Antigen-antibody reactions-precipitation, agglutination, neutralization, opsonisation. Iimmunodiffusion, immunoelectrophoresis, ELISA.

**List of recommended books:**

1. Principles of Biochemistry - A.L. Lehninger.

2. Fundamentals of Biocheminstry – J.L. Jain

3. Biocheminstry- Voet and Voet.

4. Microbial Genetics – Freifelder.

5. Text book of Microbiology – Dubey and Maheshwari.

6. Powar C.B. and G.R. Chatwal (1994). Biochemistry, 3rd Edition; Himalaya Publishing House, New Delhi.

7. Powar C.B. and H.F. Daginawala (2003). General Microbiology Vol. I: Himalaya Publishing House.

8. Jain, J. L., S. Jain and N. Jain (2005) 6th Edition. Fundamental of Biochemistry, S. Chand and Co.

9. Rama Rao, A.V.S.S. (2000) 8th Edition. Texbook of Biochemistry, UBS Publ.

## B. Sc. I Year –

## Practicals

1. Safety measures in Laboratory.

2. Study of compound microscope- Construction, working, principle, care to be taken while using the microscope. Use of oil immersion objective.

3. Study of instruments- Autoclave, hot air oven. Laminar air flow bench, calculation of NA (Numerical Aperture), RP (Resolving Power) and colony counter, Inoculation loop and needle, Incubator, centrifuge, pH meter, Seitz filter, membrane filter and colorimeter/spectrophotometer.

4. Cleaning and sterilization of glasswares.

5. Study of aseptic techniques-preparation of cotton plugs for test tubes and pipettes, wrapping of petri-plates and pipettes

6. Basic media prepation staining of bacteria-

7. Pure culture techniques- Pour, Streak and Spread.

8. Staining of bacteria

A) Simple staining methylene blue staining

b) Gram staining

9. Qualitative and Quantitative estimation of carbohydrates.

10. Qualitative and Quantitative estimation of proteins.

11. Qualitative estimation of lipids.

# B. Sc.

# INDUSTRIAL MICROBIOLOGY

## (II - Year)

(Anil Bakaso)

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(NIDHI NARULA)

(Saba Ali)

MM 42 ½

## IBM 201-MICROBIAL PHYSIOLOGY & METABOLISM

### UNIT – I: MICROBIAL GROWTH:-

Definition of growth, Mathematical nature and expression of growth, Generation time, Growth curve in Bacteria, Measurement of Growth (cell number, cell mass and cell constituent), Effect of environment on the microbial growth, (temperature, pH and Oxygen), Continous culture Synchronous culture and Batch culture.

### UNIT – II : MEMBRANE TRANSPORT PROCESS:-

Different models of cell membrane, Biochemical properties of cell membrane, function of cell membrane, Types of cellular transport( diffusion, gaseous exchange, osmosis, plasmolysis, active & passive transport, group translocation).

### UNIT – III : BACTERIAL PHOTOSYNTHESIS AND FUELING REACTIONS:-

Classification of photosynthetic bacteria(Oxygenic & anoxygenic photosynthetic bacteria), Photosynthetic structure, Photosynthetic pigments, Photosynthetic electron transport system, Mechanism of Photosynthesis(Cyclic& Non cyclic).

### UNIT – IV : METABOLIC PATHWAYS:-

Respiratory Pathways(Glycolysis, Entner Daudoroff pathway, Pentose phosphate pathway, Krebs cycle), Calvin Cycle, substrate level& oxidative phosphorylation, Fermentation process & products.

### UNIT – V- : MICROBIAL ASSIMILATION AND BIOENERGETICS:-

Assimilation of Ammonia, Nitrogen and sulphate Methanogens and methylotrophs, Principles of Bioenergetics, $\Delta G$, endergonic and exergonic reaction, oxidation reduction reaction, Redoxpotential

**Text & Reference Books:**

1. Doelle, H.W. 1975, Bacterial metabolism. 2nd edition. Academic press.

2. Moat, A.G. and Foster, J. W. 1988. Microbial physiology, 2nd edition, Springer verlag.

3. White, D. 2000. Physiology and Biochemistry of Prokaryotes. 2nd edition. Oxford University Press, New York.

4. Caldwell, D. R. 1995. Microbial physiology and metabolism. Wm. C. Brown publishers, England.

5. Madigan, M. T. Martinko, J.M., Stahl, D. A. and Clark, D.P. 2012. Brock Biology of Microorganisms. 13th edition, Benjamin Cummings, San Francisco.

## B. Sc. II – YEAR

## (INDUSTRIAL MICROBIOLOGY)

**MM 42 ½**

### PAPER 202-MICROBIAL GENETICS and MOLECULAR BIOLOGY

### UNIT – I - DNA REPLICATION AND PROTEIN SYNTHESIS:

Types and mechanism of DNA Replication; DNA topology; DNA Replication in prokaryotes and eukaryotes, Protein synthesis.

### UNIT-II- GENE REGULATION IN PROKARYOTES AND EUKARYOTES:

Operon concept- Lac and trp; Britten Davidson model of gene expression.

### UNIT- III- MUTATION:

Types of multation: Molecular basis; Mutagenic agents DNA damage andrepair mechanism; Auxotrophs; Prototrophs and ame's test

### UNIT- IV- GENETIC RECOMBINATION IN BACTERIA

Transformation, Transduction and Conjugation, Genetic mapping, extrachromosomal genetic material; Plasmid, cosmid, transposon, overlapping gens, silent genes.

### UNIT- V- RECOMBINANT DNA TECHNOLOGY:-

Isolation of DNA; Enzymes used in recombinat DNA Technology; Use of vectors:- PBR322, PUC 8 phage vectors-M.13,λ , Cosmid, phagemic, Ti plasmid, SV40; Gene cloting in prokaryotes;Southern and western blotting,

rDNA products; Insulin, Interferons and Immunotoxins.

**Text & Reference Books:**

1. Primrose, S. Twyman, R. and Old, B. 2001. Principle of Gene Manipulation, 6th edition, Blackwell Science Ltd.

2. Chakravary, A. K. 2013, Introduction to biotechnology, OUP India.

3. Chaudhuri, K. 2012, microbial genetics. The enegy and resources institute, TERI.

4. Sridhar, S. 2005. Genetics and microbial biotechnology. Dominant publishers and distributors.

5. Nicholl, D.S.T. 1994. An introduction to genetic engineering, cambridge university press.

6. Old, R. W. and Primrose, S.B. 2008. Principles of Gene manipulation, 4th edition, blackwell scientific publications, London.

7. Recombinant DNA Tech. by Sardul Singh Sandh, I. K. International, New Delhi.

## B.Sc. II - Year

### Practicals

1. Study of osmosis in bacterial cell.
2. Study of plasmolysis in bacterial cell.
3. Effect of pH on the growth of bacteria on solid media.
4. Effect of salt on the growth of microoganisms.
5. Effect of temperature on the growth of microorganisms.
6. Effect of antibiotics on bacterial growth by paper disc method.
7. Measurement of size-Micrometer.
8. Measurement of cell number-Haemocytometer.
9. Isolation of DNA from bacteria.
10. Immobilization of yeast cells by sodium alginate method.

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# INDUSTRIAL MICROBIOLOGY

## (III - Year)

## B. Sc. III - YEAR

## (INDUSTRIAL MICROBIOLOGY)

**Paper 301 : FERMENTATION TECHNOLOGY AND BIOSTATISTICS** **MM:-42½**

### UNIT – I :- PRINCIPLE OF FERMENTATION :-

Primary and secondary screening of industrially important microorganisms ; Strain improvement mutation, recombination and protoplasmic fusion; development of inoculum for industrial fermentation: types of fermentation media – saccharine materials, starchy materials, cellulosic materials, nitrogenous materials, enhancers and precursors.

### UNIT – II :- DESIGN AND TYPES OF FERMENTOR :-

Structure of a batch fermentor ; Types of fermentor ; Batch ; Continuous ; Stirred tank ; Fluidized bed and Solid State fermenter ; computer control of fermentation process.

### UNIT – III :- RECOVERY PROCESS :-

Downstream Processing – intracellular and extracellular product recovery ( Physical and Chemical methods ) ; Cell disruption method , solvent extraction and purification ; Product recovery by whole broth processing.

### UNIT – IV :- BIOSAFETY MEASURES :-

Government regulations of recombinant DNA Research ; Quality control regulations ; Hazardous industrial waste ; mycotoxin hazards ; Regulation for disposal of bio-hazardous materials ; Biopatents in industries; Biosafety in laboratories and industries (Dairy and Food, Pharmaceutical, Agricultural and Beverages).

### UNIT – V :- BIOSTATISTICS AND BIOINFORMATICS :-

A. Biostatistics : Principle of Biostatistics; Classification of Data; Tabulation and Graphical representation; Measures of Central Tendency- Mean, Mode, Median- merits and demerits; Measure of Dispersion Range; Mean Deviation variance and Standard Deviation.

B. Bioinformatics: Basic Organization of computer; Computer Hardware; Software, Bit, Byte, Computer Memory, Binary Code, Binary System; Introduction to Bioinformatics, Database and application of Bioinformatics.

**Text & Reference Books:**

1. Whitaker, A. Stanbury, P.F. and Hall, S.J. 2009. Principles of fermentation techniques. Elsevier.

2. Prescott, S.C., Dunn, C.G., and Reed, G. 1982. Prescott and Dunn's Industrical Microbiology, 4th Edition. AVI Publ. Co., Westport, Conn.

3. Hui, Y. H., Meunjer-goddik, L., Hansen, A.L., Josephsen, J., Nip, W.K., Stanfield, P.S. and Toldra, F. 2004. Handbook of Food and Beverage Fermention Technology, New York: Marcel Dekker Incorporated.

4. Casida L. E., 1968, Industrial Microbiology, Wiley New York.

5. Shrivastava M. 2008, Fermentation Technology, Alpha science International.

6. Agrawal B.L., Basic Statistics.

7. Mishra and Mishra Statistics.

8. Glover and Mitchell: Biostatistics.

## B. Sc. III – YEAR

## (INDUSTRIAL MICROBIOLOGY)

### Paper 302 : AGRICULTURAL , ENVIRONMENTAL AND INDUSTRIAL MICROBIOLOGY.

### UNIT I :- BIOFERTILIZERS AND BIOPESTICIDES :-

Biofertilizer :- Industrial production of *Rhizobium, Azotobacter,* Cyanobacteria, Mycorrhizae – VAM and phosphate solubilizing bacteria

Biopesticides :- Production of bacterial , viral and fungal biopesticides, microbial warfare on plants.

### UNIT II :- BIOREMEDIATION AND BIOLEACHING :-

Management of Industrial waste- textile, pharmaceutical and dairy industry.

Management of agricultural waste.

Management of Municipal waste- Primary, Secondary and Tertiary treatment Microorganisms in Composting., Bioleaching of copper and gold.

### UNIT III :- METABOLITES PRODUCTION :-

Industrial production of organic acids, enzymes (amylase and protease), solvents (acetone, enthanol and glycerol) Vitamins (B12 and riboflavin), Antibiotics (Penicillin and Streptomycin)

### UNIT IV :- FOOD AND DAIRY MICROBIOLOGY :-

Microbial role in production of bread, cheese, butter, yoghurt, cultured buttermilk, condensed and dry milk products, Indian fermented foods.

### UNIT V :- BIOFUEL AND MICROBIAL FOODS :-

Biofuel :-Microorganism used, fermentation condition, recovery, production and uses of hydrogen. ethanol and biogas.

SCP :- Production of SCP (Algae and Bacteria); Product quality, merits and demerits. .

Mushroom :- Production ( long and short method ) and harvesting.

**Text & Reference Books:**

1. Casida, L. E. 1968. Industrical Microbiology. Willey, New York; London.

2. Doyle, M.P. Beuchat, L.R. and Montville, T. J. 2001. Food microbiology: Fundamentals and Frontiers. 2nd edition ASM Press, Washington., D.C.

3. Frazier, W. C. and Westhoff, D.C. 2004. Food microbiology. Tata McGraw Hills Publishing Company Limited.

4. Rose, A.H. 1983. Food microbiology, Academic Press, London.

5. Garbutt, J.H. 1997. Essentials of food microbiology. Arnold, London.

6. Wood, B. J. B. 1998. Microbiology of fermented foods. 2nd edition. Blackie academic and professional, London.

7. Prajapati J.B. 1995. Fundamestals of Dairy Microbiology.

8. R.C. Dubey. A tesbook of Biotechnology.

9. R. P. Singh. A texbook of Microbiology.

## B.Sc. III – Year

### Practicals

1. Study of a bioreactor.
2. Demonstration of alcoholic fermentation by yeast.
3. Isolation of bacteria from idli batter and curd.
4. Microbiological examination of soft drinks.
5. Determination of quality of milk sample by MBRT.
6. Detection of milk quality by Resazurin test.
7. Isolation and cultivation of rhizobium.
8. Study of antagonism between soil microorganisms.
9. Isolation of microorganisms from rhizosphere and calculation of R: S. ration.
10. Bacterial examination of water by MPN technique.
11. Estimation of BOD of water/treated sewage.
12. Estimation of COD of water/treated sewage.
13. Analysis of water by standard plate count.
14. Central Pollution Control Board standards for discharge of treated waste water.
15. Numericals based on mean, mode, median and standard deviation.