New

B.Sc. Industrial Microbiology
Semester I

Paper I -General Microbiology

Max. Marks 85+CCE 15=100

Unit I

- History of Microbiology: Contributions of Antony Von Leeuwenhoek, Louis Pasture, Robert Koch, Edward Jenner, Waksman, Alexander Flemming.
- Scope of Microbiology. Introduction to Industrial Microbiology: Applications of microorganisms in Food, Dairy, Beverage and Pharmaceutical Industries.

Unit II

- Prokaryotes and Eukaryotes. General characteristics and structure of Bacteria, Cyanobacteria and Fungi. General characteristics and structure of Actinomycetes, Mycoplasma and Viruses.

Unit III

- Taxonomy: Naming of microorganisms. Contribution of C. Linnaeus, Taxonomy hierarchy, Whittaker's five kingdom and Carl Woese's three domain classification system. Bergery`s Manual of Systematic Bacteriology

Unit IV

- Microscopy-Invention of Microscope, Compound Microscope. Dark field and Flourescent microscope.
- Phase contrast and electron microscope (SEM and TEM).

Unit V

- Methods of Sterilization, Culture media and Isolation Techniques. Methods of microbial culture.
- Basic principles and usage – pH meter, Densitometer, colorimeter, Spectrophotometer.
- Fluorimetry. Centrifugation-Principle and applications. Fermenter and its usage.

Suggested Book :

1. Microbiology, by Pelczar, Chan and Krieg. Mc.Graw Hill Book Company.
2. Microbiology, by Prescott, Hailey and Klein. Wm.C Brown Publishers.
3. Principles of Micobiology, by R. M. Atlas. Macmillan Publishing Co. New York.
4. Brock Biology of Microorganismsy by M. T. Madigan, J. M. Martinko and J. Parker. Prentice Hall, Englewood Cliffs, New Jersey.
5. Microbiology: A laboratory Manual, by Cappucino and Sherman. Benjamin/Cummings Publishing Co. Inc.
6. Black, J.G. (2002) Microbiology – Principles and Exploration. V Ed. John Wiley & Sons, Inc.

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Practicals : Based on theory papers.

Semester –I

Scheme of Practical Examination

S.No.	Experiment	Marks
1	Major	15
2	Minor – I	10
3	Minor – II	5
4	Spotting	10
5	Sessional	10
	Total	50

B.Sc. Industrial Microbiology
Semester II

Paper II - Molecular Biology and Biochemistry

Max. Marks 85+CCE 15=100

Unit I

- Nucleic acids – Structure of DNA and RNA (s), Replication of DNA.
- Types of RNA and Synthesis of RNA (Transcription).

Unit II

- Genetic code, Concept of Genes. Translation-initiation, elongation and termination.
- Operon concept, cAMP, Cap (Catabolic Activator Protein). Gene expression in prokaryotes, Lac-operon. Gene regulation in eukaryotes (Britton-Davision model of gene expression).

Unit III

- Genetic recombination in Bacteria – Transformation, Transduction and Conjugation.
- Extra chromosomal genetic material- Plasmids. Transposones.
- Mutations – Molecular mechanism of mutations, Chemical and physical mutagens. Repair of mutation damage.

Unit IV

- Classification of Carbohydrates, Chemical structure and property of starch, Cellulose, Glycogen, Synthesis of Purines and Pyrimidines.
- Lipids – Saturated and Unsaturated Fatty Acids, Biosynthesis of Fatty Acids, Distribution and Function of Lipids in Microorganisms.

Unit V

- Amino acids – classification of essential amino acids based on polarity. Acid -base properties and solubilities. Amino acid sequencing of proteins. Proteins primary, Secondary and tertiary structure.
- Enzymes – Classification, Co-enzymes, Co-factors, Mechanism of enzyme action, Competitive and non competitive inhibition.
- Allosteric regulation of enzymes, isoenzymes, Factors contributing to catatlytic efficiency of enzymes.

Suggested Book :

1. Gardner EJ, Simmons MJ, Snustad DP. Principles of Genetics. John Wiley & Sons, Inc.
2. Klug WS, Cummings MR. Concepts of Genetics. Prentice Hall International Inc.
3. Gupta P.K. Genetics. Rastogi Publications.
4. Stryer, L.Biochemistry. W.H. Freeman and Company, New York
5. Lehninger, A.L., D. Nelson D. and Cox, M.M.Cox ,Principles of Biochemistry,Worth Publishers.
6. Conn Eric E., Stumpf, Paul K. Bruning, George, &Doi, Roy, H.1987. Outlines of Biochemistry .John Wiley and sons.

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Practicals : Based on theory papers.

Semester –II

Scheme of Practical Examination

S.No.	Experiment	Marks
1	Major	15
2	Minor – I	10
3	Minor – II	5
4	Spotting	10
5	Sessional	10
	Total	50

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B.Sc. Industrial Microbiology
Semester III

Paper III- Microbial Growth and physiology

Max. Marks 85+CCE 15=100

Unit I

- Definition of microbial growth. Growth curve in batch culture or closed system. Mathematics of growth-generation time and growth rate constant.
- Measurement of growth: Measurement of cell numbers- Counting chambers, electronic counters, Viable counting techniques, membrane filter technique. Measurement of cell mass-dry weight and turbidity measurement.

Unit II

- The continuous culture of microorganisms: The chemostat and Turbidostat. Influence of environmental factors on growth- Solutes and water activity, pH, Temperature, Oxygen concentration, Pressure and radiations.

Unit III

- Diffusion, gaseous exchange, Osmosis, Plasmolysis, biochemical properties of membranes.
- Passive and active transport mechanism. Role of ionophores, group translocation across membranes.

Unit IV

- Photosynthetic microbes, Oxygenic and non-oxygenic reaction centers. Electron transport.
- Photophosphorylation and its significance. Calvin cycle. Effect of various factors on rate of photosynthesis.

Unit V

- Respiration mechanism and break down of carbohydrates through Glycolysis, Kreb cycle. Pentose phosphate pathway.
- Degradation of Lipids by α, β and Co-oxidation.

Suggested Book :

1 Microbiology, by Prescott, Hailey and Klein. Wm.C Brown Publishers.
2. Microbial Physiology by Moat.A.G. and Foster J.W. 4th edition 2002 John Wiley & Sons.
3. General Microbiology by Stanier R.Y., Ingrahm J.J. Wheelis M.L. and Painter P.R. McMillan Press.
4. Lehninger, A.L., D. Nelson D. and Cox, M.M.Cox ,Principles of Biochemistry,Worth Publishers.
5. Caldwell, D.R. (1995) Microbial Physiology and Metabolism, Brown Publishers.
6. Gottschalk, G. (1986) Bacterial Mrtabolism, II Ed. Springer Verlog.

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Practicals : Based on theory papers.

Semester –III

Scheme of Practical Examination

S.No.	Experiment	Marks
1	Major	15
2	Minor – I	10
3	Minor – II	5
4	Spotting	10
5	Sessional	10
	Total	50

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B.Sc. Industrial Microbiology
Semester IV

Paper IV – Environmental Microbiology and Immunology

Max. Marks 85+CCE 15=100

Unit I

- Our environment, soil, water and air. Physiological adaptations in microorganisms. Nature of microbial populations in soil, water and air.
- Biogeochemical cycling- Carbon, Nitrogen, Sulfur and Phosphorous.

Unit II

- Population interactions: Neutralism, Commensalisms, Synergism, Mutualism.
- Antagonistic relationships. Mycorrhizal associations. VAM and its importance.
- Nitrogen fixation by symbiotic and non-symbiotic microorganisms.

Unit III

- Biohydrometallurgy and Biomineralization. Biogas production. Energy and fuel using microorganisms.
- Degradation of Xenobiotic waste. Removal of oil spills. Biopolysaccharides. Liquid waste disposal. Nature of domestic waste, municipal waste and sewage.

Unit IV

- Immunity. Innate (nonspecific) Immunity: General barriers, Physical barriers, Chemical barriers and Biological barriers.
- Specific Immunity: Acquired immunity. Lymphocytes-B cells, T cells and NK Cells.

Unit V

- Antigens, haptens. Immunoglobulins and their types.
- Cell mediated cytotoxicity. Complement system. Autoimmune diseases.
- Antigen antibody reaction- Precipitation, Agglutination. ELISA and Hybridoma Technology.
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Suggested Book :

1. P.D. Sharma: Ecology and Environment. Rastogi Pub. Meerut 1995.
2. Atlas, R.M. and Bartha, R. (1998) Microbial Ecology IV Ed., Benjamin Cummins.
3. Mitchel, R. (1992). Environmental Microbiology. Wiley Liss, John Wiley and Sons Inc. Publication.
4. Barrett, J.T. (1983) Textbook of Immunology: An Introduction to Immunochemistry and Immunology, Mosby, Missouri.
5. Boyd, R.F., (1984) General Microbiology, Times Mirror/Mosby (college publishing, St.Louis).
6. Roitt, I.M. (1998) Essentials of Immunology ELBS, Blackwell Scientific Publishers, London.

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Practicals : Based on theory papers.

Semester –IV

Scheme of Practical Examination

S.No.	Experiment	Marks
1	Major	15
2	Minor – I	10
3	Minor – II	5
4	Spotting	10
5	Sessional	10
	Total	50

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B.Sc. Industrial Microbiology
Semester V

Paper V – Agricultural Microbiology and Food Microbiology

Max. Marks 85+CCE 15=100

Unit I

- Soil fertility and management of agricultural soils. Influence of available nitrogen on soil fertility. Importance of crop rotation.
- Soil management practices, pesticides and their effect on soil fertility. Use of microorganisms as biofertilizers. Mass cultivation of *Rhizobium* and *Azotobacter*. Use of blue green algae as biofertilizer

Unit II

- Microbial diseases of crop plants with special reference to Wheat, Rice, Maize and groundnut.
- Microbial diseases of crop plants with special reference to Mustard, Grapes, Potato and Papaya.
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Unit III

- Control of plant diseases. Chemical control of plant diseases.
- Biological control – its mechanism and importance. Bacterial insecticides. Concept of Integrated Pest Management (IPM).

Unit IV

- Food spoilage mechanisms. Spoilage of stored products, fruits and vegetables. Microbial spoilage of milk and meat. Food borne diseases.
- Importance of microorganisms in dairy industries. Production of cheese, curd and yogurt.
- Applications in bakery industries – leavening of bread. Indian fermented foods. Microorganisms as source of SCP.

Unit V

- Food preservation methods – Asepsis, Pasteurization, Canning, Desiccation, temperature, anaerobiosis, filtration.
- Chemical preservation of food- salt and sugar, Organic acids, use of SO_2, ethylene and propylene oxides. Preservation by radiation treatment.
- Solid waste disposal. Hazardous industrial wastes. Regulations for disposal of hazardous wastes.

Suggested Book :

1. Bagyaraj and rangasamy. Agricultural Microbiology.
2. Conyne, Marks S (2001) Soil Microbiology: An Exploratory Approach, Delmar Thomson Learning.
3. Frazier, W.C and Westhoff; DC (1988) Food Microbiology 4th Edition, McGraw, Hill. NY.

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4. Mehrotra R.S. Plant Pathology Tata McGraw-Hill Limited.
5. Singh, R.S. Plant diseases management. Oxford & IBH, New Delhi.
6. Jay, J.M. 1992. Modern Food Microbiology. IV ed. C.B.S. India.

Practicals : Based on theory papers.

Semester –V

Scheme of Practical Examination

S.No.	Experiment	Marks
1	Major	15
2	Minor – I	10
3	Minor – II	5
4	Spotting	10
5	Sessional	10
	Total	50

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B.Sc. Industrial Microbiology
Semester VI

Paper VI – Fermentation Technology and Applied Microbiology

Max. Marks 85+CCE 15=100

Unit I

- Fermentation-equipments and production process. Principal types of fermenters-continuous stirred fermenters, tubular fermenters.
- The fluidized bed fermenter, solid state fermenters. Computer control of fermentation process.

Unit II

- Downstream processing. Strain improvement. Industrial production of antibiotics-Penicillin.
- Industrial production of organic acids- Lactic acid and citric acid. Industrial production of enzymes-Amylase and Protease. Industrial production of vitamin –Vitamin B_{12}. Industrial production of amino acids – L-lysine and glutamic acid. Production of alcohol, wine, beer and acetic acid.

Unit III

- Role of international organizations in biotechnology. Government programmes for biotechnology development. Biological risks, biosafety, Bioethics, Intellectual property rights (IPR) and patenting of biological material.

Unit IV

- Introduction to Recombinant DNA Technology: The molecular biotechnology revolution. Applications of genetically engineered bacteria- production of insulin, vaccines.
- Biosensors. PCR and its applications.

Unit V

- Basic idea of probability, normal binomial and poisson distribution. Mean. Mode and Median. Chi-Square test, Exponential and Logarithmic functions.

Suggested Book :

1. Stanbury, PR, Whitakar, A and Hall, S.J. (1995) Principles of Fermentation Technology, 2nd Edition Pergamon press.
2. Slanbury, P.F. and Whiitaker A. (1984). Principles of Fermentation Technology. Pregemen Press Oxford. pp 255
3. T.A. Brown : Gene Cloning.IRL Press Oxford Univ. PressS
4. Gupta P.K. Elements of biotechnology. Rastogi Publications.
5. Suedecor, GW and Cochram. WG (1968) 'Statistical methods' Oxford & IBH, Delhi

6. Steel, GD and Torrie JH 'Principles & Procedures of Statistics' McGraw Hill Book Co., New York.

Practicals : Based on theory papers.

Semester –VI

Scheme of Practical Examination

S.No.	Experiment	Marks
1	Major	15
2	Minor – I	10
3	Minor – II	5
4	Spotting	10
5	Sessional	10
	Total	50