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Class: B.Sc.  
Subject: Microbiology  
Semester: I  
Paper No. and Name: I- General Microbiology  
Max. Marks: 85+CCE 15=100

#### Unit I

- Scope of Microbiology: Microorganisms in human affairs and industry. History of Microbiology: Contributions of Anton van Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch and Alexander Fleming. Germ theory of disease. Developments in Microbiology in 20th century

#### Unit II

- Prokaryotic Cell: Cell wall. Distinction between cell wall of Gram positive and Gram negative bacteria. Cell membrane, Cytoplasm, nucleoid, endospore, flagella, pili, glycocalyx. Structure of Archaea cell.
- Eukaryotic cell: Cell membrane, cytoplasm. Organelles: Nucleus, Mitochondria, Endoplasmic reticulum, Ribosomes, Golgi bodies, Lysosomes and Chloroplast. External structures-flagella, cilia and cell wall.

#### Unit III

- Diversity of Microorganisms: General account of Bacteria, Fungi, Protozoa, Algae and Viruses.
- Taxonomy: Naming of microorganisms. Contribution of C. Linnaeus, Taxonomy hierarchy, Whittaker's five kingdom and Carl Woese's three domain classification system. Classification of bacteria and cyanobacteria: Bergery's Manual of Systematic Bacteriology. Classification of Fungi and Protistean Algae.

#### Unit IV

- Principle and structure of Light Microscope, Numerical Aperture, Resolving Power. Magnification. Principle and structure of electron microscope (SEM and TEM). Comparison between light and electron microscope.
- Preparation and staining of specimens for light microscopy: Fixation, Dyes and simple staining, Differential staining- Gram staining, acid-fast staining, Staining specific structures-negative staining, endospore staining, flagella staining.

#### Unit V

- Microbial Nutrition: Common nutrient requirements, Nutritional types of microorganisms, growth factors. Uptake of nutrients by cells.
- Culture Media: Synthetic or defined media. Commonly used media. Types of Media- Selective, differential and enrichment media. Aseptic Techniques: Disinfection, Sterilization.
- Cultivation of bacteria, fungi and viruses. Pure culture: Concept of pure culture. Methods of pure culture of microorganisms – Spread plate, streak plate and pour plate.

#### Suggested Books :

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 Microbiology, by R. M. Atlas. Macmillan Publishing Co. New York.

4. Brock Biology of Microorganisms 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. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.R. (1986) General Microbiology V Ed. McMillan Press Ltd. London.

**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

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Class: B.Sc.  
Subject: Microbiology  
Semester: II  
Paper No. and Name: II-Microbial Physiology and Growth  
Max. Marks: 85+CCE 15=100

#### Unit I

- Structure of atoms, chemical reactions, water and solutions. Acid, bases and pH.
- Complex organic molecules: Carbohydrates, Lipids, Proteins, DNA, RNA.
- Enzymes: Historical perspective of enzymes. Structure of enzymes and classification of enzymes. Mechanism of enzyme action. Factors affecting enzyme action. Enzyme inhibition and enzyme regulation.

#### Unit II

- Bioenergetics: Free energy change, exergonic and endergonic reactions and High energy transfer compounds.
- Anaerobic processes in energy production: Glycolysis. Pentose Phosphate Pathway, Entner-Doudroff Pathway.

#### Unit III

- Aerobic processes in energy production: Krebs cycle, Electron Transport Chain and Proton motive force.
- Utilization of energy-Bacterial motility, Transport of nutrients.
- Nitrogen fixation: Symbiotic and non-symbiotic types.
- Photosynthesis: oxygenic and anoxygenic types.

#### Unit IV

- Definition of microbial growth. Cell division. 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. Measurement of cell activity.

#### Unit V

- 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.
- Control of microorganisms: Physical agents-Temperature, Desiccation, Osmotic Pressure, Radiation, Surface tension and Filtration. Control by chemical agents.

#### Suggested Books :

1. Microbiology, by Prescott, Hailey and Klein. Wm.C Brown Publishers.
2. Microbial Physiology by Moat.A.G. and Foster J.W. 4<sup>th</sup> edition 2002 John Wiley & Sons.
3. General Microbiology by Stanier R.Y., Ingrahm J.I. 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. Stryer, L. (2001) Biochemistry. Freeman.
6. Stanier, R.Y. Ingrahm, J.L., Wheelis, M.L. and Painter, P.R. (1986) General Microbiology 5<sup>th</sup> Ed., McMillan Press Ltd

**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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Class: B.Sc.  
Subject: Microbiology  
Semester: III  
Paper No. and Name: III-Microbial Genetics  
Max. Marks: 85+CCE 15=100

Unit I

- Historical background – Foundation of Genetics (Mendel's Experiments). DNA as genetic material-Experimental evidences: Avery, MacLeod and McCarty and Hershey and Chase experiments.
- Structure of DNA and RNA. Replication of DNA.

Unit II

- Mutations –Types of mutations, Substitutions, Deletions and Insertion mutations. Spontaneous mutations. Detection of mutations. Ames Test. Mutagens-physical and chemical.
- DNA repair –Photoreactivation, Excision repair, Mismatch repair, Recombination repair and SOS repair.

Unit III

- Transcription in prokaryotes- The Central Dogma, RNA polymerase. Transcription initiation, Elongation and Termination
- Translation in prokaryotes-Genetic Code, Ribosome. tRNA, Initiation, Elongation and Termination of polypeptide biosynthesis.

Unit IV

- Bacterial plasmids-Fertility factors, Resistance factors, Col Plasmids and other types of plasmids. Transposable elements –Is sequences.
- Bacterial conjugation –F Factor, Hfr Transfer. Gene mapping. Bacterial Transformation, Transduction-Generalized and specialized transduction.

Unit V

- Genetic Engineering – Isolation of DNA, Restriction enzymes, Cloning Vectors-plasmids, cosmids and BACs. DNA transfer techniques. Screening of recombinant colonies.
- Expression of foreign gene in bacteria. Applications of genetic engineering. PCR and its applications.

Suggested Books :

1. Lodish, Berk, Zippursky.Matsudaira, Baltimore, Darnell, (2000). Molecular Cell Biology IV Ed., W.H. Freeman.
2. Lewine, B. (2000). Gene VII, Oxford University Press.
3. Watson, J.M., Hopkins, N.H., Robert , J.W., Stietz,J.A.and Weiner, A.M. (1987). Molecular Biology of Gene. IV Ed. Benjamin and Cumming Pub. Inc. Comp.
4. Freifelder, D. (1995). Molecular Biology. Narosa Publishing House, New Delhi.
5. Brown, T.A., (2001). Gene Cloning and DNA Analysis. IV Ed. Blackwell Science.
6. Klug, W.S. and Cummings, M.K. (2000) Concept of genetics. VII Ed., Pearson Education, New Delhi.

5  
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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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Class: B.Sc.  
Subject: Microbiology  
Semester: IV  
Paper No. and Name: IV-Environmental and Food Microbiology  
Max. Marks: 85+CCE 15=100

#### Unit I

- Definition of environment, Interaction between environment and biota. Distribution of Microorganisms in soil and air.
- Fresh water and Marine Environment – Winogradsky column. Benthic environment. Microbiology of Extreme environments.

#### Unit II

- Interaction between Microorganisms – Commensalism, Synergism, Mutualism (symbiosis). Lichen symbiosis.
- Microbe –Plant interactions – Root nodule symbiosis, Ectomycorrhiza. Endomycorrhiza, Rhizosphere. Microbe-animal interaction –Rumen.

#### Unit III

- Waste water treatment – Primary sedimentation, Biological treatment. Anaerobic digestion of sludge.
- Biogeochemical cycles-N-cycle, C-cycle and S-cycle and P-cycle

#### Unit IV

- Food as substrate for microorganisms. Food Spoilage – Intrinsic factors and Extrinsic factors. Disease transmission by foods –Food poisoning, Alfatoxins, Botulinum toxin.
- Microorganisms as source of food. SCP. Fermented Dairy Products-Yoghurt, Curd, Cheese. Fermented alcoholic beverages: Wine and Beer. Bread and Indian fermented foods

#### Unit V

- Food preservation –Asepsis, Pasteurization, Canning, Desiccation, Temperature effects.
- Chemical preservation of food-salt and sugar, Organic acids, use of SO<sub>2</sub>, ethylene and propylene. Preservation by radiation.

#### Suggested Books :

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. I.Banwart, G.J. 1981. Basic Food Microbiology, Abridged edition, An avi Book, New York.
5. Jay, J.M. 1992. Modern Food Microbiology. IV ed. C.B.S. India.
6. Adam, M.R. and M.O. Moss. 1995. Food Microbiology. New Age International (P) Ltd. Publishers New Delhi.

**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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Class: B.Sc.  
Subject: Microbiology  
Semester: V  
Paper No. and Name: V- Immunology and Medical Microbiology  
Max. Marks: 85+CCE 15=100

#### Unit I

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

#### Unit II

- Antigens, haptens. Immunoglobulins and their types.
- Cell mediated cytotoxicity. Complement system. Autoimmune diseases.
- Hypersensitivities –Type I, II, III and IV. ELISA and Hybridoma Technology.

#### Unit III

- Pathogen, Pathogenicity, Virulence, Disease, Determinants of infectious diseases- transmissibility, Attachment and colonization, Entry, growth and multiplication.
- Toxicogenicity- Exotoxins and endotoxins.

#### Unit IV

- Skin infections: Frunucle, Chicken pox, Measles and Herpes simplex.
- Respiratory infections: Diphtheria, Pneumonia, Tuberculosis, Influenza and Rheumatic fever.

#### Unit V

- Alimentary infections: Dental plaque, Cholera, Typhoid fever, Giardiasis and Amoebiasis.
- Nervous system infections: Leprosy, poliomyelitis, Rabies and meningitis

#### Suggested Books :

1. Barrett, J.T. (1983) Textbook of Immunology: An Introduction to Immunochemistry and Immunology, Mosby, Missouri.
2. Boyd, R.F., (1984) General Microbiology, Times Mirror/Mosby (college publishing, St.Louis).
3. Roitt, I.M. (1998) Essentials of Immunology ELBS, Blackwell Scientific Publishers, London.
4. Nester, E.W., Robert C.V. and M.T. Nester (2001). Microbiology, A Human Perspective IIIrd Ed.. WCB, Dubuque, Iowa.
5. Zoklik, W.K., Willet, H.P., Amoe, O.B. and Wilfort, C.M. (1992). Zirsser's Microbiology. XX Ed. E. Nonwel Cann. Appelton and Long.
6. Ananthanarayanan, R. and C.K. Panikar (1996). Text Book of Microbiology, V ed. Orient Longman, Hyderabad.

9  
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**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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Class:	B.Sc.
Subject:	Microbiology
Semester:	VI
Paper No. and Name:	VI - Applied and Industrial Microbiology
Max. Marks:	85+CCE 15=100

#### Unit I

- Microbial metabolism – Primary and secondary metabolism. Introduction to microbial products obtained by industrial process. Industrial strains – characteristics and isolation techniques.
- Improvement of Industrial strains-Mutation, Genetic engineering techniques. Preservation of cultures- Storage on agar slants, Soil culture, Lyophilization, Storage in Liquid nitrogen.

#### Unit II

- Fermentation. Batch and continuous culture. Types of Fermenters –Aerated and Agitated fermenters, Air lift fermenter. Basic function of Baffle, Impeller and Sparger.
- Inoculum and Culture media in fermentation. Recovery Process- Biomass separation, centrifugation, Liquid –Liquid extraction, Cell disruption.

#### Unit III

- Production of Organic acids (Citric acid and lactic acid), Amino acids (Lysine), Alcohol and Penicillin.
- Production of Enzymes- Amylase, protease and lipase. Immobilized enzymes and Enzyme immobilization Techniques.

#### Unit IV

- Biofertilizers-Bacterial fertilizers, Algal fertilizer and Mycorrhiza. Bioinsecticides – *Bacillus thuringiensis*.
- Biohydrometallurgy and Biomineralization. Biogas production. Energy and fuel using microorganisms.

#### Unit V

- Applications of genetically engineered bacteria- production of insulin, vaccines. Degradation of Xenobiotic waste. Removal of oil spills. Biosensors.
- Biological risks, biosafety, Bioethics, Intellectual property rights (IPR) and patenting of biological material.

#### Suggested Books :

1. Arnold L. Demain, Julien E. Davies. (1999). Manual of Industrial Microbiology and Biotechnology. ASM Press.
2. Whitaker and P.F. Stanbury. (1995). Principles of Fermentation Technology. Butterworth-Heinemann.
3. Prescott, C.S. and Dunn, G.C. (1959). Industrial Microbiology. III Ed. McGraw Hill Book Company, New York.
4. Riviere. J. (1975). Industrial Applications of Microbiology. John Wiley & Sons. New York. pp 248.
5. Casida Jr. L.E. (1998). Industrial Microbiology. New Age International (P) Limited, Publishers. New Delhi. pp 460

**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

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