

MICROBIOLOGY HONOURS SYLLABUS

CONTENTS

Semester	Paper Code and No	Papers	Credits	Marks
I	MIC-UG-E101	Microbial Diversity	4	100
II	MIC-UG-E201	Microbial Biochemistry	4	100
III	MIC-UG-E301	Microbial Growth and Metabolism	4	100
IV	MIC-UG-C401	Microbial Genetics and Molecular Biology	4	100
	MIC-UG-C402	Biostatistics, Bioinformatics and Instrumentation	4	100
V	MIC-UG-C501	Agricultural Microbiology	4	100
	MIC-UG-C502	Environmental Microbiology	4	100
VI	MIC-UG-C601	Immunology and Medical Microbiology	4	100
	MIC-UG-C602	Industrial and Food Microbiology	4	100

MIC-UG-E101: Microbial Diversity

Unit I: History of Microbiology

Contributions of the following scientists in the field of microbiology: Ferdinand Cohn's, Louis Pasteur's, Robert Koch's, Antony van Leewenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Martinus W. Beijerinck, Alexander Fleming, Elie Metchnikoff, Anand M. Chakraborty's, Winogradsky

The spontaneous generation versus biogenesis controversy, Germ theory of disease,

Principle of classification: Outline classification of eubacteria and archae with special emphasis on major groups of bacteria (Gram positive and Gram negative)

Unit II: Structure and function

Difference between prokaryotes and eukaryotes;

Cell wall of prokaryotes: peptidoglycan and related molecules, outer membrane of Gram-Negative and Gram Positive bacteria; mechanism of gram reaction, cell membrane Capsule, nuclear material (nucleoid and plasmids), Intracytoplasmic structures, flagella, pili, fimbriae, and cell inclusions prokaryotes (storage food reserves), endospore

Unit III: Cyanobacteria, Virology

Cyanobacteria: Habitat, structure and function of Cyanobacteria

Mycology: Classification, morphology and reproduction of fungi, Brief account of isolation and cultivation of fungi

General properties of viruses, Capsid symmetry, virus architecture and genetic materials; Overview of viral classification with few examples; virusoids and prions and satellite viruses. Isolation and cultivation of viruses. Brief description of lytic, lysogenic cycles.

Unit IV: Practical

1. Introduction to Microbiology Laboratory: Good Laboratory Practices followed in Microbiology Laboratory
2. Microscopy: Light microscopy, Simple staining, Differential staining, Negative staining, endospore
3. Sterilization and Disinfection: principle and methods- moist heat, dry heat and filtration methods; chemical disinfection-demonstration of physical and chemical disinfection

4. Media preparation and culture preservation: Preparation of Liquid media, solid media-Agar slants, Agar plates
5. Pure culture techniques: Serial dilution, Streak plate, pour plate.
6. Morphological study of fungi – Yeast cells, *Penicillium*

Reading List

1. Dubey, R.C. and Maheshwari, D.K: 1999. *Text book of Microbiology*. S. Chand & Company Ltd., New Delhi.
2. Madigan, M.T., Martinko, J.M. and Parker, J: 1997, *Brock Biology of Microorganisms*, 8th edition. Prentice-Hall Inc.
3. Power, C.V and Dagainawala, H.F, 2008, *Cell Biology*, Vol. I, Himalayan Publishing House, New Delhi.
4. Pelczar, M.J. and Chan, E.C.S, 2003, *Elements of Microbiology*. Tata McGraw-Hill.
5. Prescott, L. M., Harley, J.P. and Klein, D.A: 1999, *Microbiology*, 4 edition. Tata McGraw Hill.
6. Schlegel, H.G: 1997, *General Microbiology*. Cambridge University Press.
7. Talaro K.P: 2008, *Foundations in Microbiology*. Academic Press, Inc.
8. Talaro K.P: 2004, *Foundations in Microbiology-Text Only*. McGraw-Hill Publishing Com.
9. Tortora, G.J., Funke, B.R. and case, C.L: 1998; *Microbiology: an Introduction*, 5th edition. The Benjamin-Cummings Publishing Company, Inc

MIC-UG-E201: Microbial Biochemistry

Unit I: Water, pH and buffers, Carbohydrates and Lipids

Water structure and interactions, dissociation of water, and its ionic product, Water as a solvent, the Handerson Hasselbach equation. Buffer solutions, biological and physiological buffers. Laws of thermodynamics, Different types of bonds.

Classification of carbohydrates: Monosaccharides: reducing and non-reducing sugars. Disaccharides: lactose, maltose, and sucrose. Polysaccharides: structural-cellulose, peptidoglycan;

Lipids: Classification: simple vs. complex. Fatty acids the building blocks, structure and properties. Structure and functions of triacylglycerols, phospholipids, sphingolipids, steroids. Beta-oxidation of saturated fatty acids and oxidation of unsaturated fatty acid.

Unit II: Proteins and Nucleic Acid

Amino acids and proteins: Classification and structure of amino acids, non-protein and essential amino acids, peptide bond. Proteins: Primary, Secondary structure, Tertiary structure, Quarternary structure.

Nucleic Acid: Building blocks: Nitrogenous bases, sugars and phosphates. Nucleosides and nucleotides, polynucleotides- DNA and RNA. Primary and secondary structure (A, B, Z). RNA: Structure and functions of rRNA, mRNA, and tRNA

Unit III: Enzymes and Nutrient uptake

Enzymes: Outline classification and nomenclature; general properties, Enzyme- substrate reaction; Michaelis Menten equation, Lineweaver-Burke plot. Enzyme specificity, factor influencing enzymic activity. Cofactors: coenzymes, prosthetic groups, Isozymes, Ribozyme.

Nutrient uptake: Passive and facilitated diffusion, active transport, secondary active transport, group translocation. Specific transport systems-ATP linked ion motive pumps, Ion transport. Transporting proteins: periplasmic binding proteins and porins.

Unit IV: Practical

1. Preparation of buffers and standard solution.
2. Measurement of pH of microbial culture media and other solvents
3. Qualitative detection of carbohydrates (reducing/non-reducing) and proteins
4. Quantitative Estimation of reducing sugar.
5. Qualitative detection of enzymes: catalase and amylase
6. Estimation of DNA/RNA

Reading List

1. Jain, J.L, Jain, Sunjay, Jain, Nitin, 2005, *Fundamentals of Biochemistry*. S. Chand & Company Ltd. New Delhi.
2. Nelson, D.L. and Cox, M.M, 2007, *Lehninger Principles of Biochemistry*, 4th edition. W.H. Freeman and Com
3. Nicholls, D.G. and Ferguson, 2002, S.J: *Bioenergetics*. Academic Press, Inc.
4. Rama Rao, A.V.S.S. 2006, A Text Book of Biochemistry, 10th edition, UBS Publisher Distributors Pvt. Ltd.
5. Stryer, L. 2005, *Biochemistry*, 3rd edition, Springer Verlag.

MIC-UG-E301: Microbial Growth and Metabolism

Unit I: Bacterial Growth

Bacterial Growth: Requirements of growth: Physical and chemical parameters of growth. Different Culture media: complex, aerobic growth, selective, differential and enrichment media.

Overview of cell growth: Growth cycles: phases of a growth cycle and diauxic growth curve. Primary and secondary metabolite production during different growth phases. The mathematics of growth: logarithmic and arithmetic growth, calculation of growth rate and generation time. Growth yield, continuous culture kinetics, chemostat, turbidostat, synchronous growth.

Control of Microbial Growth: Factors influencing microbial growth, Microbial control agents, Methods of microbial control (physical and chemical).

Unit II: Carbon Metabolism and Bacterial fermentations

Carbon Metabolism: Glycolysis, ED pathway, phosphoketolase pathway, oxidative pentose phosphate pathway, TCA cycle, Anaplerotic reactions, glyoxalate cycle, gluconeogenesis.

Bacterial fermentations: Substrate level phosphorylation, Alcoholic, lactic acid, butyric acid, mixed acid, 2,3-butanediol, propionic acid and acetic acid fermentations.

Unit III: Microbial Respiration and Chemolithotrophy

Microbial Respiration: Aerobic-Mitochondrial and bacterial electron transport chain. Anaerobic respiration-sulphate, nitrate and CO₂ reducers, methanogenesis, proton reduction. Oxidative phosphorylation: mechanism

Chemolithotrophy: Nitrifying bacteria, iron bacteria, hydrogen bacteria, sulphur bacteria, carbon monoxide bacteria, Reverse electron transport.

Unit IV: Practical

1. Determination of cell Numbers: Direct microscopic Count, total viable count by pour plate methods/spread method.
2. Growth curve of *E. coli* and determination of generation time.
3. Effect of physiological factors (physical and chemical) on growth of microorganisms- pH, temperature, nitrogen and carbon sources.

Reading List

1. Dawes, I.W. and Sutherland, I.W. 1992, *Microbial Physiology*. Blackwell Scientific Publications.
2. Dubey, R.C. and Maheshwari, D.K: 1999. *Text book of Microbiology*. S. Chand & Company Ltd., New Delhi.
3. Madigan, M.T., Martinko, J.M. and Parker, J. 1997, *Brock Biology of Microorganisms*, 8th edition. Prentice-Hall Inc.
4. Pelczer, M.J. and Chan, E.C.S, 2003, *Elements of Microbiology*. Tata McGraw-Hill.
5. Prescott, L. M., Harley, J.P. and Klein, D.A: 1999, *Microbiology*, 4 edition. McGraw Hill.
6. Schlegel, H.G: 1997, *General Microbiology*. Cambridge University Press.
7. Stanier, R.Y. *et al*: 1986. *General Microbiology*, 5th edition. McMillan Education.

MIC-UG-C401: Microbial Genetics and Molecular Biology

Unit I: Genome organization and Mutations

Chemical mutagens- base analogues, nitrous acid, hydroxyl amine, intercalating agents and alkylating agents; Physical and Biological mutagens. Uses of mutants.

Mutations: Types of mutations: Point mutation, reverse mutation, suppressor mutation, frameshift mutation, base pair substitution, transition, transversion, missense mutation, nonsense mutation, silent mutation, neutral mutation.

Unit II: Genetic exchange

Mechanisms of genetic exchange: Transformation- History and discovery of transforming principle. Conjugation – F⁺ cell x F⁻ cell conjugation, Hfr x F⁻ cell conjugation. Transduction: Specialized transduction, generalized transduction.

Central Dogma, DNA replication: Mechanism of DNA replication in prokaryotes. Similarity and differences in replication in Prokaryotes and Eukaryotes.

Plasmid replication; Structure and types of bacterial transposons.

Unit III: Transfer of Information and Recombinant DNA

Genetic Code-Properties of genetic code, Wooble Hypothesis.

Protein biosynthesis (Transcription and Translation), Examples of Inhibitors of protein biosynthesis.

Gene regulation in prokaryotes (Operon concept).

Recombinant DNA Technology:

Basic steps in Gene Cloning: Cutting and joining DNA molecules-Restriction and modification systems, restriction endonucleases, DNA ligases, Vectors: Plasmids as cloning vectors, Cosmids, Shuttle vectors, Expression vectors. Southern, Northern and Western blotting, Applications of recombinant DNA technology.

Unit IV: Practical

1. Replica Plate technique: study of Drug Resistance and Auxotrophy.
2. Study of UV survival curve of bacteria.
3. Bacterial conjugation/transformation (*demonstration only*).
4. Isolation of bacterial chromosomal DNA.
5. Gel electrophoresis of bacterial genomic DNA and examination of agarose gels (*demonstration only*).

Reading List

1. Benjamin, L: 2004. *Genes VIII*. Pearson Education India.
2. Dubey, R.C. and Maheshwari, D.K: 1999. *Text book of Biotechnology*. S. Chand & Company Ltd., New Delhi
3. Henderson, B. *et al*: 1999. *Cellular Microbiology*. John Wiley and Sons.

4. Madigan, M.T., Martinko, J.M. and Parker, J. 1997, *Brock Biology of Microorganisms*, 8th edition. Prentice-Hall Inc.
5. Power, C.V and Dagainawala, H.F, 2008, *Cell Biology, Vol. I*, Himalayan Publishing House, New Delhi.
6. Prescott, L. M., Harley, J.P. and Klein, D.A: 1999, *Microbiology*, 4 edition. McGraw Hill.
7. Rastogi.S.C.2008, *Cell Biology*. New Age International (P) Limited, Publisher, New Delhi.
8. Roy,S.C & De, K.K, 2001. *Cell Biology*. New Central Book Agencies(p) Ltd., Kolkata.

MIC-UG-C402: Instrumentation, Bioinformatics and Biostatistics

Unit I: Instrumentation

Instrumentation- Principle and applications of:

1. Phase contrast microscopy
2. Spectrophotometry
3. Chromatography: Paper thin layer, column chromatography (affinity, gel filtration and ion exchange), GLC and HPLC
4. Electrophoresis: SDS-PAGE, Native PAGE and Isoelectric focusing
5. Centrifugation: High speed centrifugation and ultracentrifugation
6. Autoradiography, X-ray diffraction and scintillation counter
7. PCR techniques; DNA Sequencing techniques

Unit II: Bioinformatics

Introduction to bioinformatics: Computational biology as an extension of molecular biology/essential tool of modern biology; Role of Biology, mathematics, statistics, information technology and computer science in Bioinformatics development, role of internet.

Nature of biological information: From Central Dogma of molecular biology to Central Paradigm of Bioinformatics. Sequence alignment: basis of and general principles involved, global/ local, tools available like BLAST. Biological database: Types, properties and applications of biological databases, with suitable illustrative examples (GeneBank at NCBI, PDB, Swiss Prot at EBI). Illustrative applications of bioinformatics: Predicting structure, localization, function of proteins; Gene Expression analysis; Identification of essential genes; Phylogenetic analysis;

Unit III: Biostatistics

Aims and objective of biostatistics. Introduction to Data, Primary and Secondary Data. Differences between sample and population. Frequency distribution: Cumulative frequency distribution, relative frequency distribution, Size and types of class intervals. Various measures of central tendency: Arithmetic mean, geometric mean, harmonic mean, use of assumed mean, weighed mean, median and mode. Measures of dispersion: Range, variance, standard deviation, standard error.

Unit IV: Practical

1. Beer Lambert's Law
2. Separation, detection and identification of amino acids by paper chromatography
3. Column Chromatography (Demonstration)
4. Separation detection and identification of sugar by thin layer chromatography
5. PAGE (Demonstration)
6. Demonstration of PCR technique
7. Bioinformatics-Computer Lab Work
8. Biostatistics Problems: Determination of mean, mode, median, range, mean deviation, standard deviation, standard error.

Reading List

1. Ghosh, B.N., *Scientific methods and social research*, 1982, Sterling Publishers Pvt. Ltd. New Delhi.
2. Jain, J.L., Jain.Sunjay, Jain.Nitin, 2005, *Fundamentals of Biochemistry*. S.Chand & Company Ltd. New Delhi.
3. Kothari, C.R, 2005, *Research Methodology, (Methods & Teaching)* 2nd edition, New Age International (P) Limited, Publisher, New Delhi.
4. Nelson, D.L. and Cox, M.M, 2007, *Lehninger Principles of Biochemistry*, 4th edition. W.H. Freeman and Com
5. S. Lgnacimuthu, S.J, *Basic Bioinformatics*, 2008. Narosa Publishing House, Chennai.
6. Shrivastava, S. 2012, *Molecular Technique in Biochemistry & Biotechnology*. New Central Aook Agencies (P) Ltd., New Delhi.

MIC-UG-C501: Agricultural Microbiology

Unit I: Soil Microorganisms

Development and significant contributions in the field of soil microbiology [Beijerinck and Winogradsky, physical and chemical properties of soil, classification of soils, soil profile, soil microflora and soil as a natural habitat for microbes.

Nature of soil: Soil as a microenvironment, Soil organic matters and humus, Soil and surface environment, Soil pores and movement of gases for microbial activity, Microbes in different zones of soil. Decomposition of plant and animal residues by microorganisms.

Unit II: Microbial habitat and their interactions

Microorganisms in the rhizosphere, root surfaces and phylloplane. Biological Nitrogen fixation- symbiotic and asymbiotic, mass production of Biofertilizers- *Rhizobium*, *Azotobacter* and Cyanobacteria, *Azolla*. Nitrosifying, nitrifying, ammonifying and Denitrifying bacteria. Photosynthetic, Phosphate solubilizing bacteria. Soil anerobic methanogens in rice field.

Control of Plant Diseases: Principles and practices involved in the management of plant diseases by different methods, viz., regulatory (quarantine & legislative measures), physical, chemical and biological control, Integrated eco-friendly approach of plant disease control (as a component of Integrated Pest Management),

Unit III: Genetic Engineering in Agriculture

Use of genetic engineering in Agriculture: Significance of *Agrobacterium tumefaciens* and viral vectors in development of transgenic plants- brief technique used. Brief discussion of Bt cotton, release of GMOs

Unit IV: Practical

1. Analysis of Soil: Texture, pH, moisture content, water holding capacity, percolation, capillary action.
2. Isolation of *Rhizobium* from legume root nodules.
3. Isolation of microbes from decomposing plant litter.
4. Isolation of *Azotobacter*.
5. Isolation of Bacteria/fungi from rhizosphere, root surfaces and phylloplane.
6. Isolation of phosphate solubilizers from soil.

Reading List

1. Dubey, R.C. and Maheshwari, D.K: 1999. *Text book of Biotechnology*. S. Chand & Company Ltd., New Delhi
2. Madigan, M.T., Martinko, J.M. and Parker, J. 1997, *Brock Biology of Microorganisms*, 8th

edition. Prentice-Hall Inc.

3. Prescott, L. M., Harley, J.P. and Klein, D.A: 1999, *Microbiology*, 4th edition. McGraw Hill.
4. Subba Rao, N.S: 2000, *Soil Microbiology*, 4th edition. Oxford and IBH Publishing Co.
5. Tortora, G.J., Funke, B.R. and case, C.L:1998; *Microbiology:an Introduction*, 5th edition. The Benjamin-Cummings Publishing Company, Inc.

MIC-UG-C502: Environmental Microbiology

Unit I: Microbial Ecosystems

Introduction to ecological concepts.

Microbe-microbe interactions: Symbiosis, synergism, mutualism, neutralism, commensalisms, amensalism, competition, parasitism, predation, co-metabolism.

Microbe-animal interactions: Rumen microflora, nematophagus fungi

Biogeochemical cycles: Nitrogen, Sulfur, Phosphorous, Carbon - Degradation of cellulose, hemicellulose, lignin, starch, chitin, acid mine drainage, bioleaching; Winogradsky column; Iron-Siderophores.

Unit II: Microbial environments

Aquatic environment: Fresh water and marine microflora; eutrophication and water (algal) blooms; biomagnification; biofilms.

Atmospheric environment: Aeromicroflora, features of spores that favour their transport in air, airborne toxins; aerosols; concept of bioterrorism (Microbial agents of concern as weapons of Bioterrorism).

Animal environment: Microbes on the surface and in the alimentary tract of animals and human beings, rumen microbes and luminescent bacteria as symbionts in fishes.

Extreme environments: General characteristics of Extremophiles- (thermophiles, psychrophiles, barophiles, halophiles, osmophiles, alkalophiles, acidophiles).

Unit III: Waste management and Bioremediation

Waste management: Liquid waste management: Microbial treatment of sewage and industrial effluents. Concepts of BOD and COD. Sewage treatment: Primary, secondary (aerobic activated sludge, oxidation ponds, trickling filters and anaerobic septic tank, imhoff tank, anaerobic digesters) and tertiary treatment systems. Potable water: microbial assessment of water quality and treatment.

Solid waste management: Sources and types of solid waste, methods of disposal: incineration, composting (vermicomposting) and sanitary landfill.

Biodeterioration: Biodeterioration of wood and paints. Biodegradation of xenobiotic compounds (pesticides, synthetic polymers and hydrocarbons).

Unit IV: Practical

1. Determination of dissolved Oxygen (DO) of water
2. Determination biochemical oxygen demand (BOD) of water
3. Determination of chemical oxygen demand (COD) of water.
4. Determination of fecal contamination in potable water by MPN methods(presumptive, confirmed and completed test.)
5. Determination of total bacterial population by standard plate count technique.
6. Methods to study aeromicroflora.

Reading List

1. Dubey, R.C. and Maheshwari, D.K: 1999. *Text book of Microbiology*. S. Chand & Company Ltd., New Delhi
2. Madigan, M.T., Martinko, J.M. and Parker, J: 1997, *Brock Biology of Microorganisms*, 8th

edition. Prentice-Hall Inc.

3. Pelczar, M.J. and Chan, E.C.S, 2003, *Elements of Microbiology*. Tata McGraw-Hill.
4. Prescott, L. M., Harley, J.P. and Klein, D.A: 1999, *Microbiology*, 4 edition. McGraw Hill.
5. Pepper, I.L: 2005, *Environmental Microbiology-Laboratory Manual*. Academic Press, Inc.
6. Schlegel, H.G: 1997, *General Microbiology*. Cambridge University Press.
7. Tortora, G.J., Funke, B.R. and case, C.L: 1998; *Microbiology: an Introduction*, 5th edition. The Benjamin-Cummings Publishing Company, Inc.

MIC-UG-C601: Immunology and Medical Microbiology

Unit I: Immunology

Historical background, innate and acquired immunity, humoral and cell mediated immunity, organs and cells involved in immune response, identification and characterization of T and B cells; Cells surface receptors, cellular cooperation,

Humoral immune response, immunoglobulin structure and properties, monoclonal antibodies, antigen-antibody reactions (In-vivo and in-vitro), complement.

Overview of: hypersensitivity, auto immune disease, super antigens.

Unit II: Epidemiology

Epidemiology and public health microbiology: epidemiological terminology; infectious disease transmission; public health measures for the control of epidemics (controls directed against reservoir and transmission of pathogens; vaccination; quarantine; surveillance); emerging and resurgent diseases. Nosocomial infections: An overview of normal flora, host-parasite interaction. Mechanism of pathogenicity: entry of pathogen into host (portal of entry: adherence; invasion); colonization and growth; mechanism of damaging host cells and establishment of diseases; virulence; nonspecific host defenses

Unit III: Clinical Microbiology

Brief account of morphology, cultural characteristics, clinical features and laboratory diagnosis of following pathogens:

Staphylococcus aureus, *Streptococcus pyogenes*, *Mycobacterium tuberculosis*, *Salmonella typhi*, *Vibrio cholerae*, *Campylobacter*. Human Immunodeficiency Virus, Influenza virus, Hepatitis virus, *Plasmodium vivax*, *Entamoeba histolytica*, Tape worm, Dermatophytes.

Antimicrobial chemotherapy: Basic mechanisms of drug action; drug resistance, major antimicrobial drugs with their mode of action and clinical uses. Overview of Vaccines

Unit IV: Practical

Students are supposed to perform the following experiments:

A: Bacteriological test

1. Isolation and characterization of pathogenic bacteria in terms of morphological, Cultural and biochemical characteristics. *E. coli*, *Klebsiella*, *Pseudomonas* and *Staphylococcus aureus*, *Streptococcus pyogenes*
2. IMViC test.
3. Antimicrobial testing using
 - Disc Diffusion (Kirby Bauer method).
 - Minimum Inhibitory Concentration
4. Acid fast staining

B: Serological test

1. Blood grouping -ABO and Rh.
2. VDRL.

3. Agglutination: slide, Widal (*demonstration only*).
4. Hepatitis-B surface (HBsAg) antigen detection.

Reading List

1. Dubey, R.C. and Maheshwari, D.K: 1999. *Text book of Microbiology*. S. Chand & Company Ltd., New Delhi
2. Forbes, B.A., Sahm, D.F. and Weissfeld, A.S: 2007. *Bailey & Scott's Diagnostic Microbiology*. CV Mosby Co.
3. Janeway, C.A. and Travers, P: 1997. *Immunology: The Immune System in Health and Diseases*. Garland Publishing Logan, N.A: 1994. *Bacterial Systematics*. Blackwell Scientific Publications.
4. Logan, N.A: 1994. *Bacterial Systematics*. Blackwell Scientific Publications.
5. Madigan, M.T., Martinko, J.M. and Parker, J: 1997, *Brock Biology of Microorganisms*, 8th edition. Prentice-Hall Inc.
6. Pelczar, M.J. and Chan, E.C.S, 2003, *Elements of Microbiology*. Tata McGraw-Hill.
7. Prescott, L. M., Harley, J.P. and Klein, D.A: 1999, *Microbiology*, 4 edition. McGraw Hill.
8. Schlegel, H.G: 1997, *General Microbiology*. Cambridge University Press.
9. Salyers, A.A. and White, D.D: 2002. *Bacterial Pathogenesis: a Molecular Approach*. American Society for Microbiology, Washington, DC.
10. Tortora, G.J., Funke, B.R. and case, C.L: 1998; *Microbiology: an Introduction*, 5th edition. The Benjamin-Cummings Publishing Company, Inc.

MIC-UG-C602: Industrial and Food Microbiology

Unit I: Principles of Industrial Microbiology

General concepts of industrial microbiology, principles of exploitation of microorganisms and their products, screening, strain development industrial sterilization, fermentation equipment and its uses, types of fermentation- single batch, fed batch, continuous (dual or multi stage), surface, submerged and solid state/substrate fermentation, downstream processing (product recovery)

Unit II: Industrial Microbial Products

Industrial products derived from microbes, industrial enzyme- cellulase; amino acid production: glutamic acid; production of antibiotics: penicillin; vitamins: riboflavin; exopolysaccharides (xanthan gum), bioplastics (PHA).

Unit III: Food spoilage and Preservation and Fermented Foods

Brief account of important microorganisms in foods (Food spoiling, intoxicating and disease causing). Spoilage of vegetables, fruits, meat and milk products. Factors affecting their growth and survival (extrinsic and intrinsic). Microbiology of canned foods.

Principles of food preservation- chemical, physical and biological approach.

General account of food safety, HACCP.

Fermented foods and beverages: Methods of production, microbiology and nutritive value of *kinema* and *beer*. Concept of Probiotics – Introduction, characteristics, health benefit and examples of probiotic microorganisms.

Unit IV: Practical

1. Ethanol production from molasses and starchy materials
2. Isolation of microorganisms from food samples – Moulds/Yeasts, bacteria.
3. Determination of quality of a milk sample by methylene blue reductase test
4. Determination of pathogenic microorganisms from food samples – *Bacillus cereus*/*Staphylococcus aureus*/Enterobacteriaceae

5. Mushroom cultivation
6. *Industrial visit/Local laboratory visit of different segments
*Not compulsory

Reading List

1. Adams, M.R. and Nout, M.J. R: 2001. *Fermentation and Food Safety*. Aspen Publishers Inc.
2. Adams, M. and Moss, M.O: 2004. *Food Microbiology*. Panima Publishing Corporation, New Delhi.
3. Casida, L.E: 2002. *Industrial Microbiology*. Wiley & Sons, Inc.
4. Jay, J.M., Loessner, M.J. and Golden, D.A: 2005. *Modern Food Microbiology*. Springer.
5. Madigan, M.T., Martinko, J.M. and Parker, J: 1997, *Brock Biology of Microorganisms*, 8th edition. Prentice-Hall Inc.
6. Prescott, L. M., Harley, J.P. and Klein, D.A: 1999, *Microbiology*, 4 edition. McGraw Hill.
7. Steinkraus, K.H: 1996. *Handbook of Indigenous Fermented Food*. Marcel Dekker, Inc.
8. Tortora, G.J., Funke, B.R. and case, C.L: 1998; *Microbiology: an Introduction*, 5th edition. The Benjamin-Cummings Publishing Company, Inc.
9. Vela, G.R: 1997. *Applied Food Microbiology*. Star Publisher.