M.G. KASHI VIDYAPITH, VARANASI

Three Years Degree Course Syllabus for

Industrial Microbiology

(BASED ON UNIFORM SYLLABUS FOR U.P. STATE UNIVERSITIES)

Year	Paper	Paper Title	Max.Marks
I Year	IM 101	Fundamentals of Microbiology	50
	IM 102	Microbial Physiology and Biochemistry	50
	IM 103	Tools and Techniques in Microbiology	50
	IM 104	Practicals	50
		Total	200
II Year	IM 201	Microbial Genetics and Molecular Biology	50
	IM 202	Environmental Microbiology	50
	IM 203	Computers, Bioinformatics and Biostats	50
	IM 204	Practicals	50
		Total	200
III Year	IM 301	Immunology and Medical Microbiology	75
	IM 302	Agriculture and Food Microbiology	75
	IM 303	Industrial Microbiology	75
	IM 304	Practicals	75
		Total	300

B.Sc. Industrial Microbiology

B.Sc. I

Paper I

Fundamentals of Microbiology

Unit 1. Definition and Scope of Microbiology, History and Development of Microbiology (contribution of pioneers), Golden Era of Microbiology.

Unit 2. Diversity of Microbial World, Prokaryotic cell, Structure of Bacterial cell, Archaebacteria and Eubacteria, Structure and function of Plasma membrane, cell wall, capsule, flagella, nucleod, plasmid, Gram positive and Gram negative bacteria.

Unit 3. Characteristics of Fungi, Algae, Protozoans, Viruses. Principles of classification of bacteria, algae, fungi, protozoa, viruses.

Unit 4. Methods for studying microorganisms, pure culture techniques, methods of sterilization – physical and chemical, media – types, preservation techniques.

Unit 5. Microbial growth, phases of growth, conditions of growth, measurement of growth, bacterial sporulation and germination, binary fission.

References

1. M J Pelczar, E C S Chan and N R Krieg. Microbiology. Tata McGrawHill.
2. T D Brock. Biology of Microorganisms. Prentice Hall
3. R C Dubey and D K Maheshwari. A Textbook of Microbiology. S.Chand.

Paper II
Microbial Physiology and Biochemistry

Unit 1. Biochemistry of Microbes: Chemical composition of cell, molecules of living systems, pH and pK, Buffers.

Unit 2. Structure and classification of carbohydrates, lipids, proteins, DNA and RNA.

Unit 3. Biosynthesis of bacterial cell wall, transport across membrane, effect of temperature, salinity and oxygen on growth. Anaerobic bacteria, adaptations in extreme conditions.

Unit 4. Enzymes and their classification, Enzyme kinetics, allosteric enzymes, Michaelis- Menten equation, coenzyme, isozyme, enzyme inhibition and regulation.

Unit 5. Microbial photosynthesis, photosynthetic apparatus in pro and eukaryotes, anoxygenic and oxygenic photosynthesis (cyanobacteria and algae). Light and dark reactions.

References:

1. Lehninger. Principles of Biochemistry, Nelson and Cox.
2. J L Jain. Biochemistry. S. Chand.
3. A G Moat, J W Foster and M P Spector. Microbial Physiology. Wiley.

Paper III

Tools and Techniques in Microbiology

Unit 1. Microscopy – Light, phase contrast, electron, scanning and transmission electron microscopy, staining techniques for light microscopy, sample preparation for electron microscopy.

Unit 2. Common equipments of microbiology lab and principle of their working – autoclave, oven, laminar air flow, centrifuge.

Unit 3. Calorimetry and spectrophotometry, Electrophoretic techniques – proteins and nucleic acids, PCR.

Unit 4. Chromatography techniques: adsorption, partition, ion exchange, gel filtration, HPLC, FPLC.

Unit 5. Cultivation of extraordinary microorganisms, techniques used for identification of microorganisms – biotyping, serotyping, molecular techniques.

References:

1. R M Atlas, A E Brown, K W Dobra and L Miller. Basic Experimental Microbiology. Prentice Hall.
2. Gunasekaran. Introduction to Microbial Techniques.

Practicals

1. Learning the equipments of a common microbiology laboratory.
2. Preparation of culture media (agar/ broth).
3. Learning the techniques of sterilization.
4. Isolation of pure culture.
5. Enumeration of microbial population.
6. Staining techniques to study morphology of miroorganisms.
7. Staining technique for endospore, Gram staining.
8. Estimation of proteins.
9. Estimation of glucose.
10. Measurement of bacterial growth spectrophotometrically.
11. Isolation and cultivation of anaerobes.
12. Checking the motility of bacteria by hanging drop method.
13. Paper chromatography.
14. Enzyme assays – amylase, gelatinase, catalase etc.

B.Sc. II

Paper I
Microbial Genetics and Molecular Biology

Unit 1. Genetic recombination in bacteria: transformation, transduction and conjugation, gene mapping.

Unit 2. Extra chromosomal genetic material: plasmids, cosmids, transposons, silent genes, exons and introns.

Unit 3. DNA as genetic material, basic mechanism of replication, enzymes involved in replication, transcription mechanism, translation, genetic code, regulation of gene expression, reference to prokaryotes.

Unit 4. Mutations: spontaneous and induced – chemical and radiations, base pair changes, frameshift, deletions, inversions, tandem duplications, insertions, useful phenotypes – auxotrophy, conditional lethal, resistant.

Unit 5. DNA repair and restriction: Types of repair system, restriction endonucleases, various types of restriction enzymes – properties and uses, methylation – dependent restriction enzymes.

References:

1. S R Maloy, D Freifelder and J E Cronan. Microbial Genetics. Jones and Barlett Publishers.
2. Prescott

Paper II
Environmental Microbiology

Unit 1. Aerobiology: droplet nuclei, aerosol, assessment of air quality, airborne diseases and their control, enumeration of microbes from air.

Unit 2. Soil Microbiology: soil microflora and its enumeration, rhizosphere, phyllosphere, microbial interactions, mycorrhizae, lichens.

Unit 3. Nitrogen fixation: mechanism of symbiotic and asymbiotic, nitrogenase complex, nif genes and their regulation, *Rhizobiaceae, Frankia*.

Unit 4. Biogeochemical cycling: role of microorganisms in carbon, nitrogen, phosphorus and sulfur cycles. Biodegradation of xenobiotics, bioaccumulation, biodeterioration.

Unit 5. Water microbiology: ecosystems – fresh water and marine, zonations, eutrophication, water borne diseases and their control. Waste treatment – solid liquid, aerobic and anaerobic methods.

References:

1. Bagyaraj and Rangasamy. Agricultural Microbiology..
2. N S Subba Rao. Soil Microbiology. Oxford and IBH.
3. Atlas and Bartha. Microbial Ecology. Pearson.

Paper III
Computers, Bioinformatics and Biostatistics

Unit 1. Introduction to Computers – classification, computer generation, low, medium and high level languages, software and hardware, operating systems, compilers and interpreters, personal, mini, main frame and super computers, characteristics and application, computer memory and its types, data representation and storage.

Unit 2. Microsoft excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media.

Unit 3. Overview of bioinformatics, database types, computer tools for sequence analysis, finding and retrieving sequences, similarity searching.

Unit 4. Nature and scope of statistical methods, compilation, classification, tabulation and applications in life sciences, graphical representation, introduction to probability theory and distributions.

Unit 5. Correlation and regression – concepts of sampling and sampling distribution, tests of significance based on t, chi square and F for means, variances and correlations. Sampling methods – simple Random, stratified systematic and cluster sampling procedures, analysis of variance.

References:

1. G W Snedecar and W G Cochram. Statistical Methods. Oxford.
2. R White. How Computers Work. Techmedia.
3. Higgins and Taylor. Bioinformatics. OUP.

Practicals

1. Isolation of *E. coli* plasmid.
2. Transformation in *E. coli.*
3. Replica plate technique for detection of auxotrophy.
4. Isolation of DNA from bacteria.
5. Electrophoretic analysis of proteins and nucleic acids.
6. Isolation of root nodulating bacteria.
7. Enumeration of microorganisms from air.
8. Isolation of bacteria from rhizosphere.
9. Coliform test.
10. Determination of standard deviation.
11. Determining ANOVA
12. Learning to use EXCEL and Word.

B.Sc. III

Paper I
Immunology and Medical Microbiology

Unit 1. Innate and acquired immunity, humoral and cell mediated immunity, organs and cells involved in immune response, identification and characterization of T and B cells, MHC, antigen characteristics, types of antigens, adjuvants.

Unit 2. Humoral immune response, immunoglobulins – structure and properties, antibody diversity theories, monoclonal antibodies, antigen-antibody reactions, complement system.

Unit 3. Characterization and types of T cells, macrophage activation, cytokines, types of hypersensitivity, cell mediated toxicity, principles of serological test methods.

Unit 4. Diseases caused by specific bacterial pathogens: *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Mycobacterium*, *Salmonella*, *Vibrio*, *Clostridium*, *Enterobacter, Mycobacteria, Spirochaetes, Chlamydiae and Rickettsiae*.

Unit 5. Diseases caused by Viruses: HIV, Hepatitis, Rabies, pox, Herpes, oncogenic viruses. Diseases caused by protozoans: *Entamoeba histolytica, Plasmodium* species, *Trypanosoma, Leishmania*.

References:

1. B Annadurai. A textbook of Immunology and Immunotechnology. S. Chnd
2. R Ananthanarayanan and C K Panicker. Textbook of Microbiology. Orient Longman.

Paper II
Agriculture and Food Microbiology

Unit 1. Microorganisms as biofertilizers (Rhizobial, Cyanobacterial, Mycorrhizal, Azotobacter): production and application of. Microbial biopesticides, recombinant pesticides (special reference to Bt), GMO and their impact.

Unit 2. Microbial diseases of crops: transmission of pathogens, Citrus canker, little leaf of brinjal, red rot of sugarcane, brown rot of potato, black rot, mosaic virus, tomato spot, early and late blight, wilt disease. Control of plant diseases.

Unit 3. Microorganisms important in food microbiology – molds, yeasts, bacteria, principles of food preservation – high and low temperatures, drying, chemical preservatives, food additives.

Unit 4. Food spoilage and food borne infections, general principles underlying food spoilage and contamination, canned food spoilage, spoilages of vegetables, fruits, meat and meat products, milk and milk products, fish, seafood and poultry.

Unit 5. Food produced by microbes: bread, cheese, fermented dairy products, microbial cells as food – single cell proteins, mushroom, fermented Indian foods.

References:

1. Adams and Moss. Food Microbiology. Cambridge.
2. R S Mehrotra. Plant Pathology.
3. Frazier and Westhoff. Food Microbiology. Tata McGraw Hill.

Paper III
Industrial Microbiology

Unit 1. Exploitation of microorganisms and their products, screening, strain development strategies, immobilization methods, fermentation media, raw material used in media production, antifoaming agents, buffers, downstream processing.

Unit 2. Fermentation equipment and its uses, fermentor design, Types of fermentors and fermentations- single, batch, continuous, multiple, surface, submerged and solid state.

Unit 3. Industrial products from microorganisms- antibiotics: production of penicillin, streptomycin. Interferons, vaccines, hormones, vitamins.

Unit 4. Enzymes from microbes: amylase, protease. Organic acids: citric acid, acetic acid, amino acids: glutamic acid, lysine.

Unit 5. Production of alcoholic beverages: bear and wine, biofuels: ethanol, methane, biogas.

References:

1. Whitaker and Stanbury. Principles of Fermentation Technology.
2. Casida. Industrial Microbiology. Tata McGraw Hill.

Practicals

1. Bacteriological analysis of food products.
2. Determining the quality of milk by MBRT.
3. Agglutination reactions – blood group, Widal, VDRL.
4. Enzyme Linked Immunosorbent Assay.
5. Antibiotic sensitivity test by well and disc methods.
6. DLC, TLC.
7. Preservation methods.
8. Isolation and identification of major bacterial pathogens such as *Staphylococcus, Streptococcus* etc.