

Shiksha Mandal's

Bajaj College of Science (Autonomous), Wardha

Syllabus

B.Sc. Microbiology

B.Sc. Semester I (Microbiology)

History and Microbial Morphology

Unit-I: A. History of Microbiology

- i) Discovery of microbe
- ii) Theory of biogenesis and abiogenesis.
- iii) Contributions of Louis Pasteur, Robert Koch, Sergei Winogradsky, Martinus Beijerinck, John Tyndal and Joseph Lister.

B. Scope of Microbiology: Basic Branches of Microbiology: Bacteriology, Mycology, Phycology, Virology Applied Branches Biotechnology: Medical Microbiology, Biotechnology, Geomicrobiology, Exobiology, Environmental Microbiology, Food and Dairy Microbiology

Unit -II: Classification of Bacteria

- i) Definition: Taxonomy, classification, Identification, Nomenclature.
- ii) Approaches in Bacterial Classification, Bacterial Classification: Whittaker Five Kingdom System, Intuitive Method of Classification, Numerical Taxonomy, Genetic Relatedness: GC: AT Ratio, DNA Hybridization, 16SrRNA Cataloguing
- iii) Bergey's Manual of Systematic and Determinative Bacteriology.

Unit-III: A. Prokaryotic Cell structure

- i) Concept and difference between Eukaryotes and Prokaryotes.
- ii) Typical Bacterial cell structure: Structure of cell wall (gram +ve, gram-ve), Cell membrane: Fluid mosaic model, Mesosomes, Ribosomes, Nucleoid, plasmids, Storage granule, Capsules, slime layer, Pili, Flagella (including types and structure).
- iii) Endospore structure, formation and germination
- iv) Exospores, Myxospores.
- v) Significance of Dormancy

Unit-IV: Eukaryotic Microbes

- i) Fungi and yeast: General characters, Asexual and sexual mode of reproduction, slide culture techniques.
- ii) Algae: General characters and industrially important algal cells
- iii) Protozoans: General characters and life cycle of trypanosome

Unit-V: Microbial Nutrition

- i) Basic nutritional requirements. ii) Nutritional classification of bacteria
- iii) Types of culture media: selective, enriched, enrichment, synthetic, non synthetic
- iv) Pure culture v) Axenic cultures, Diauxic cultures.
- i) Isolation of pure culture: various techniques.
- ii) Determination of C, N, P by auxanographic and replica plate technique

Unit-VI: Unit-III: Acellular Microbes: Viruses

- i) Discovery of viruses, General structure, symmetry and classification
- ii) Cultivation of viruses: chick embryo, tissue culture
- iii) Detection of viral growth iv) T4-Bacteriophages and Lambda viruses.
- v) lytic and Lysogeny cycle

Practicals Sem I

1. General concept of basic equipment's and apparatus
2. Preparation of media: Nutrient agar, nutrient broth, PDA, selective & differential media.
3. Demonstration of microbes from air, water, soil
4. Performance of simple, Grams, acid fast and spores staining
5. Isolation of pure culture by streak plate, spread plate and pour plate method.
6. Enumeration of microorganisms by SPC
7. Demonstration of Micrometry
8. Cultivation of fungi by slide culture technique
9. Isolation of bacteriophage from sewage
10. Isolation of staphylococcus from contaminated food

Note: Minimum 8 experiments (4*+4) should be performed in each semester.

Distribution of marks for practical exam (**Total: 30 Marks**)

- 1) Major one experiment (Marks **08**)
- 2) Minor two experiments (Marks **08**)
- 3) Spotting (Marks **04**)
- 4) Viva (Marks **05**)
- 5) Record book (Marks **05**)

Duration of practical exam: 8 Hours (4 Hours each day)

List of Books Recommended For Semester I and Semester II Microbiology

- 1) General Microbiology : Stainer, Roger et. al.
- 2) General Virology : Luria, S.E.
- 3) Handbook of Genetics : Esser, K.
- 4) Fundamentals Principles of : A.J. Salle. bacteriology
- 5) Microbiology : Pelczar, Chan, Krieg.(TMH)
- 6) Fundamental of Microbiology : Frobisher
- 7) General Microbiology Vol. I & II : Power & Dagainawala. (Himalaya Publication)
- 8) Zinsser Microbiology : W.K. Joklik
- 9) General Microbiology : W.G. Walter
- 10) Elements of Microbiology : M.J. Pelozar & E.C.S. Chan
- 11) Essays in Microbiology : J.N. Norris & M.H. Richmond
- 12) Microbiology : L. Mckane & J. Kandel (Essentials & Applications)
- 13) Basic Microbiolgy : Volk
- 14) Chemical Microbiology : Rose
- 15) Microbiology : Paul A. Ketchum. (Introduction to Health of Professional)
- 16) Molecular Biology of the gene : J.D. Watson.
- 17) Elementary Microbiology : Modi (Akta Prakashan) Vol. I & II
- 18) Basic experimental : Ronald M., Atlas, & Alfred Microbiology Miller
E.Brown, Kenneth
W. Dobra, Lionas (1986) (Prentice Hall - 316 PP)
- 19) General Microbiology : Robert F.Boyd (1984) times mirror / mosby college,
Pub.
- 20) Text Book of Microbiology : Dubey & Maheshwari (S.Chand, Publication)
- 21) Foundation in Microbiology:Ulhas
Patil,A.B.Chaudhary,Dr.S.B.Chincholkar,J.S.Kulkarni(Neerali Publication)

List of books for practicals

- 1) Microbes in Action : Seely, Wander Mark Tarporewala, Bombay
- 2) A Mannual of Microbiology : A.J. Salle.
- 3) Microbiology Methods : Collins
- 4) Bacteriological Techniques : F.J.Baker
- 5) Introduction to Microbial Techniques : Gunasekaran
- 6) Biochemical methods: Sadashivam & Manickam
- 7) Laboratory Fundamentals of Microbiology: Alcamo, I.E., Jones and
Bartlett Publishers

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B.Sc. Semester II (Microbiology)

Microbial Techniques

Unit-I: Microscopy: Principle and Applications

- i) Bright field microscopy
- ii) Dark field microscopy
- iii) Electron microscopy (TEM, SEM)
- iv) Confocal microscopy
- v) Phase contrast microscopy
- vi) Fluorescent microscopy.

Unit-II: Staining Techniques

- i) Stains and dyes, chromophore, auxochrome, chromogens, types of stains.
- ii) Staining techniques: simple, differential, gram staining, acid fast staining.
- iii) Staining of specific structure: flagella, spores, capsule (negative), Metachromatic granule staining.

Unit-III: Microbial Reproduction and Growth.

- i) Microbial Reproduction: Binary fission, Budding, Fragmentation, Sporulation
- ii) Microbial growth: Principle of growth curve, Different phases and mathematical expression of growth rate
- iii) Continuous culture: Dialysis, Turbidostat and Chemostat.
- iii) Factors influencing microbial growth

Unit-IV: Microbial Control.

- i) General Terminologies: sterilization, disinfection, disinfectants, sanitizer, antiseptics, microbiostatic, microbiocidal, sanitizer, preservation.
- ii) Physical methods: Heat, moist heat sterilization, Dry heat sterilization, Low temperature, Filtration, radiation, osmotic pressure.

Unit-V: Chemical Control Agents

- i) Characteristics of an ideal disinfectants, Phenolics, Alcohols, Halogens, Heavy metals, Quaternary ammonium compounds, Surface active agents, Aldehydes, Gaseous sterilization, Chemotherapeutic agents.
- ii) Mechanism of cell injury, Factors influencing antibacterial activity.
- iii) Phenol coefficient.

Unit-VI: Microbial interaction

- i) Positive and negative interaction: Commensalism, synergism, syntropism, mutualism, parasitism, predation, antagonism, competition
- ii) Protist-Protist Interaction: Bdellovibrio
- iii) Protist-Plant interaction: Root nodule bacteria
- iv) Protist-Animal interaction: Rumen bacteria, insect midgut bacteria, luminescent bacteria

Practicals Sem II

1. Demonstration of Antibiosis
2. Simple, Grams, acid-fast, fungal and endospore staining
3. Determination of phenol coefficient
4. To Study the effect of salt on bacterial growth
5. To perform membrane filtration
6. To demonstrate the effect of radiation on bacterial growth
7. To cultivate anaerobic bacteria
8. Isolation of Gram negative bacteria
9. Performance of Oligodynamic action of metals
10. Antibiotic disc sensitivity test.

Note: Minimum 8 experiments (4*+4) should be performed in each semester.

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Duration of practical exam: 8 Hours (4 Hours each day)

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- 2) General Virology : Luria, S.E.
- 3) Handbook of Genetics : Esser, K.
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- 3) Microbiology Methods : Collins
- 4) Bacteriological Techniques : F.J.Baker
- 5) Introduction to Microbial Techniques : Gunasekaran
- 6) Biochemical methods : Sadashivam & Manickam
- 7) Laboratory Fundamentals of Microbiology: Alcamo, I.E., Jones and
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B.Sc. Semester III (Microbiology)

Chemistry of Organic Constituents, Enzymology and Metabolism

Unit I—Carbohydrates and Metabolism

- A) Definition of Carbohydrate, Classification of carbohydrates, Structure of monosaccharides: glucose, fructose. Structure of disaccharides: maltose, lactose, sucrose. Concept of glycosidic bond, Trisaccharide: raffinose. Homopolysaccharides: starch, glycogen, cellulose. Heteropolysaccharides: hyluronic acid.
- B) General strategy of metabolism, EMP pathway and its regulation, TCA cycle and its regulation, substrate level phosphorylation, Cyclic and noncyclic photophosphorylation, Oxidative phosphorylation.

Unit II--- Proteins, Amino acids and Metabolism

- A) Definition of protein, Classification of protein, Biological importance of protein, Protein degradation.
- B) Classification of amino acids, titration curve, acidic, basic and neutral amino acids, peptide bond theory, organizational levels of proteins, concept of oligomeric protein.
- C) Amino acid breakdown, deamination (alanine, tyrosine, methionine), urea cycle, gluconeogenesis and ketogenesis.

Unit III---Lipid and Lipid Metabolism

- A) Definition of lipids, Classification of lipids, structure of triglycerides, compound lipids, derived lipids, Biological functions of lipids.
- B) Definition of fatty acid, Beta oxidation, Omega oxidation, alpha oxidation, oxidation of odd number fatty acids, oxidation of branched chain fatty acids.

Unit IV --- Nucleic acid and Metabolism

- A) DNA, RNA and various forms of DNA & RNA, Structure of purines, pyrimidines, nucleosides & nucleotides, Replication of DNA, Modes of replication, general features, rolling circle & knife & fork model.
- B) Nucleotide metabolism, biosynthesis of purine nucleotide & biosynthesis of pyrimidine nucleotides.

Unit V--- Enzymology

- A) General concept, Definition and nature of enzymes, classification, nomenclature, primary concept of enzyme kinetics, MM equation, modifications of MM equations, activation energy, transition state, ES complex, enzyme activity, katal, specific activity, turn over number
- B) Enzyme inhibition and their types, enzyme regulation & their types, allosteric sites, allosteric modulators, functional diversity such as holoenzyme, apoenzyme, coenzyme, cofactor, prosthetic group, isoenzymes, membrane bound enzymes, multienzyme complex, zymogens.

Unit VI---Vitamins

- A) Classification on the basis of solubility, Water soluble vitamins, structure, function & chemistry of vitamin B1,B2,B12, vitamin C.
- B) fat soluble vitamin: Structure, function & chemistry of vitamin A, D,E & K, Hyper and hypovitaminosis

Practicals Semester III

1. Qualitative analysis of carbohydrates, lipids and proteins.
2. Estimation of carbohydrates by DNS/ anthrone =method.
3. Detection of enzymes: amylase, catalase, gelatinase, lipase.
4. Estimation of proteins by Lawrys method.
5. Estimation of DNA.
6. Estimation of RNA.
7. Immobilization of yeast and demonstration of invertase activity
8. UV absorption of Nucleic acid.
9. Effect of PH on enzyme activity
10. Effect of temperature on enzyme activity.
11. Effect of substrate concentration on enzyme activity.

List of Reference Books for Sem III Microbiology:

1. Biochemistry: - Lehninger
2. General Microbiology. Vol 1& II. : - Powar & Dagainawala
3. An Introduction to Biochemistry by Plummer 3 rd Edition ,Tata McGraw – Hill
4. Molecular Biology of the Cell: - J. D. Watson, D. Bray
- 5 The DNA Story: - J. D. Watson
- 6 Genetics of Prokaryotes: - Srivastava et.al
- 7 Genes: - Pramod Kumar
8. Genetic Engineering and its Applications -Joshi P.
- 9 Gene Transfer and Expression a Laboratory Manual: - Michael Kriegler
- 10) Concept in biotechnology: - D. Balasubramanium
11. Essential Genetics: - Daniel. Hartl.
12. Nelson D.L and Cox M.M.(2002) Lehninger's Principles of Biochemistry, Macmillan Worth Pub.Co.New Delhi.
13. Garrett, R.H and Grisham,C.M (2004) biochemistry. 3rd ed.Brooks/Cole, publishing company,California.
14. Jain J.L,Nitin Jain, Sunjay Jain (1979) Fundamentals of Biochemistry.7th edition, S.Chand publishers.
15. Satyanarayana U., Chakrapani U.(2014)Biochemistry ,4th edition.

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B.Sc. Semester IV (Microbiology)

Industrial and Applied Microbiology

Unit I---Fundamentals of industrial microbiology

Definition and scope of industrial microbiology, general concept, primary screening, secondary screening, strain development, types of fermentation processes, design of typical fermenter, parts of fermentor, types of fermentors, sterilization of fermentors.

Unit II ---Concept of upstream & downstream processes.

Raw materials for media preparation, sterilization of media, Inoculum development, scale up of fermentation process, raw media for media preparation, Conditions required for fermentation, control of agitation, temperature, aeration, pH and dissolved oxygen.

Unit III ---Industrial Production

Production, biochemistry, recovery and uses of: SCP, Bakers yeast, ethanol, penicillin, semisynthetic penicillin, citric acid, Vit B12 and beer and wine.

Unit IV ---Water microbiology

A) Significance of bacteriological analysis of water, indicators of excretal pollution, collection and handling of water samples, Definition of coliforms, bacteriological analysis of water for coliforms and faecal streptococci (MTFT, MFT).

B) water treatment using SSF and RSF, methods of chlorination.

Unit V---Waste water treatment

Definition and composition of sewage, Sewage types, characteristics of sewage, BOD, COD, Treatments of sewage, Primary & secondary treatment, Trickling filter, activated sludge, RBC, sludge digester, oxidation pond, septic tank, imhoff tank.

Unit VI--- Air, Soil and Food microbiology

A) Microbial analysis of air, composition of air, settling plate and Anderson sampler, Lemons sampler.

B) Symbiotic & non symbiotic nitrogen fixers examples in soil, biopesticides, biofertilizers, mycorrhiza, microbial leaching of copper and uranium.

Milk: Composition, Pasteurization of milk, Grades of milk

Food spoilage organisms, factors affecting food spoilage, canning process, pasteurization, food preservation, low temperature preservation, chemical preservation

Food borne diseases: salmonellosis and food intoxication: botulism

Practicals IVth Sem

1. Production and estimation of alcohol
2. Isolation of amylase producer from soil
3. Isolation & microscopic observation of organisms from water and sewage
4. Bacteriological analysis of water by MTFT & determination of MPN
5. Identification and differentiation of coliforms by IMViC Test
6. Determination of DO
7. Determination of Alkalinity of water
8. Determination of BOD
9. Determination COD
10. Detection of arsenic by bioassay
11. Determination of Chlorine demand
13. Isolation & microscopic observation of microorganisms from spoiled food.

List of Reference Books for Microbiology:

1. Introduction to Soil Microbiology : Alexander Martin
2. Soil Microbiology: Subbaroa N.S.
3. Introduction to environmental Microbiology: Mitchell, Ralph
4. Sewage & Waste treatment : Hammer
5. Water Pollution : Zajic J.E.
6. Water Pollution Microbiology : Mitchell R.
7. Air Pollution : Perlins H.L.
8. Aquatic Microbiology : Stainer & Shewan
9. Introduction to Waste Water Treatment processes: Ramalhr R.S.
10. Fermented Foods (Vol.7): Rose A.A.
11. Industrial Microbiology: Prescott S.C. & Dunn C.G.
12. Industrial Microbiology : Miller B.M. & W. Litsky
13. Industrial Microbiology : A.H. Patel
14. Microbial Technology : Pepler H.J. (Vol. I & II)
15. Industrial Microbiology : Casida L.E.
16. Principles of Fermentation : Stanbury, Peter F. & Technology Allan.
17. Outlines of Dairy Bacteriology : Sukumar De
18. Modern Food Microbiology : Jay, Mames M.
19. Principles of Industrial : Rhodes & Fletcher. Microbiology
20. Industrial Fermentation : Under Kofler & Hick. Vol. I & II
21. Dairy Microbiology : Foster Etal
22. Industrial Microbiology : Rose

BOOKS RECOMMENDED FOR PRACTICALS :

1. Microbes in Action : Seely, Wander Mark, Taraporewala, Bombay.
2. Manual of Microbiological : A.J. Salle, Methods
3. Microbiological Methods : Collins
4. Difco Manual.