

Devi Ahilya Vishwavidyalaya, Indore

Syllabus for B.Sc. Part-I, II and III (Optional subject- Microbiology)

2011 Onwards

Semester Course title Distribution of marks

CCE Semester

Exam

Practical

Exam

Total

Sem-I General microbiology 15 85 50 150

Sem-II Microbial physiology and

Biochemistry

15 85 50 150

Sem-III Bacterial genetics 15 85 50 150

Sem-IV Immunology and Clinical

microbiology

15 85 50 150

Sem-V Industrial microbiology 15 85 50 150

Sem-VI Applied and Environmental

microbiology

15 85 50 150

Scheme of practical examination in each semester

Total marks- 50

Duration- 6 Hrs.

1. Major exercise 12 Marks
2. Minor exercise-1 10 Marks
3. Minor exercise-2 10Marks
4. Spotting 08 Marks
5. Viva-voce 05 Marks
6. Practical record 05 Marks

Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- I (Microbiology) Semester-I

Semester-I General microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I History and Scope of Microbiology

Contributions of Pioneers- Anton von Leeuwenhoek, Robert Koch, Edward Jenner, Louis Pasteur, Paul Ehrlich, Alexander Fleming and Joseph Lister.

Branches of Microbiology and its development.

Spontaneous generation v/s Biogenesis.

Place of microbes in living world.

Beneficial and harmful microbes.

Microbes in extreme environments.

Unit-II Tools and Techniques in Microbiology

Microscopy- Bright field, Dark field, Fluorescence, Phase contrast and Electron microscopes.

Colorimetry, Centrifugation and Electrophoresis.

Hot air oven, Autoclave, Laminar Air Flow Bench.

Stains and Staining Techniques- Dyes: Classification and types; Types of staining- Simple

(Monochrome, Negative), Differential (Gram & Acid Fast) and Special staining (Spore, Granules, Flagella, Spirochetes).

Wet mount and Hanging drop preparations.

Unit-III Taxonomy and Morphology of Bacteria

Classification systems of prokaryotes. Bacterial nomenclature.

Size, shape and arrangement of bacterial cells.

Cell wall of Gram positive and negative bacteria (Protoplast, Spheroplast).

Structures external to the cell wall- flagella, pili, capsule, sheath and prosthecae.

Structures internal to the cell wall- cell membrane, nuclear material, spores, cytoplasmic inclusions, magnetosomes and plasmids.

Unit-IV Eucaryotes, Acaryotes and Bacteria with unusual properties

General characters and economic importance of – Fungi (Yeast and Moulds), Algae and Protozoans.

Introduction to acellular forms of life- Viruses, Virioids, Prions.

Structure of Bacterial Viruses.

Classification and cultivation of Viruses.

Multiplication of Bacterial Viruses.

Bacteria with unusual properties- Rickettsia, Chlamydia, Mycoplasma, Archaeobacteria, Cyanobacteria, Actinomycetes.

Unit-V Control of Microorganisms

Fundamentals of control

Physical methods of control- Temperature, radiation, dessication, osmotic pressure and filtration

Chemical methods of control- Phenol, alcohol, halogens, heavy metals, dyes, detergents, quaternary ammonium compounds, aldehydes and gaseous chemosterilizers

Evaluation of antimicrobial potency of disinfectants and antiseptics- Tube dilution method, Agar diffusion method, Phenol coefficient.

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List of Practicals

1. Principles, working knowledge of Instruments like Autoclave, pH meter, Incubator, Hot air oven,

Centrifuge, Microscope, Refrigerator, Colony counter, Laminar Air Flow.

2. Neutralization, cleaning and sterilization of glassware.

3. Measurement of microorganisms.

4. Preparation of culture media like Nutrient Agar and its uses.

5. Preparation of stains.

6. Motility of bacteria by Hanging drop method.

7. Staining procedures I- Simple staining – Monochrome staining and Negative staining.
8. Staining procedures II- Differential staining - Gram Staining and Acid Fast Staining.
9. Staining procedures III- Special / Structural staining - Cell wall staining, Capsule staining,
Metachromatic Granule staining, Endospore staining, Spirochete staining.
10. Identification of some common fungi..

Scheme of Practical Examination- Semester -I M.M. 50 (4 Hrs. 1 day)

- Ex.1 Perform Gram staining of given bacterial culture. [12]
 Ex.2 Perform Structural / Special Staining (Cell wall staining, Capsule staining, Metachromatic Granule staining, Endospore staining, Spirochete staining). [10]
 Ex.3 Perform wet mount of given fungal strain. [10]
 Ex.4 Spotting. [8]
 Ex. 5 Viva-Voce. [5]
 Ex. 6 Practical Record. [5]

Recommended Books

- Microbiology - Pelczar, Chan & Kreig
 Microbiology - Prescott, Harley and Klein
 General Microbiology - Stainer RY. Ingharam JL.
 Alcamo's Fundamentals of Microbiology - Pommerville
 Elementary Microbiology - Modi, H.A.
 The Microbial World - Roger Stanier
 Fundamentals of Microbiology - Frobisher Hinsdill
 Fundamental Principles of Bacteriology - Salle, A.J.
 Textbook of Microbiology - Dubey, R.C.
 Microbiology- A Human Perspective - Nester, Roberts
 Foundations in Microbiology - Kathleen Talaro
 General Microbiology (Vol I, II, III) - Powar & Daginawala
 General Microbiology - Hans G. Schlegel
 General Microbiology - Robert Boyd.
 Microbiology – A Practical Approach - Bhavesh Patel and Nandini Phanse
 Solutions to Practical Microbiology - Bhavesh Patel and Nandini Phanse

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B.Sc. Part- I (Microbiology) Semester-II

Semester-II Microbial physiology and Biochemistry CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Cultivation and preservation of bacteria

- Nutrition and nutritional types of bacteria.
 Bacteriological media and its types.
 Cultivation of aerobic and anaerobic microbes.
 Pure culture and cultural characteristics.
 Maintenance and preservation of cultures.

Unit-II Bacterial growth

- Mathematical expression of bacterial growth.
 Growth curve of bacteria.

Batch, continuous, synchronous and diauxic growth.

Factors affecting microbial growth.

Quantitative measurement of bacterial growth by cell mass, cell number and cell activity.

Unit-III Enzymes

General characters, classification and nomenclature of enzymes.

Factors affecting enzyme activity.

Mechanism of enzyme action.

Regulation of enzyme activity.

Applications of enzymes.

Unit-IV Basic Biochemistry

Bonds of life- covalent, ionic and hydrogen bonds

General properties, classification and functions of – Carbohydrates, Lipids, Amino acids, Proteins, Nucleic acids.

Unit-V Bioenergetics and Metabolism

Principles of Bioenergetics.

Modes of energy production- Photophosphorylation, Substrate level phosphorylation,

Oxidative phosphorylation

Catabolism- Carbohydrates-(Aerobic and Anaerobic); Proteins- (Proteolysis,

Transamination, Deamination) and Fats/Lipids- (Beta oxidation)

Bacterial photosynthesis

List of Practicals

1. Isolation of microorganisms by streak plate method.
2. Isolation of microorganisms by pour plate method.
3. Growth of microorganisms on agar slants and agar stabs
4. Growth of microorganisms in broth.
5. Qualitative detection of carbohydrates, proteins and lipids.
6. Effect of environment on bacterial growth : a. Temperature b. Osmotic pressure c. pH
7. The lethal action of Ultraviolet light on growth.
8. The oligodynamic action of heavy metals on bacterial growth.
9. Comparative evaluation of antimicrobial agents.

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Scheme of Practical Examination- Semester-II (3+3 Hrs., 2 days)

Ex.1 Perform isolation of microorganisms by streak plate / pour plate method. [12]

Ex.2 Study the effect of [10]

a. Environmental condition on bacterial growth – Temperature / pH

b. Lethal action of Ultra-Violet light on bacterial growth.

c. Oligodynamic action of heavy metals on bacterial growth.

Ex.3 Qualitative analysis of biomolecules – Carbohydrates/ Proteins / Lipids [10]

Ex.4 Spotting [8]

Ex. 5 Viva-Voce [5]

Ex. 6 Practical Record [5]

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Microbiology- A Human Perspective - Nester, Roberts
Foundations in Microbiology - Kathleen Talaro
General Microbiology (Vol I, II, III) - Powar & Daginawala
Principles of Biochemistry - Lehninger, A.L.
Microbial Physiology - Moat & Foster
Fundamentals of Biochemistry - Jain, J.L.
General Microbiology - Hans G. Schlegel

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B.Sc. Part- II (Microbiology) Semester-III

Semester-III Bacterial Genetics CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Fundamentals of Genetics

Genotype and Phenotype.
DNA as genetic material.
Structure and types of DNA and RNA.
Genetic code.
DNA Replication.

Unit-II Mutation

Evidence for spontaneous nature of mutation.
Molecular basis of mutation – Types of mutations.
Types of bacterial mutants and their isolation.
Mutagenic agents – Physical: Mechanism of mutagenesis by UV and Ionizing radiations.
Chemical mutagenesis: Base analogues (5BU, 2AP), HNO₂ and NH₂OH
Mutation Rate, Ames Test.

Unit-III Genetic Recombination

Transformation – Competence, DNA up take, artificially induced competence, electroporation.
Conjugation – F factor, Characters of donar and recipient. Steps in conjugation, Seduction, formation of Hfr and F prime cells.
Transduction – U tube experiment, Generalized and specialized transduction, Abortive transduction.
Plasmid – Structure, properties, types and applications of plasmids.

Unit-IV Expression and Regulation of Gene Activity

Protein Synthesis.
Operon Concept, Induction, Repression and Attenuation.
Inducible Operon – Lac Operon.
Repressible Operon – Trp Operon.

Unit-V Techniques in Molecular Biology

Genetic Engineering – Tools and Techniques.
Restriction Endonucleases – Types and uses.

Isolation of DNA.

Vectors – Plasmid, Phage, Cosmid and Yeast Vectors.

Cloning Technique and Identification of Clones.

Achievements, biohazards and ethical issue of Genetic engineering.

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List of Practicals

1. Isolation of bacterial genomic DNA.
2. Isolation of Plasmid DNA.
3. Electrophoretic analysis of DNA.
4. UV as a mutagenic agent.
5. Replica plating technique.
6. Isolation of antibiotic resistant mutants by gradient plate technique.
7. Quantitative estimation of DNA by DPA method.
8. Quantitative estimation of RNA by oricinol method.

Scheme of Practical Examination- Semester- III (3+3 Hrs., 2 days)

Ex.1– Isolation of bacterial genomic /plasmid DNA. [12]

Ex.2 – Quantitative estimation of DNA/RNA. [10]

Ex.3 – Replica plating technique/gradient plate technique/UV as mutagenic agent. [10]

Ex.4 – Spotting [08]

Ex.5 – Viva Voce [05]

Ex.6 – Practical Record [05]

Recommended Books

Genes XI - Lewin, B.

Principles of Genetics - Gardner, Simmons and Snustad

Concepts of Genetics - Klug and Cummings

Microbial Genetics - Freifelder

Genetics - Arora and Sandhu

Microbiology – A Practical Approach - Bhavesh Patel and Nandini Phanse

Solutions to Practical Microbiology - Bhavesh Patel and Nandini Phanse

Experiments in Biotechnology - Nighojkar and Nighojkar

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B.Sc. Part- II (Microbiology) Semester-IV

Semester-IV Immunology and Clinical Microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Infection and Immunity

Normal flora of human body.

Infection and its type.

Mechanism of pathogenesis.

Immunity – Natural and acquired.

Defense mechanisms – First line, second line and third line of host defense.

Vaccines – Preparation and types, vaccination schedule for children in India.

Unit-II Epidemiology of infectious diseases

Transmission of diseases.

Types of diseases – Epidemic, Pandemic, Sporadic.

Nosocomial Infections.

Epidemiological Methods – Descriptive, Analytical and Experimental Epidemiology.

Antibiotics – Mode of action and development of resistance. Transmission of drug resistance.

Antiviral and Antifungal drugs.

Unit-III Components of Immune System

Organs and cells involved in immune response.

Antigen – Properties and types, Adjuvants.

Immunoglobulin – Separation, structure and types.

Primary and secondary responses.

Complement – Components and Biological activities.

Unit-IV Antigen – Antibody Reactions

Antigen and antibody reactions – agglutination, precipitation. Toxin neutralization test.

Immunofluorescence, ELISA, RIA.

Allergic skin tests – Tuberculin test and Lepormin test.

Hypersensitivity – Immediate and delayed type.

Autoimmune Diseases.

Unit-V Microorganisms and Diseases

Gram positive cocci – *Staphylococcus aureus* .

Gram negative bacilli – *Salmonella typhi* .

Acid fast bacteria – *Mycobacterium tuberculosis*.

Anaerobic, Gram positive bacilli – *Clostridium tetani*.

Spirochaete – *Treponema pallidum*.

Virus – *Hepatitis and HIV*.

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List of Practicals

1. Determination of Blood Groups.
2. Estimation of hemoglobin by Sahli's method.
3. Estimation of hemoglobin by Cyanmethaemoglobin method.
4. Total count of W.B.C.
5. Total count of R.B.C.
6. Differential W.B.C. count.
7. Flocculation reaction- VDRL.
8. Agglutination reaction- Widal test.
9. Examination of urine- chemical, physical, microscopic and bacteriological.
10. Isolation and identification of gram positive bacteria: *Staphylococcus aureus*.
11. Isolation and identification of gram negative bacteria: *E. coli*, *Proteus sp.* and *Salmonella*

Scheme of Practical Examination- Semester- IV (3+3 Hrs., 2 days)

Ex.1 – Identification of medically important organisms *Staphylococcus*/
E.coli / *Proteus* / *Salmonella* [12]

Ex.2 - Total count :RBC/WBC/Differential count of WBC/Hemoglobin estimation/
/Urine Analysis. [10]

Ex.3 – Antigen-Antibody reactions – Widal /VDRL Test. [10]

Ex.4 – Spotting [08]

Ex.5 – Viva Voce [05]

Ex.6 – Practical Record [05]

Recommended Books

Immunology - Kuby, J.

Fundamental Immunology - W.E. Paul

Fundamentals of Immunology - Coleman, Lombord and Sicard

Immunology - Weir and Steward

Immunology - Rao, C.V.

Lecture Notes in Immunology - Todd. I.R.

Microbiology – A Practical Approach - Bhavesh Patel and Nandini Phanse

Experiments in Biotechnology - Nighojkar and Nighojkar

Solutions to Practical Microbiology - Bhavesh Patel and Nandini Phanse

Essentials of Immunology - Roitt, I.M

Immunology. - Klaus D. Elgert ,

Fundamental Immunology. - Paul, W.E.

Immunology. - Weir, D.M and J. Steward, J.

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B.Sc. Part- III (Microbiology) Semester-V

Semester-V Industrial Microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Fundamentals of Industrial Fermentations

Primary and secondary screening of industrially important organisms.

Strain development strategies.

Scale up of fermentation process.

Raw materials for media preparation.

Harvesting and product recovery.

Unit-II Fermentor Design

Design of typical batch fermentor.

Factors affecting fermentor design.

Types of fermentations – Batch and continuous fermentations.

Monitoring and control of – agitation, aeration, pH, temperature and dissolved oxygen.

Industrial sterilization of media and air.

Unit-III Analytical Microbiology

Bioassay of growth supporting substances – Amino acids and vitamins.

Bioassay of growth inhibiting substances – Antibiotics.

Phenol coefficient of antimicrobial substances

Quality control tests – Sterility testing, Microbial limit test (MLT), pyrogen testing (LAL test), Minimum inhibitory concentration (MIC).

Unit-IV Industrial Production

Enzymes – Protease

Amino acids – Lysine

Antibiotics – Penicillin

Vitamins – Cyanocobalamin

Organic acids – Citric acid

Solvent – Ethyl alcohol.

Unit-V Microbial biotechnology

Applications of microbes in pest control- Bacterial, fungal and viral biocontrol agents

Biofertilizers- Symbiotic and non-symbiotic nitrogen fixation.

Fuel from microorganisms – Digester design and biogas production technology.

Immobilized enzymes – Methods of immobilization and their applications.

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List of Practicals

1. Screening of Antibiotic producing microorganisms.
2. Primary screening of amylase producing microorganisms.
3. Primary screening of protease producing microorganisms.
4. Primary screening of cellulase producing microorganisms.
5. Primary screening of lipase producing microorganisms.
6. Microbial assay of Antibiotics.
7. Microbial assay of Vitamins.
8. Estimation of MIC for antibiotics.
9. Sterility testing of pharmaceutical products- injectibles, eye drops and ear drops.
10. Microbial Limit Test- tablets and syrups.
11. Area monitoring.

Scheme of Practical Examination- Semester- V (3+3 Hrs., 2 days)

Ex.1 – Microbial assay of antibiotics / vitamins/ MIC [12]

Ex.2 – Sterility testing/MLT/ Area Monitoring [10]

Ex.3 – Primary screening of antibiotic/amylase/ protease/cellulose / lipase producers. [10]

Ex.4 – Spotting [08]

Ex.5 – Viva Voce [05]

Ex.6 – Practical Record [05]

Recommended Books

Textbook of Industrial Microbiology - Patel, A. H.

Industrial Microbiology - Cassida, L. E.

Industrial Microbiology - Reed, G.

Industrial Microbiology - Agarwal And Parihar

Biology of Industrial Microorganisms - Demain, A.L.

Principles of Fermentation Technology - Standbary, Whitaker and Hall

Text of Microbiology - Ananthanarayanan and Panikar

Experiments in Biotechnology - Nighojkar and Nighojkar

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B.Sc. Part- III (Microbiology) Semester-VI

Semester-VI Applied and Environmental microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Microbiology of Soil

Composition of soil.

Estimation of soil microflora

Rhizosphere – Interactions among soil microflora

Biogeochemical cycles – Nitrogen, Carbon and Sulfur cycles
Phosphate solubilizers, Mycorrhiza

Unit-II Microbiology of Food

Microbiological examination of food and milk.

Food and milk-borne diseases.

Food intoxications.

Spoilage of food – Fresh food, Canned food, Vegetables and Milk products.

Grading of milk – MBRT, Resazurin and Phosphatase tests.

Preservation of food.

Dairy products – Cheese, Butter and Yogurt.

Microorganisms as food – Single Cell Protein.

Unit-III Microbiology of water and waste-water

Microbiological examination of water and waste-water.

Water borne diseases.

Water purification.

Treatment of waste-water – Primary, secondary, advanced and final treatments, Solids processing.

Eutrophication.

Unit-IV Microbiology of air

Air borne diseases.

Analysis of air.

Aeromicroflora of different habitats.

Aeroallergens.

Control of microorganisms in air.

Unit-V Applications of microorganisms

Microbial leaching of Copper and Uranium.

Biorecovery of Petroleum.

Bioremediation, Biodeterioration – Petroleum products, Leather, Textile and Paper.

Applications of biosensors and biopolymers.

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List of Practicals

1. Qualitative and quantitative examination of Food.
2. Qualitative and quantitative examination of Milk.
3. Qualitative and quantitative examination of Water.
4. Qualitative and quantitative examination of Sewage.
5. Estimation of soil microflora (Bacteria, Yeast and Mould).
6. Isolation of *Azotobacter*.
7. Isolation of *Rhizobium* from root nodules.
8. Isolation of PSB
9. Estimation of air micro-flora
10. Isolation of *Lactobacillus*
11. Isolation of Yeast.

Scheme of Practical Examination- Semester- VI (3+3 Hrs., 2 days)

Ex.1 – Qualitative and Quantitative analysis of water/food/milk/sewage. [12]

Ex.2 – Isolation of *Azotobacter/Rhizobium*/PSB [10]

Ex.3 – Isolation of *Lactobacillus* /Yeast [10]

Ex.4 – Spotting [08]
Ex.5 – Viva Voce [05]
Ex.6 – Practical Record [05]

Recommended Books

Introduction to soil microbiology - Alexander M
Bioremediation - Baker, KH and Herson DS
Experimental Microbial Ecology - Burns R.G. and Slater J.H
Introduction to environmental microbiology - Michel R
Fundamental Principles of Bacteriology - Salle, A.J.
Experiments in Biotechnology - Nighojkar and Nighojkar
Food Microbiology - Frazier and Westhoff
Food Microbiology - Adams and Moss
Introductory Food Microbiology - Modi, H.A.
Modern food Microbiology - Jay

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Total marks- 50

Duration- 6 Hrs.

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4. Spotting 08 Marks

5. Viva-voce 05 Marks
 6. Practical record 05 Marks
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B.Sc. Part- I (Microbiology) Semester-I

Semester-I General microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I History and Scope of Microbiology

Contributions of Pioneers- Anton von Leeuwenhoek, Robert Koch, Edward Jenner, Louis Pasteur, Paul Ehrlich, Alexander Fleming and Joseph Lister.

Branches of Microbiology and its development.

Spontaneous generation v/s Biogenesis.

Place of microbes in living world.

Beneficial and harmful microbes.

Microbes in extreme environments.

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Microscopy- Bright field, Dark field, Fluorescence, Phase contrast and Electron microscopes.

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Hot air oven, Autoclave, Laminar Air Flow Bench.

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Unit-IV Eucaryotes, Acaryotes and Bacteria with unusual properties

General characters and economic importance of – Fungi (Yeast and Moulds), Algae and Protozoans.

Introduction to acellular forms of life- Viruses, Virioids, Prions.

Structure of Bacterial Viruses.

Classification and cultivation of Viruses.

Multiplication of Bacterial Viruses.

Bacteria with unusual properties- Rickettsia, Chlamydia, Mycoplasma, Archaeobacteria, Cyanobacteria, Actinomycetes.

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Fundamentals of control

Physical methods of control- Temperature, radiation, dessication, osmotic pressure and filtration

Chemical methods of control- Phenol, alcohol, halogens, heavy metals, dyes, detergents, quaternary ammonium compounds, aldehydes and gaseous chemosterilizers
Evaluation of antimicrobial potency of disinfectants and antiseptics- Tube dilution method, Agar diffusion method, Phenol coefficient.

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List of Practicals

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2. Neutralization, cleaning and sterilization of glassware.
3. Measurement of microorganisms.
4. Preparation of culture media like Nutrient Agar and its uses.
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6. Motility of bacteria by Hanging drop method.
7. Staining procedures I- Simple staining – Monochrome staining and Negative staining.
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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- I (Microbiology) Semester-II

Semester-II Microbial physiology and Biochemistry CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Cultivation and preservation of bacteria

Nutrition and nutritional types of bacteria.

Bacteriological media and its types.

Cultivation of aerobic and anaerobic microbes.

Pure culture and cultural characteristics.

Maintenance and preservation of cultures.

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Mathematical expression of bacterial growth.

Growth curve of bacteria.

Batch, continuous, synchronous and diauxic growth.

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Quantitative measurement of bacterial growth by cell mass, cell number and cell activity.

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General characters, classification and nomenclature of enzymes.

Factors affecting enzyme activity.

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Regulation of enzyme activity.

Applications of enzymes.

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Principles of Bioenergetics.

Modes of energy production- Photophosphorylation, Substrate level phosphorylation, Oxidative phosphorylation

Catabolism- Carbohydrates-(Aerobic and Anaerobic); Proteins- (Proteolysis,

Transamination, Deamination) and Fats/Lipids- (Beta oxidation)

Bacterial photosynthesis

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5. Qualitative detection of carbohydrates, proteins and lipids.
6. Effect of environment on bacterial growth : a. Temperature b. Osmotic pressure c. pH
7. The lethal action of Ultraviolet light on growth.
8. The oligodynamic action of heavy metals on bacterial growth.
9. Comparative evaluation of antimicrobial agents.

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Scheme of Practical Examination- Semester-II (3+3 Hrs., 2 days)

Ex.1 Perform isolation of microorganisms by streak plate / pour plate method. [12]

Ex.2 Study the effect of [10]

a. Environmental condition on bacterial growth – Temperature / pH

b. Lethal action of Ultra-Violet light on bacterial growth.

c. Oligodynamic action of heavy metals on bacterial growth.

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Principles of Biochemistry - Lehninger, A.L.

Microbial Physiology - Moat & Foster

Fundamentals of Biochemistry - Jain, J.L.

General Microbiology - Hans G. Schlegel

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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- II (Microbiology) Semester-III

Semester-III Bacterial Genetics CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Fundamentals of Genetics

Genotype and Phenotype.

DNA as genetic material.

Structure and types of DNA and RNA.

Genetic code.

DNA Replication.

Unit-II Mutation

Evidence for spontaneous nature of mutation.

Molecular basis of mutation – Types of mutations.

Types of bacterial mutants and their isolation.

Mutagenic agents – Physical: Mechanism of mutagenesis by UV and Ionizing radiations.

Chemical mutagenesis: Base analogues (5BU, 2AP), HNO₂ and NH₂OH

Mutation Rate, Ames Test.

Unit-III Genetic Recombination

Transformation – Competence, DNA up take, artificially induced competence,

electroporation.

Conjugation – F factor, Characters of donar and recipient. Steps in conjugation, Seduction, formation of Hfr and F prime cells.

Transduction – U tube experiment, Generalized and specialized transduction, Abortive transduction.

Plasmid – Structure, properties, types and applications of plasmids.

Unit-IV Expression and Regulation of Gene Activity

Protein Synthesis.

Operon Concept, Induction, Repression and Attenuation.

Inducible Operon – Lac Operon.

Repressible Operon – Trp Operon.

Unit-V Techniques in Molecular Biology

Genetic Engineering – Tools and Techniques.

Restriction Endonucleases – Types and uses.

Isolation of DNA.

Vectors – Plasmid, Phage, Cosmid and Yeast Vectors.

Cloning Technique and Identification of Clones.

Achievements, biohazards and ethical issue of Genetic engineering.

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List of Practicals

1. Isolation of bacterial genomic DNA.
2. Isolation of Plasmid DNA.
3. Electrophoretic analysis of DNA.
4. UV as a mutagenic agent.
5. Replica plating technique.
6. Isolation of antibiotic resistant mutants by gradient plate technique.
7. Quantitative estimation of DNA by DPA method.
8. Quantitative estimation of RNA by oricinol method.

Scheme of Practical Examination- Semester- III (3+3 Hrs., 2 days)

Ex.1– Isolation of bacterial genomic /plasmid DNA. [12]

Ex.2 – Quantitative estimation of DNA/RNA. [10]

Ex.3 – Replica plating technique/gradient plate technique/UV as mutagenic agent. [10]

Ex.4 – Spotting [08]

Ex.5 – Viva Voce [05]

Ex.6 – Practical Record [05]

Recommended Books

Genes XI - Lewin, B.

Principles of Genetics - Gardner, Simmons and Snustad

Concepts of Genetics - Klug and Cummings

Microbial Genetics - Freifelder

Genetics - Arora and Sandhu

Microbiology – A Practical Approach - Bhavesh Patel and Nandini Phanse

Solutions to Practical Microbiology - Bhavesh Patel and Nandini Phanse

Experiments in Biotechnology - Nighojkar and Nighojkar

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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- II (Microbiology) Semester-IV

Semester-IV Immunology and Clinical Microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Infection and Immunity

Normal flora of human body.

Infection and its type.

Mechanism of pathogenesis.

Immunity – Natural and acquired.

Defense mechanisms – First line, second line and third line of host defense.

Vaccines – Preparation and types, vaccination schedule for children in India.

Unit-II Epidemiology of infectious diseases

Transmission of diseases.

Types of diseases – Epidemic, Pandemic, Sporadic.

Nosocomial Infections.

Epidemiological Methods – Descriptive, Analytical and Experimental Epidemiology.

Antibiotics – Mode of action and development of resistance. Transmission of drug resistance.

Antiviral and Antifungal drugs.

Unit-III Components of Immune System

Organs and cells involved in immune response.

Antigen – Properties and types, Adjuvants.

Immunoglobulin – Separation, structure and types.

Primary and secondary responses.

Complement – Components and Biological activities.

Unit-IV Antigen – Antibody Reactions

Antigen and antibody reactions – agglutination, precipitation. Toxin neutralization test.

Immunofluorescence, ELISA, RIA.

Allergic skin tests – Tuberculin test and Lepormin test.

Hypersensitivity – Immediate and delayed type.

Autoimmune Diseases.

Unit-V Microorganisms and Diseases

Gram positive cocci – *Staphylococcus aureus* .

Gram negative bacilli – *Salmonella typhi* .

Acid fast bacteria – *Mycobacterium tuberculosis*.

Anaerobic, Gram positive bacilli – *Clostridium tetani*.

Spirochaete – *Treponema pallidum*.

Virus – *Hepatitis and HIV*.

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List of Practicals

1. Determination of Blood Groups.
2. Estimation of hemoglobin by Sahli's method.
3. Estimation of hemoglobin by Cynamethaemoglobin method.
4. Total count of W.B.C.
5. Total count of R.B.C.
6. Differential W.B.C. count.
7. Flocculation reaction- VDRL.

8. Agglutination reaction- Widal test.
9. Examination of urine- chemical, physical, microscopic and bacteriological.
10. Isolation and identification of gram positive bacteria: *Staphylococcus aureus*.
11. Isolation and identification of gram negative bacteria: *E. coli*, *Proteus sp.* and *Salmonella*

Scheme of Practical Examination- Semester- IV (3+3 Hrs., 2 days)

- Ex.1 – Identification of medically important organisms *Staphylococcus*/
E.coli / *Proteus* / *Salmonella* [12]
- Ex.2 - Total count :RBC/WBC/Differential count of WBC/Hemoglobin estimation/
/Urine Analysis. [10]
- Ex.3 – Antigen-Antibody reactions – Widal /VDRL Test. [10]
- Ex.4 – Spotting [08]
- Ex.5 – Viva Voce [05]
- Ex.6 – Practical Record [05]

Recommended Books

- Immunology - Kuby, J.
Fundamental Immunology - W.E. Paul
Fundamentals of Immunology - Coleman, Lombord and Sicard
Immunology - Weir and Steward
Immunology - Rao, C.V.
Lecture Notes in Immunology - Todd. I.R.
Microbiology – A Practical Approach - Bhavesh Patel and Nandini Phanse
Experiments in Biotechnology - Nighojkar and Nighojkar
Solutions to Practical Microbiology - Bhavesh Patel and Nandini Phanse
Essentials of Immunology - Roitt, I.M
Immunology. - Klaus D. Elgert ,
Fundamental Immunology. - Paul, W.E.
Immunology. - Weir, D.M and J. Steward, J.

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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- III (Microbiology) Semester-V

Semester-V Industrial Microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Fundamentals of Industrial Fermentations

- Primary and secondary screening of industrially important organisms.
Strain development strategies.
Scale up of fermentation process.
Raw materials for media preparation.
Harvesting and product recovery.

Unit-II Fermentor Design

- Design of typical batch fermentor.
Factors affecting fermentor design.
Types of fermentations – Batch and continuous fermentations.
Monitoring and control of – agitation, aeration, pH, temperature and dissolved oxygen.

Industrial sterilization of media and air.

Unit-III Analytical Microbiology

Bioassay of growth supporting substances – Amino acids and vitamins.

Bioassay of growth inhibiting substances – Antibiotics.

Phenol coefficient of antimicrobial substances

Quality control tests – Sterility testing, Microbial limit test (MLT), pyrogen testing (LAL test), Minimum inhibitory concentration (MIC).

Unit-IV Industrial Production

Enzymes – Protease

Amino acids – Lysine

Antibiotics – Penicillin

Vitamins – Cyanocobalamin

Organic acids – Citric acid

Solvent – Ethyl alcohol.

Unit-V Microbial biotechnology

Applications of microbes in pest control- Bacterial, fungal and viral biocontrol agents

Biofertilizers- Symbiotic and non-symbiotic nitrogen fixation.

Fuel from microorganisms – Digester design and biogas production technology.

Immobilized enzymes – Methods of immobilization and their applications.

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List of Practicals

1. Screening of Antibiotic producing microorganisms.
2. Primary screening of amylase producing microorganisms.
3. Primary screening of protease producing microorganisms.
4. Primary screening of cellulase producing microorganisms.
5. Primary screening of lipase producing microorganisms.
6. Microbial assay of Antibiotics.
7. Microbial assay of Vitamins.
8. Estimation of MIC for antibiotics.
9. Sterility testing of pharmaceutical products- injectibles, eye drops and ear drops.
10. Microbial Limit Test- tablets and syrups.
11. Area monitoring.

Scheme of Practical Examination- Semester- V (3+3 Hrs., 2 days)

Ex.1 – Microbial assay of antibiotics / vitamins/ MIC [12]

Ex.2 – Sterility testing/MLT/ Area Monitoring [10]

Ex.3 – Primary screening of antibiotic/amylase/ protease/cellulose / lipase producers. [10]

Ex.4 – Spotting [08]

Ex.5 – Viva Voce [05]

Ex.6 – Practical Record [05]

Recommended Books

Textbook of Industrial Microbiology - Patel, A. H.

Industrial Microbiology - Cassida, L. E.

Industrial Microbiology - Reed, G.

Industrial Microbiology - Agarwal And Parihar

Biology of Industrial Microorganisms - Demain, A.L.

Principles of Fermentation Technology - Standbary, Whitaker and Hall
Text of Microbiology - Ananthanarayanan and Panikar
Experiments in Biotechnology - Nighojkar and Nighojkar
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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- III (Microbiology) Semester-VI

Semester-VI Applied and Environmental microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Microbiology of Soil

Composition of soil.

Estimation of soil microflora

Rhizosphere – Interactions among soil microflora

Biogeochemical cycles – Nitrogen, Carbon and Sulfur cycles

Phosphate solubilizers, Mycorrhiza

Unit-II Microbiology of Food

Microbiological examination of food and milk.

Food and milk-borne diseases.

Food intoxications.

Spoilage of food – Fresh food, Canned food, Vegetables and Milk products.

Grading of milk – MBRT, Resazurin and Phosphatase tests.

Preservation of food.

Dairy products – Cheese, Butter and Yogurt.

Microorganisms as food – Single Cell Protein.

Unit-III Microbiology of water and waste-water

Microbiological examination of water and waste-water.

Water borne diseases.

Water purification.

Treatment of waste-water – Primary, secondary, advanced and final treatments, Solids processing.

Eutrophication.

Unit-IV Microbiology of air

Air borne diseases.

Analysis of air.

Aeromicroflora of different habitats.

Aeroallergens.

Control of microorganisms in air.

Unit-V Applications of microorganisms

Microbial leaching of Copper and Uranium.

Biorecovery of Petroleum.

Bioremediation, Biodeterioration – Petroleum products, Leather, Textile and Paper.

Applications of biosensors and biopolymers.

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List of Practicals

1. Qualitative and quantitative examination of Food.
2. Qualitative and quantitative examination of Milk.
3. Qualitative and quantitative examination of Water.

4. Qualitative and quantitative examination of Sewage.
5. Estimation of soil microflora (Bacteria, Yeast and Mould).
6. Isolation of *Azotobacter*.
7. Isolation of *Rhizobium* from root nodules.
8. Isolation of PSB
9. Estimation of air micro-flora
10. Isolation of *Lactobacillus*
11. Isolation of Yeast.

Scheme of Practical Examination- Semester- VI (3+3 Hrs., 2 days)

Ex.1 – Qualitative and Quantitative analysis of water/food/milk/sewage. [12]

Ex.2 – Isolation of *Azotobacter/Rhizobium/PSB* [10]

Ex.3 – Isolation of *Lactobacillus /Yeast* [10]

Ex.4 – Spotting [08]

Ex.5 – Viva Voce [05]

Ex.6 – Practical Record [05]

Recommended Books

Introduction to soil microbiology - Alexander M
 Bioremediation - Baker, KH and Herson DS
 Experimental Microbial Ecology - Burns R.G. and Slater J.H
 Introduction to environmental microbiology - Michel R
 Fundamental Principles of Bacteriology - Salle, A.J.
 Experiments in Biotechnology - Nighojkar and Nighojkar
 Food Microbiology - Frazier and Westhoff
 Food Microbiology - Adams and Moss
 Introductory Food Microbiology - Modi, H.A.
 Modern food Microbiology - Jay

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Devi Ahilya Vishwavidyalaya, Indore

Syllabus for B.Sc. Part-I, II and III (Optional subject- Microbiology)

2011 Onwards

Semester Course title Distribution of marks

CCE Semester

Exam

Practical

Exam

Total

Sem-I General microbiology 15 85 50 150

Sem-II Microbial physiology and

Biochemistry

15 85 50 150

Sem-III Bacterial genetics 15 85 50 150

Sem-IV Immunology and Clinical

microbiology

15 85 50 150

Sem-V Industrial microbiology 15 85 50 150

Sem-VI Applied and Environmental

microbiology

15 85 50 150

Scheme of practical examination in each semester

Total marks- 50

Duration- 6 Hrs.

1. Major exercise 12 Marks
2. Minor exercise-1 10 Marks
3. Minor exercise-2 10Marks
4. Spotting 08 Marks
5. Viva-voce 05 Marks
6. Practical record 05 Marks

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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- I (Microbiology) Semester-I

Semester-I General microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I History and Scope of Microbiology

Contributions of Pioneers- Anton von Leeuwenhoek, Robert Koch, Edward Jenner, Louis Pasteur, Paul Ehrlich, Alexander Fleming and Joseph Lister.

Branches of Microbiology and its development.

Spontaneous generation v/s Biogenesis.

Place of microbes in living world.

Beneficial and harmful microbes.

Microbes in extreme environments.

Unit-II Tools and Techniques in Microbiology

Microscopy- Bright field, Dark field, Fluorescence, Phase contrast and Electron microscopes.

Colorimetry, Centrifugation and Electrophoresis.

Hot air oven, Autoclave, Laminar Air Flow Bench.

Stains and Staining Techniques- Dyes: Classification and types; Types of staining- Simple

(Monochrome, Negative), Differential (Gram & Acid Fast) and Special staining (Spore, Granules, Flagella, Spirochetes).

Wet mount and Hanging drop preparations.

Unit-III Taxonomy and Morphology of Bacteria

Classification systems of prokaryotes. Bacterial nomenclature.

Size, shape and arrangement of bacterial cells.

Cell wall of Gram positive and negative bacteria (Protoplast, Spheroplast).

Structures external to the cell wall- flagella, pili, capsule, sheath and prosthecae.

Structures internal to the cell wall- cell membrane, nuclear material, spores, cytoplasmic inclusions, magnetosomes and plasmids.

Unit-IV Eucaryotes, Acaryotes and Bacteria with unusual properties

General characters and economic importance of – Fungi (Yeast and Moulds), Algae and Protozoans.

Introduction to acellular forms of life- Viruses, Virioids, Prions.

Structure of Bacterial Viruses.

Classification and cultivation of Viruses.

Multiplication of Bacterial Viruses.

Bacteria with unusual properties- Rickettsia, Chlamydia, Mycoplasma, Archaeobacteria, Cyanobacteria, Actinomycetes.

Unit-V Control of Microorganisms

Fundamentals of control

Physical methods of control- Temperature, radiation, desiccation, osmotic pressure and filtration

Chemical methods of control- Phenol, alcohol, halogens, heavy metals, dyes, detergents, quaternary ammonium compounds, aldehydes and gaseous chemosterilizers

Evaluation of antimicrobial potency of disinfectants and antiseptics- Tube dilution method, Agar diffusion method, Phenol coefficient.

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List of Practicals

1. Principles, working knowledge of Instruments like Autoclave, pH meter, Incubator, Hot air oven, Centrifuge, Microscope, Refrigerator, Colony counter, Laminar Air Flow.
2. Neutralization, cleaning and sterilization of glassware.
3. Measurement of microorganisms.
4. Preparation of culture media like Nutrient Agar and its uses.
5. Preparation of stains.
6. Motility of bacteria by Hanging drop method.
7. Staining procedures I- Simple staining – Monochrome staining and Negative staining.
8. Staining procedures II- Differential staining - Gram Staining and Acid Fast Staining.
9. Staining procedures III- Special / Structural staining - Cell wall staining, Capsule staining, Metachromatic Granule staining, Endospore staining, Spirochete staining.
10. Identification of some common fungi..

Scheme of Practical Examination- Semester -I M.M. 50 (4 Hrs. 1 day)

Ex.1 Perform Gram staining of given bacterial culture. [12]

Ex.2 Perform Structural / Special Staining (Cell wall staining, Capsule staining, Metachromatic Granule staining, Endospore staining, Spirochete staining). [10]

Ex.3 Perform wet mount of given fungal strain. [10]

Ex.4 Spotting. [8]

Ex. 5 Viva-Voce. [5]

Ex. 6 Practical Record. [5]

Recommended Books

Microbiology - Pelczar, Chan & Kreig

Microbiology - Prescott, Harley and Klein

General Microbiology - Stainer RY. Ingharam JL.

Alcamo's Fundamentals of Microbiology - Pommerville

Elementary Microbiology - Modi, H.A.

The Microbial World - Roger Stanier
Fundamentals of Microbiology - Frobisher Hinsdill
Fundamental Principles of Bacteriology - Salle, A.J.
Textbook of Microbiology - Dubey, R.C.
Microbiology- A Human Perspective - Nester, Roberts
Foundations in Microbiology - Kathleen Talaro
General Microbiology (Vol I, II, III) - Powar & Daginawala
General Microbiology - Hans G. Schlegel
General Microbiology - Robert Boyd.
Microbiology – A Practical Approach - Bhavesh Patel and Nandini Phanse
Solutions to Practical Microbiology - Bhavesh Patel and Nandini Phanse

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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- I (Microbiology) Semester-II

Semester-II Microbial physiology and Biochemistry CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Cultivation and preservation of bacteria

Nutrition and nutritional types of bacteria.

Bacteriological media and its types.

Cultivation of aerobic and anaerobic microbes.

Pure culture and cultural characteristics.

Maintenance and preservation of cultures.

Unit-II Bacterial growth

Mathematical expression of bacterial growth.

Growth curve of bacteria.

Batch, continuous, synchronous and diauxic growth.

Factors affecting microbial growth.

Quantitative measurement of bacterial growth by cell mass, cell number and cell activity.

Unit-III Enzymes

General characters, classification and nomenclature of enzymes.

Factors affecting enzyme activity.

Mechanism of enzyme action.

Regulation of enzyme activity.

Applications of enzymes.

Unit-IV Basic Biochemistry

Bonds of life- covalent, ionic and hydrogen bonds

General properties, classification and functions of – Carbohydrates, Lipids, Amino acids,

Proteins, Nucleic acids.

Unit-V Bioenergetics and Metabolism

Principles of Bioenergetics.

Modes of energy production- Photophosphorylation, Substrate level phosphorylation,

Oxidative phosphorylation

Catabolism- Carbohydrates-(Aerobic and Anaerobic); Proteins- (Proteolysis,

Transamination, Deamination) and Fats/Lipids- (Beta oxidation)

Bacterial photosynthesis

List of Practicals

1. Isolation of microorganisms by streak plate method.
2. Isolation of microorganisms by pour plate method.
3. Growth of microorganisms on agar slants and agar stabs
4. Growth of microorganisms in broth.
5. Qualitative detection of carbohydrates, proteins and lipids.
6. Effect of environment on bacterial growth : a. Temperature b. Osmotic pressure c. pH
7. The lethal action of Ultraviolet light on growth.
8. The oligodynamic action of heavy metals on bacterial growth.
9. Comparative evaluation of antimicrobial agents.

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Scheme of Practical Examination- Semester-II (3+3 Hrs., 2 days)

Ex.1 Perform isolation of microorganisms by streak plate / pour plate method. [12]

Ex.2 Study the effect of [10]

a. Environmental condition on bacterial growth – Temperature / pH

b. Lethal action of Ultra-Violet light on bacterial growth.

c. Oligodynamic action of heavy metals on bacterial growth.

Ex.3 Qualitative analysis of biomolecules – Carbohydrates/ Proteins / Lipids [10]

Ex.4 Spotting [8]

Ex. 5 Viva-Voce [5]

Ex. 6 Practical Record [5]

Recommended Books

Microbiology - Pelczar, Chan

Microbiology - Prescott, Harley and Klein

Alcamo's Fundamentals of Microbiology - Pommerville

Elementary Microbiology - Modi, H.A.

The Microbial World - Roger Stanier

Fundamentals of Microbiology - Frobisher Hinsdill

Fundamental Principles of Bacteriology - Salle, A.J.

Textbook of Microbiology - Dubey, R.C.

Microbiology- A Human Perspective - Nester, Roberts

Foundations in Microbiology - Kathleen Talaro

General Microbiology (Vol I, II, III) - Powar & Dagainawala

Principles of Biochemistry - Lehninger, A.L.

Microbial Physiology - Moat & Foster

Fundamentals of Biochemistry - Jain, J.L.

General Microbiology - Hans G. Schlegel

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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- II (Microbiology) Semester-III

Semester-III Bacterial Genetics CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Fundamentals of Genetics

Genotype and Phenotype.

DNA as genetic material.

Structure and types of DNA and RNA.

Genetic code.

DNA Replication.

Unit-II Mutation

Evidence for spontaneous nature of mutation.

Molecular basis of mutation – Types of mutations.

Types of bacterial mutants and their isolation.

Mutagenic agents – Physical: Mechanism of mutagenesis by UV and Ionizing radiations.

Chemical mutagenesis: Base analogues (5BU, 2AP), HNO₂ and NH₂OH

Mutation Rate, Ames Test.

Unit-III Genetic Recombination

Transformation – Competence, DNA up take, artificially induced competence, electroporation.

Conjugation – F factor, Characters of donar and recipient. Steps in conjugation,

Seduction, formation of Hfr and F prime cells.

Transduction – U tube experiment, Generalized and specialized transduction, Abortive transduction.

Plasmid – Structure, properties, types and applications of plasmids.

Unit-IV Expression and Regulation of Gene Activity

Protein Synthesis.

Operon Concept, Induction, Repression and Attenuation.

Inducible Operon – Lac Operon.

Repressible Operon – Trp Operon.

Unit-V Techniques in Molecular Biology

Genetic Engineering – Tools and Techniques.

Restriction Endonucleases – Types and uses.

Isolation of DNA.

Vectors – Plasmid, Phage, Cosmid and Yeast Vectors.

Cloning Technique and Identification of Clones.

Achievements, biohazards and ethical issue of Genetic engineering.

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List of Practicals

1. Isolation of bacterial genomic DNA.
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3. Electrophoretic analysis of DNA.
4. UV as a mutagenic agent.
5. Replica plating technique.
6. Isolation of antibiotic resistant mutants by gradient plate technique.
7. Quantitative estimation of DNA by DPA method.
8. Quantitative estimation of RNA by oricinol method.

Scheme of Practical Examination- Semester- III (3+3 Hrs., 2 days)

Ex.1– Isolation of bacterial genomic /plasmid DNA. [12]

Ex.2 – Quantitative estimation of DNA/RNA. [10]

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Ex.4 – Spotting [08]

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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- II (Microbiology) Semester-IV

Semester-IV Immunology and Clinical Microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Infection and Immunity

Normal flora of human body.

Infection and its type.

Mechanism of pathogenesis.

Immunity – Natural and acquired.

Defense mechanisms – First line, second line and third line of host defense.

Vaccines – Preparation and types, vaccination schedule for children in India.

Unit-II Epidemiology of infectious diseases

Transmission of diseases.

Types of diseases – Epidemic, Pandemic, Sporadic.

Nosocomial Infections.

Epidemiological Methods – Descriptive, Analytical and Experimental Epidemiology.

Antibiotics – Mode of action and development of resistance. Transmission of drug resistance.

Antiviral and Antifungal drugs.

Unit-III Components of Immune System

Organs and cells involved in immune response.

Antigen – Properties and types, Adjuvants.

Immunoglobulin – Separation, structure and types.

Primary and secondary responses.

Complement – Components and Biological activities.

Unit-IV Antigen – Antibody Reactions

Antigen and antibody reactions – agglutination, precipitation. Toxin neutralization test.

Immunofluorescence, ELISA, RIA.

Allergic skin tests – Tuberculin test and Lepormin test.

Hypersensitivity – Immediate and delayed type.

Autoimmune Diseases.

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Gram positive cocci – *Staphylococcus aureus* .

Gram negative bacilli – *Salmonella typhi* .

Acid fast bacteria – *Mycobacterium tuberculosis*.
Anaerobic, Gram positive bacilli – *Clostridium tetani*.
Spirochaete – *Treponema pallidum*.
Virus – *Hepatitis and HIV*.

9

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2. Estimation of hemoglobin by Sahli's method.
3. Estimation of hemoglobin by Cyanmethaemoglobin method.
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5. Total count of R.B.C.
6. Differential W.B.C. count.
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9. Examination of urine- chemical, physical, microscopic and bacteriological.
10. Isolation and identification of gram positive bacteria: *Staphylococcus aureus*.
11. Isolation and identification of gram negative bacteria: *E. coli*, *Proteus sp.* and *Salmonella*

Scheme of Practical Examination- Semester- IV (3+3 Hrs., 2 days)

- Ex.1 – Identification of medically important organisms *Staphylococcus*/
E.coli / *Proteus* / *Salmonella* [12]
Ex.2 - Total count :RBC/WBC/Differential count of WBC/Hemoglobin estimation/
/Urine Analysis. [10]
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Immunology. - Klaus D. Elgert ,
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Immunology. - Weir, D.M and J. Steward, J.

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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- III (Microbiology) Semester-V

Semester-V Industrial Microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Fundamentals of Industrial Fermentations

Primary and secondary screening of industrially important organisms.

Strain development strategies.

Scale up of fermentation process.

Raw materials for media preparation.

Harvesting and product recovery.

Unit-II Fermentor Design

Design of typical batch fermentor.

Factors affecting fermentor design.

Types of fermentations – Batch and continuous fermentations.

Monitoring and control of – agitation, aeration, pH, temperature and dissolved oxygen.

Industrial sterilization of media and air.

Unit-III Analytical Microbiology

Bioassay of growth supporting substances – Amino acids and vitamins.

Bioassay of growth inhibiting substances – Antibiotics.

Phenol coefficient of antimicrobial substances

Quality control tests – Sterility testing, Microbial limit test (MLT), pyrogen testing (LAL test), Minimum inhibitory concentration (MIC).

Unit-IV Industrial Production

Enzymes – Protease

Amino acids – Lysine

Antibiotics – Penicillin

Vitamins – Cyanocobalamin

Organic acids – Citric acid

Solvent – Ethyl alcohol.

Unit-V Microbial biotechnology

Applications of microbes in pest control- Bacterial, fungal and viral biocontrol agents

Biofertilizers- Symbiotic and non-symbiotic nitrogen fixation.

Fuel from microorganisms – Digester design and biogas production technology.

Immobilized enzymes – Methods of immobilization and their applications.

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2. Primary screening of amylase producing microorganisms.
3. Primary screening of protease producing microorganisms.
4. Primary screening of cellulase producing microorganisms.
5. Primary screening of lipase producing microorganisms.
6. Microbial assay of Antibiotics.
7. Microbial assay of Vitamins.
8. Estimation of MIC for antibiotics.
9. Sterility testing of pharmaceutical products- injectibles, eye drops and ear drops.
10. Microbial Limit Test- tablets and syrups.
11. Area monitoring.

Scheme of Practical Examination- Semester- V (3+3 Hrs., 2 days)

- Ex.1 – Microbial assay of antibiotics / vitamins/ MIC [12]
Ex.2 – Sterility testing/MLT/ Area Monitoring [10]
Ex.3 – Primary screening of antibiotic/amylase/ protease/cellulose / lipase producers. [10]
Ex.4 – Spotting [08]
Ex.5 – Viva Voce [05]
Ex.6 – Practical Record [05]

Recommended Books

Textbook of Industrial Microbiology - Patel, A. H.
Industrial Microbiology - Cassida, L. E.
Industrial Microbiology - Reed, G.
Industrial Microbiology - Agarwal And Parihar
Biology of Industrial Microorganisms - Demain, A.L.
Principles of Fermentation Technology - Standbary, Whitaker and Hall
Text of Microbiology - Ananthanarayanan and Panikar
Experiments in Biotechnology - Nighojkar and Nighojkar
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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- III (Microbiology) Semester-VI

Semester-VI Applied and Environmental microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Microbiology of Soil

Composition of soil.

Estimation of soil microflora

Rhizosphere – Interactions among soil microflora

Biogeochemical cycles – Nitrogen, Carbon and Sulfur cycles

Phosphate solubilizers, Mycorrhiza

Unit-II Microbiology of Food

Microbiological examination of food and milk.

Food and milk-borne diseases.

Food intoxications.

Spoilage of food – Fresh food, Canned food, Vegetables and Milk products.

Grading of milk – MBRT, Resazurin and Phosphatase tests.

Preservation of food.

Dairy products – Cheese, Butter and Yogurt.

Microorganisms as food – Single Cell Protein.

Unit-III Microbiology of water and waste-water

Microbiological examination of water and waste-water.

Water borne diseases.

Water purification.

Treatment of waste-water – Primary, secondary, advanced and final treatments, Solids processing.

Eutrophication.

Unit-IV Microbiology of air

Air borne diseases.

Analysis of air.

Aeromicroflora of different habitats.

Aeroallergens.

Control of microorganisms in air.

Unit-V Applications of microorganisms

Microbial leaching of Copper and Uranium.

Biorecovery of Petroleum.

Bioremediation, Biodeterioration – Petroleum products, Leather, Textile and Paper.

Applications of biosensors and biopolymers.

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List of Practicals

1. Qualitative and quantitative examination of Food.
2. Qualitative and quantitative examination of Milk.
3. Qualitative and quantitative examination of Water.
4. Qualitative and quantitative examination of Sewage.
5. Estimation of soil microflora (Bacteria, Yeast and Mould).
6. Isolation of *Azotobacter*.
7. Isolation of *Rhizobium* from root nodules.
8. Isolation of PSB
9. Estimation of air micro-flora
10. Isolation of *Lactobacillus*
11. Isolation of Yeast.

Scheme of Practical Examination- Semester- VI (3+3 Hrs., 2 days)

Ex.1 – Qualitative and Quantitative analysis of water/food/milk/sewage. [12]

Ex.2 – Isolation of *Azotobacter/Rhizobium*/PSB [10]

Ex.3 – Isolation of *Lactobacillus* /Yeast [10]

Ex.4 – Spotting [08]

Ex.5 – Viva Voce [05]

Ex.6 – Practical Record [05]

Recommended Books

Introduction to soil microbiology - Alexander M

Bioremediation - Baker, KH and Herson DS

Experimental Microbial Ecology - Burns R.G. and Slater J.H

Introduction to environmental microbiology - Michel R

Fundamental Principles of Bacteriology - Salle, A.J.

Experiments in Biotechnology - Nighojkar and Nighojkar

Food Microbiology - Frazier and Westhoff

Food Microbiology - Adams and Moss

Introductory Food Microbiology - Modi, H.A.

Modern food Microbiology - Jay

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Devi Ahilya Vishwavidyalaya, Indore

Syllabus for B.Sc. Part-I, II and III (Optional subject- Microbiology)

2011 Onwards

Semester Course title Distribution of marks

CCE Semester**Exam****Practical****Exam****Total**

Sem-I General microbiology 15 85 50 150

Sem-II Microbial physiology and

Biochemistry

15 85 50 150

Sem-III Bacterial genetics 15 85 50 150

Sem-IV Immunology and Clinical

microbiology

15 85 50 150

Sem-V Industrial microbiology 15 85 50 150

Sem-VI Applied and Environmental

microbiology

15 85 50 150

Scheme of practical examination in each semester**Total marks- 50****Duration- 6 Hrs.**

1. Major exercise 12 Marks
2. Minor exercise-1 10 Marks
3. Minor exercise-2 10Marks
4. Spotting 08 Marks
5. Viva-voce 05 Marks
6. Practical record 05 Marks

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Devi Ahilya Vishwavidyalaya, Indore**B.Sc. Part- I (Microbiology) Semester-I**

Semester-I General microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I History and Scope of Microbiology

Contributions of Pioneers- Anton von Leeuwenhoek, Robert Koch, Edward Jenner, Louis Pasteur, Paul Ehrlich, Alexander Fleming and Joseph Lister.

Branches of Microbiology and its development.

Spontaneous generation v/s Biogenesis.

Place of microbes in living world.

Beneficial and harmful microbes.

Microbes in extreme environments.

Unit-II Tools and Techniques in Microbiology

Microscopy- Bright field, Dark field, Fluorescence, Phase contrast and Electron microscopes.

Colorimetry, Centrifugation and Electrophoresis.

Hot air oven, Autoclave, Laminar Air Flow Bench.

Stains and Staining Techniques- Dyes: Classification and types; Types of staining- Simple

(Monochrome, Negative), Differential (Gram & Acid Fast) and Special staining (Spore, Granules, Flagella, Spirochetes).

Wet mount and Hanging drop preparations.

Unit-III Taxonomy and Morphology of Bacteria

Classification systems of prokaryotes. Bacterial nomenclature.

Size, shape and arrangement of bacterial cells.

Cell wall of Gram positive and negative bacteria (Protoplast, Spheroplast).

Structures external to the cell wall- flagella, pili, capsule, sheath and prosthecae.

Structures internal to the cell wall- cell membrane, nuclear material, spores, cytoplasmic inclusions, magnetosomes and plasmids.

Unit-IV Eucaryotes, Acaryotes and Bacteria with unusual properties

General characters and economic importance of – Fungi (Yeast and Moulds), Algae and Protozoans.

Introduction to acellular forms of life- Viruses, Virioids, Prions.

Structure of Bacterial Viruses.

Classification and cultivation of Viruses.

Multiplication of Bacterial Viruses.

Bacteria with unusual properties- Rickettsia, Chlamydia, Mycoplasma, Archaeobacteria, Cyanobacteria, Actinomycetes.

Unit-V Control of Microorganisms

Fundamentals of control

Physical methods of control- Temperature, radiation, desiccation, osmotic pressure and filtration

Chemical methods of control- Phenol, alcohol, halogens, heavy metals, dyes, detergents, quaternary ammonium compounds, aldehydes and gaseous chemosterilizers

Evaluation of antimicrobial potency of disinfectants and antiseptics- Tube dilution method, Agar diffusion method, Phenol coefficient.

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List of Practicals

1. Principles, working knowledge of Instruments like Autoclave, pH meter, Incubator, Hot air oven, Centrifuge, Microscope, Refrigerator, Colony counter, Laminar Air Flow.
2. Neutralization, cleaning and sterilization of glassware.
3. Measurement of microorganisms.
4. Preparation of culture media like Nutrient Agar and its uses.
5. Preparation of stains.
6. Motility of bacteria by Hanging drop method.
7. Staining procedures I- Simple staining – Monochrome staining and Negative staining.
8. Staining procedures II- Differential staining - Gram Staining and Acid Fast Staining.
9. Staining procedures III- Special / Structural staining - Cell wall staining, Capsule staining, Metachromatic Granule staining, Endospore staining, Spirochete staining.
10. Identification of some common fungi..

Scheme of Practical Examination- Semester -I M.M. 50 (4 Hrs. 1 day)

Ex.1 Perform Gram staining of given bacterial culture. [12]

Ex.2 Perform Structural / Special Staining (Cell wall staining, Capsule staining, Metachromatic Granule staining, Endospore staining, Spirochete staining). [10]

Ex.3 Perform wet mount of given fungal strain. [10]

Ex.4 Spotting. [8]

Ex. 5 Viva-Voce. [5]

Ex. 6 Practical Record. [5]

Recommended Books

Microbiology - Pelczar, Chan & Kreig

Microbiology - Prescott, Harley and Klein

General Microbiology - Stainer RY. Ingharam JL.

Alcamo's Fundamentals of Microbiology - Pommerville

Elementary Microbiology - Modi, H.A.

The Microbial World - Roger Stanier

Fundamentals of Microbiology - Frobisher Hinsdill

Fundamental Principles of Bacteriology - Salle, A.J.

Textbook of Microbiology - Dubey, R.C.

Microbiology- A Human Perspective - Nester, Roberts

Foundations in Microbiology - Kathleen Talaro

General Microbiology (Vol I, II, III) - Powar & Daginawala

General Microbiology - Hans G. Schlegel

General Microbiology - Robert Boyd.

Microbiology – A Practical Approach - Bhavesh Patel and Nandini Phanse

Solutions to Practical Microbiology - Bhavesh Patel and Nandini Phanse

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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- I (Microbiology) Semester-II

Semester-II Microbial physiology and Biochemistry CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Cultivation and preservation of bacteria

Nutrition and nutritional types of bacteria.

Bacteriological media and its types.

Cultivation of aerobic and anaerobic microbes.

Pure culture and cultural characteristics.

Maintenance and preservation of cultures.

Unit-II Bacterial growth

Mathematical expression of bacterial growth.

Growth curve of bacteria.

Batch, continuous, synchronous and diauxic growth.

Factors affecting microbial growth.

Quantitative measurement of bacterial growth by cell mass, cell number and cell activity.

Unit-III Enzymes

General characters, classification and nomenclature of enzymes.

Factors affecting enzyme activity.

Mechanism of enzyme action.
Regulation of enzyme activity.
Applications of enzymes.

Unit-IV Basic Biochemistry

Bonds of life- covalent, ionic and hydrogen bonds
General properties, classification and functions of – Carbohydrates, Lipids, Amino acids, Proteins, Nucleic acids.

Unit-V Bioenergetics and Metabolism

Principles of Bioenergetics.
Modes of energy production- Photophosphorylation, Substrate level phosphorylation, Oxidative phosphorylation
Catabolism- Carbohydrates-(Aerobic and Anaerobic); Proteins- (Proteolysis, Transamination, Deamination) and Fats/Lipids- (Beta oxidation)
Bacterial photosynthesis

List of Practicals

1. Isolation of microorganisms by streak plate method.
 2. Isolation of microorganisms by pour plate method.
 3. Growth of microorganisms on agar slants and agar stabs
 4. Growth of microorganisms in broth.
 5. Qualitative detection of carbohydrates, proteins and lipids.
 6. Effect of environment on bacterial growth : a. Temperature b. Osmotic pressure c. pH
 7. The lethal action of Ultraviolet light on growth.
 8. The oligodynamic action of heavy metals on bacterial growth.
 9. Comparative evaluation of antimicrobial agents.
- 5

Scheme of Practical Examination- Semester-II (3+3 Hrs., 2 days)

Ex.1 Perform isolation of microorganisms by streak plate / pour plate method. [12]

Ex.2 Study the effect of [10]

- a. Environmental condition on bacterial growth – Temperature / pH
- b. Lethal action of Ultra-Violet light on bacterial growth.
- c. Oligodynamic action of heavy metals on bacterial growth.

Ex.3 Qualitative analysis of biomolecules – Carbohydrates/ Proteins / Lipids [10]

Ex.4 Spotting [8]

Ex. 5 Viva-Voce [5]

Ex. 6 Practical Record [5]

Recommended Books

Microbiology - Pelczar, Chan

Microbiology - Prescott, Harley and Klein

Alcamo's Fundamentals of Microbiology - Pommerville

Elementary Microbiology - Modi, H.A.

The Microbial World - Roger Stanier

Fundamentals of Microbiology - Frobisher Hinsdill

Fundamental Principles of Bacteriology - Salle, A.J.

Textbook of Microbiology - Dubey, R.C.

Microbiology- A Human Perspective - Nester, Roberts

Foundations in Microbiology - Kathleen Talaro

General Microbiology (Vol I, II, III) - Powar & Dagainawala

Principles of Biochemistry - Lehniger, A.L.

Microbial Physiology - Moat & Foster

Fundamentals of Biochemistry - Jain, J.L.

General Microbiology - Hans G. Schlegel

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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- II (Microbiology) Semester-III

Semester-III Bacterial Genetics CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Fundamentals of Genetics

Genotype and Phenotype.

DNA as genetic material.

Structure and types of DNA and RNA.

Genetic code.

DNA Replication.

Unit-II Mutation

Evidence for spontaneous nature of mutation.

Molecular basis of mutation – Types of mutations.

Types of bacterial mutants and their isolation.

Mutagenic agents – Physical: Mechanism of mutagenesis by UV and Ionizing radiations.

Chemical mutagenesis: Base analogues (5BU, 2AP), HNO₂ and NH₂OH

Mutation Rate, Ames Test.

Unit-III Genetic Recombination

Transformation – Competence, DNA up take, artificially induced competence, electroporation.

Conjugation – F factor, Characters of donar and recipient. Steps in conjugation,

Seduction, formation of Hfr and F prime cells.

Transduction – U tube experiment, Generalized and specialized transduction, Abortive transduction.

Plasmid – Structure, properties, types and applications of plasmids.

Unit-IV Expression and Regulation of Gene Activity

Protein Synthesis.

Operon Concept, Induction, Repression and Attenuation.

Inducible Operon – Lac Operon.

Repressible Operon – Trp Operon.

Unit-V Techniques in Molecular Biology

Genetic Engineering – Tools and Techniques.

Restriction Endonucleases – Types and uses.

Isolation of DNA.

Vectors – Plasmid, Phage, Cosmid and Yeast Vectors.

Cloning Technique and Identification of Clones.

Achievements, biohazards and ethical issue of Genetic engineering.

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List of Practicals

1. Isolation of bacterial genomic DNA.
2. Isolation of Plasmid DNA.
3. Electrophoretic analysis of DNA.
4. UV as a mutagenic agent.
5. Replica plating technique.
6. Isolation of antibiotic resistant mutants by gradient plate technique.
7. Quantitative estimation of DNA by DPA method.
8. Quantitative estimation of RNA by oricinol method.

Scheme of Practical Examination- Semester- III (3+3 Hrs., 2 days)

Ex.1– Isolation of bacterial genomic /plasmid DNA. [12]

Ex.2 – Quantitative estimation of DNA/RNA. [10]

Ex.3 – Replica plating technique/gradient plate technique/UV as mutagenic agent. [10]

Ex.4 – Spotting [08]

Ex.5 – Viva Voce [05]

Ex.6 – Practical Record [05]

Recommended Books

Genes XI - Lewin, B.

Principles of Genetics - Gardner, Simmons and Snustad

Concepts of Genetics - Klug and Cummings

Microbial Genetics - Freifelder

Genetics - Arora and Sandhu

Microbiology – A Practical Approach - Bhavesh Patel and Nandini Phanse

Solutions to Practical Microbiology - Bhavesh Patel and Nandini Phanse

Experiments in Biotechnology - Nighojkar and Nighojkar

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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- II (Microbiology) Semester-IV

Semester-IV Immunology and Clinical Microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Infection and Immunity

Normal flora of human body.

Infection and its type.

Mechanism of pathogenesis.

Immunity – Natural and acquired.

Defense mechanisms – First line, second line and third line of host defense.

Vaccines – Preparation and types, vaccination schedule for children in India.

Unit-II Epidemiology of infectious diseases

Transmission of diseases.

Types of diseases – Epidemic, Pandemic, Sporadic.

Nosocomial Infections.

Epidemiological Methods – Descriptive, Analytical and Experimental Epidemiology.

Antibiotics – Mode of action and development of resistance. Transmission of drug resistance.

Antiviral and Antifungal drugs.

Unit-III Components of Immune System

Organs and cells involved in immune response.
Antigen – Properties and types, Adjuvants.
Immunoglobulin – Separation, structure and types.
Primary and secondary responses.
Complement – Components and Biological activities.

Unit-IV Antigen – Antibody Reactions

Antigen and antibody reactions – agglutination, precipitation. Toxin neutralization test.
Immunofluorescence, ELISA, RIA.
Allergic skin tests – Tuberculin test and Lepormin test.
Hypersensitivity – Immediate and delayed type.
Autoimmune Diseases.

Unit-V Microorganisms and Diseases

Gram positive cocci – *Staphylococcus aureus* .
Gram negative bacilli – *Salmonella typhi* .
Acid fast bacteria – *Mycobacterium tuberculosis*.
Anaerobic, Gram positive bacilli – *Clostridium tetani*.
Spirochaete – *Treponema pallidum*.
Virus – *Hepatitis and HIV*.

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List of Practicals

1. Determination of Blood Groups.
2. Estimation of hemoglobin by Sahli's method.
3. Estimation of hemoglobin by Cyanmethaemoglobin method.
4. Total count of W.B.C.
5. Total count of R.B.C.
6. Differential W.B.C. count.
7. Flocculation reaction- VDRL.
8. Agglutination reaction- Widal test.
9. Examination of urine- chemical, physical, microscopic and bacteriological.
10. Isolation and identification of gram positive bacteria: *Staphylococcus aureus*.
11. Isolation and identification of gram negative bacteria: *E. coli*, *Proteus sp.* and *Salmonella*

Scheme of Practical Examination- Semester- IV (3+3 Hrs., 2 days)

- Ex.1 – Identification of medically important organisms *Staphylococcus*/
E.coli / *Proteus* / *Salmonella* [12]
Ex.2 - Total count :RBC/WBC/Differential count of WBC/Hemoglobin estimation/
/Urine Analysis. [10]
Ex.3 – Antigen-Antibody reactions – Widal /VDRL Test. [10]
Ex.4 – Spotting [08]
Ex.5 – Viva Voce [05]
Ex.6 – Practical Record [05]

Recommended Books

Immunology - Kuby, J.
Fundamental Immunology - W.E. Paul
Fundamentals of Immunology - Coleman, Lombord and Sicard
Immunology - Weir and Steward

Immunology - Rao, C.V.
Lecture Notes in Immunology - Todd. I.R.
Microbiology – A Practical Approach - Bhavesh Patel and Nandini Phanse
Experiments in Biotechnology - Nighojkar and Nighojkar
Solutions to Practical Microbiology - Bhavesh Patel and Nandini Phanse
Essentials of Immunology - Roitt, I.M
Immunology. - Klaus D. Elgert ,
Fundamental Immunology. - Paul, W.E.
Immunology. - Weir, D.M and J. Steward, J.

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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- III (Microbiology) Semester-V

Semester-V Industrial Microbiology CCE- 15 Marks

End Exam. - 85 Marks

Unit-I Fundamentals of Industrial Fermentations

Primary and secondary screening of industrially important organisms.

Strain development strategies.

Scale up of fermentation process.

Raw materials for media preparation.

Harvesting and product recovery.

Unit-II Fermentor Design

Design of typical batch fermentor.

Factors affecting fermentor design.

Types of fermentations – Batch and continuous fermentations.

Monitoring and control of – agitation, aeration, pH, temperature and dissolved oxygen.

Industrial sterilization of media and air.

Unit-III Analytical Microbiology

Bioassay of growth supporting substances – Amino acids and vitamins.

Bioassay of growth inhibiting substances – Antibiotics.

Phenol coefficient of antimicrobial substances

Quality control tests – Sterility testing, Microbial limit test (MLT), pyrogen testing (LAL test), Minimum inhibitory concentration (MIC).

Unit-IV Industrial Production

Enzymes – Protease

Amino acids – Lysine

Antibiotics – Penicillin

Vitamins – Cyanocobalamin

Organic acids – Citric acid

Solvent – Ethyl alcohol.

Unit-V Microbial biotechnology

Applications of microbes in pest control- Bacterial, fungal and viral biocontrol agents

Biofertilizers- Symbiotic and non-symbiotic nitrogen fixation.

Fuel from microorganisms – Digester design and biogas production technology.

Immobilized enzymes – Methods of immobilization and their applications.

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List of Practicals

1. Screening of Antibiotic producing microorganisms.
2. Primary screening of amylase producing microorganisms.
3. Primary screening of protease producing microorganisms.
4. Primary screening of cellulase producing microorganisms.
5. Primary screening of lipase producing microorganisms.
6. Microbial assay of Antibiotics.
7. Microbial assay of Vitamins.
8. Estimation of MIC for antibiotics.
9. Sterility testing of pharmaceutical products- injectibles, eye drops and ear drops.
10. Microbial Limit Test- tablets and syrups.
11. Area monitoring.

Scheme of Practical Examination- Semester- V (3+3 Hrs., 2 days)

- Ex.1 – Microbial assay of antibiotics / vitamins/ MIC [12]
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Devi Ahilya Vishwavidyalaya, Indore

B.Sc. Part- III (Microbiology) Semester-VI

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Composition of soil.

Estimation of soil microflora

Rhizosphere – Interactions among soil microflora

Biogeochemical cycles – Nitrogen, Carbon and Sulfur cycles

Phosphate solubilizers, Mycorrhiza

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Food intoxications.

Spoilage of food – Fresh food, Canned food, Vegetables and Milk products.

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Preservation of food.

Dairy products – Cheese, Butter and Yogurt.

Microorganisms as food – Single Cell Protein.

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Water borne diseases.

Water purification.

Treatment of waste-water – Primary, secondary, advanced and final treatments, Solids processing.

Eutrophication.

Unit-IV Microbiology of air

Air borne diseases.

Analysis of air.

Aeromicroflora of different habitats.

Aeroallergens.

Control of microorganisms in air.

Unit-V Applications of microorganisms

Microbial leaching of Copper and Uranium.

Biorecovery of Petroleum.

Bioremediation, Biodeterioration – Petroleum products, Leather, Textile and Paper.

Applications of biosensors and biopolymers.

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List of Practicals

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8. Isolation of PSB
9. Estimation of air micro-flora
10. Isolation of *Lactobacillus*
11. Isolation of Yeast.

Scheme of Practical Examination- Semester- VI (3+3 Hrs., 2 days)

Ex.1 – Qualitative and Quantitative analysis of water/food/milk/sewage. [12]

Ex.2 – Isolation of *Azotobacter/Rhizobium*/PSB [10]

Ex.3 – Isolation of *Lactobacillus* /Yeast [10]

Ex.4 – Spotting [08]

Ex.5 – Viva Voce [05]

Ex.6 – Practical Record [05]

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Bioremediation - Baker, KH and Herson DS

Experimental Microbial Ecology - Burns R.G. and Slater J.H

Introduction to environmental microbiology - Michel R
Fundamental Principles of Bacteriology - Salle, A.J.
Experiments in Biotechnology - Nighojkar and Nighojkar
Food Microbiology - Frazier and Westhoff
Food Microbiology - Adams and Moss
Introductory Food Microbiology - Modi, H.A.
Modern food Microbiology - Jay