Devi Ahilya Vishwavidyalaya, Indore

Syllabus for B.Sc. Part-I, II and III (Optional subject- Industrial 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	Immunology and Bacterial Genetics	15	85	50	150
Sem-IV	Environmental Microbiology	15	85	50	150
Sem-V	Fermentation Technology	15	85	50	150
Sem-VI	Food and Pharmaceutical Microbiology	15	85	50	150

Scheme of practical examination in each semester		
Total marks- 50 **Duration- 6 Hrs.**	1. Major exercise 2. Minor exercise 3. Minor exercise 4. Spotting 5. Viva-voce 6. Practical record	12 Marks 10 Marks 10Marks 08 Marks 05 Marks 05 Marks

Devi Ahilya Vishwavidyalaya, Indore
B.Sc. Part- I (Industrial 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, Viriods, Prions. Structure of Bacterial Viruses. Classification and cultivation of Viruses. Multiplication of Bacterial Viruses. Bacteria with unusual properties- Rickettsia, Chlamydia, Mycoplasma, Archaebacteria, 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.	

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 (6 Hrs.)

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 (Industrial 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.

Scheme of Practical Examination- Semester- II **M.M. 50 (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 & Daginawala
Principles of Biochemistry	-	Lehniger, A.L.
Microbial Physiology	-	Moat & Foster
Fundamentals of Biochemistry	-	Jain, J.L.
General Microbiology	-	Hans G. Schlegel

Devi Ahilya Vishwavidyalaya, Indore
B.Sc. Part- II (Industrial microbiology) Semester-III

Semester-III	Immunology and Bacterial Genetics	CCE- 15 Marks End Exam. - 85 Marks
Unit-I	**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-II	**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-III	**Fundamentals of Genetics** Genotype and Phenotype. DNA as genetic material. Structure and types of DNA and RNA. Genetic code. DNA Replication.	
Unit-IV	**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), HNO_2 and NH_2OH Mutation Rate, Ames Test.	
Unit-V	**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.	

List of Practicals

1. Determination of Blood Group
2. Estimation of hemoglobin by Sahli's method.
3. Estimation of hemoglobin by Cyname haemoglobin mehod.
4. Total count of W.B.C.
5. Total count of R.B.C.
6. Differential W.B.C. count
7. Isolation of bacterial genomic DNA.
8. Isolation of Plasmid DNA.

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9. UV as a mutagenic agent.
10. Replica plating technique.
11. Isolation of antibiotic resistant mutants by gradient plate technique.

Scheme of Practical Examination- Semester- I **M.M. 50 (3+3 Hrs., 2 days)**

Ex.1– Isolation of bacterial genomic /plasmid DNA.	[12]
Ex.2 – Replica plating technique/gradient plate technique/UV as mutagenic agent.	[10]
Ex.3 - Total count of RBC/WBC/Differential count of WBC/Hb estimation	[10]
Ex.4 – Spotting	[08]
Ex.5 – Viva Voce	[05]
Ex.6 – Practical Record	[05]

Recommended Books

Immunology	-	Kuby
Fundamental Immunology	-	Paul, W.E.
Fundamentals of Immunology	-	Coleman, Lombord and Sicard
Immunology	-	Weir and Steward
Immunology	-	Rao, C.V.
Lecture Notes in Immunology	-	Todd, I.R.
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

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B.Sc. Part- II (Industrial microbiology) Semester-IV

Semester-IV	**Environmental microbiology**	**CCE- 15 Marks** **End Exam. - 85 Marks**
Unit-I	**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-II	**Microbiology of air** Air borne diseases. Analysis of air. Aeromicroflora of different habitats. Aeroallergens. Control of microorganisms in air.	
Unit-III	**Microbiology of Soil** Composition of soil Estimation of soil microflora Rhizosphere – Interactions among soil microflora Biogeochemical cycles – Nitrogen, Carbon and Sulfur cycles Symptoms, transmission and control of plant diseases.	
Unit-IV	**Microbial Fertilizers** Nitrogen fixation by symbiotic and non-symbiotic microorganisms. Mass cultivation of *Rhizobium* and *Azotobacter*. Use of blue-green algae as biofertilizers. Phosphate solublizing bacteria.	
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.	

List of Practicals

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

Scheme of Practical Examination- Semester- IV **M.M. 50 (3+3 Hrs., 2 days)**

Ex.1 – Qualitative and Quantitative analysis of water/sewage.	[12]
Ex.2 – Isolation of *Azotobacter*/*Rhizobium*/PSB.	[10]
Ex.3 – Isolation of *Xanthomonas citri* /Yeast	[10]
Ex.4 – Spotting	[08]
Ex.5 – Viva Voce	[05]
Ex.6 – Practical Record	[05]

Recommended Books

Microbial ecology	-	Alexander, M
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
Environmental Microbiology	-	P.D. Sharma

Devi Ahilya Vishwavidyalaya, Indore
B.Sc. Part- III (Industrial microbiology) Semester-V

Semester-V	Fermentation technology	CCE- 15 Marks End Exam. - 85 Marks
Unit-I	**Fundamentals of Industrial Fermentations** General concepts of industrial microbiology. Primary screening methods for isolation of industrially important organisms. Secondary screening methods. Regulatory mechanisms in microbes and strain development strategies.	
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	**Scale up and Down stream processing** Inoculum development. Scale up of fermentation process. Raw material for media preparation. Harvesting and recovery of intracellular and extracellular products.	
Unit-IV	**Industrial production – I** Production of antibiotics- Penicillin and semi-synthetic penicillins. Production of enzymes- Amylase, cellulose and protease. Immobilized enzymes – Methods of immobilization and their applications.	
Unit-V	**Industrial production – II** Production of solvent- Ethanol. Production of Vitamins- Cyanocobalamine. Production of Organic Acids- Citric acid. Production of Amino Acids- Glutamic Acid.	

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 organic acid producing microorganisms.
6. Production of enzymes –Amylase, protease and cellulose.
7. Production of Ethanol.
8. Production of Citric acid.
9. Sugar estimation by Cole's method.
10. Demonstration of fermentation equipment.

Scheme of Practical Examination- Semester- V **M.M. 50 (3+3 Hrs., 2 days)**

Ex.1 – Production of Amylase/ Ethanol/ Citric acid /Sugar estimation by Cole's method	[12]
Ex.2 – Primary Screening of antibiotic producers/organic acid producers	[10]
Ex.3 – Primary screening of enzyme producers (amylase/cellulase/protease)	[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	-	Prescott
Industrial Microbiology	-	Waites
Principles of Fermentation Technology	-	Standbary, Whitaker and Hall
Industrial Microbiology	-	Reed, D
Industrial Microbiology	-	Agarwal And Parihar
Biology of Industrial Microorganisms	-	Demain, A. L
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- III (Industrial microbiology) Semester-VI

Semester-VI	Food and Pharmaceutical microbiology	CCE- 15 Marks End Exam. - 85 Marks
Unit-I	**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 product.	
Unit-II	**Food Preservation** Principles of food preservation - Asepsis, removal of microorganisms, anaerobic conditions, high and low temperatures and drying. Chemical preservatives and food additives. Food packaging.	
Unit-III	**Pharmaceutical Industry** Formulation units and Active Pharmaceutical Ingredient manufacture Units (API) Departments in a pharmaceutical company - Raw material, Production, Research and development, Quality assurance, Quality Control, Marketing and Sales. QC Tests - Guidelines for quality control tests- Indian Pharmacopeia, Sterility testing, Microbial Limit Test (MLT) for pharmaceutical products, Pyrogen testing (LAL test), Water analysis and Area monitoring.	
Unit-IV	**Government regulations** Good manufacturing practices. Food and drugs administration, Indian pharmacopeia and standards. Recombinant DNA and Biosafety guidelines. IPR(Intellectual property rights)-Patents.	
Unit-V	**Microbiological Assays** Organisms and precautions during bioassays. Bioassay of growth supporting substances- Amino acids and Vitamins. Bioassay of growth inhibiting substances- Antibiotics. Minimum inhibitory concentration. Phenol coefficient of antimicrobial substances.	

List of Practicals

1. Determination of MIC.
2. Sterility testing of pharmaceutical products- injectibles, eye and ear drops.
3. Microbial Limit Test- Tablets and syrups.
4. Area monitoring
5. Determination of Phenol coefficient of Dettol / phenyl / hand-wash.
6. Bioassay of Penicillin
7. Qualitative and quantitative examination of Food.
8. Qualitative and quantitative examination of Milk.

Scheme of Practical Examination- Semester- VI **M.M. 50 (3+3 Hrs., 2 days)**

Ex.1 – Microbial assay of Antibiotics/Phenol coefficient/MIC	[12]
Ex. 2- Qualitative and Quantitative analysis of food/milk	[10
Ex.3 – Area monitoring/MLT	[10]
Ex.4 – Spotting	[08]
Ex.5 – Viva Voce	[05]
Ex.6 – Practical Record	[05]

Recommended Books

Pharmaceutical Microbiology	-	Bhatt
Pharmaceutical Microbiology	-	Hugo, N.B. and Russel, A.D.
Pharmaceutical Microbiology	-	Malcolm Harris, Tindall & Cox
Pharmaceutical Microbiology	-	N.K.Jain, N.K.
Textbook of Industrial Microbiology	-	Patel, A.H.
Industrial Microbiology	-	Cassida, L.E.
Industrial Microbiology	-	Prescott
Industrial Microbiology	-	Waites
Principles of Fermentation Technology	-	Standbary, Whitaker and Hall
Industrial Microbiology	-	Reed, G.
Food Microbiology	-	Frazier and Westhoff
Food Microbiology	-	Adams and Moss
Introductory Food Microbiology	-	Modi, H.A.
Modern food Microbiology	-	Jay