DEVI AHILYA VISHWAVIDYALAYA, INDORE

B.Sc. (MICROBIOLOGY) SYLLABUS

(SEMESTER SYSTEM)

Year	Semester	Paper	Nomenclature	M. marks	Practicals	M. Marks
B. Sc. Part-I	Sem-I	Paper-I Paper-II	General microbiology Microbial physiology	50 50	Semester-I practical	50
	Sem-II	Paper-I Paper-II	Microbial biochemistry Environmental microbiology	50 50	Semester-II practical	50
B. Sc. Part-II	Sem-III	Paper-I Paper-II	Microbial genetics Immunology	50 50	Semester-III practical	50
	Sem-IV	Paper-I Paper-II	Bioinformatics and Biostatistics Medical microbiology	50 50	Semester-IV practical	50
B. Sc. Part-III	Sem-V	Paper-I Paper-II	Industrial microbiology Analytical microbiology	50 50	Semester-V practical	50
	Sem-VI	Paper-I Paper-II	Applied microbiology Molecular biology and Genetic engineering	50 50	Semester-VI practical	50

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

Paper – I- General microbiology

Unit I: History, Taxonomy and Classification:

- History of microbiology- Contributions of pioneers.
- Introduction to major groups of microorganisms and fields of Microbiology.
- Spontaneous generation *versus* biogenesis hypothesis.
- Whittaker's classification system of prokaryotes. Introduction to Bergey's manual of determinative and systematic classification.
- Bacterial nomenclature.

Unit II: Microscopy and Staining Techniques

- Bright Field, Dark Field, Phase Contrast, Fluorescence and Scanning and Transmission Electron Microscopy.
- Stains and staining techniques- Stains and Dyes: classification and types.
- Types of staining- Simple (Monochrome, Negative), Differential (Gram and Acid fast).

Unit III: Morphology of Bacteria

- Size, shape and arrangement of bacterial cells.
- Structures external to cell wall- Flagella, pili, capsule, sheath and prosthecae.
- Structures internal to cell wall- Cell membrane, nuclear material, cell wall (Protoplast and Spheroplast), spores, cytoplasmic inclusions, magnetosomes and plasmids.

Unit IV: Microbial Diversity

- Bacteria with unusual properties- *Rickettsia, Chlamydia, Mycoplasma, Archaebacteria, Cyanobacteria, Actinomycetes.*
- Microbes of extreme environments– Adaptations and industrial importance of Thermophiles,
- Alkalophiles and Halophiles.

Unit V: Introduction to acellular forms of life

- Introduction to viruses, viroids and prions.
- Structure of animal, plant and bacterial viruses.
- Classification and cultivation of viruses.
- Multiplication of bacterial viruses (lytic and lysogenic cycles).

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

Paper – II- Microbial physiology

Unit I: Cultivation and Pure Culture Techniques

- Nutrition and nutritional types of bacteria.
- Bacteriological media (types and uses), cultivation of aerobic and anaerobic microbes.
- Isolation of microorganisms, pure culture and cultural characteristics.

Unit II: Microbial Growth

- Mathematical expression of bacterial growth, generation time and growth rate.
- Growth curve and phases of growth cycle.
- Batch, continuous and synchronous cultures; diauxic growth.
- Factors affecting microbial growth.

Unit III:Measurement and Preservation Methods

- Quantitative measurement of bacterial growth by cell mass, cell number and cell activity.
- Maintenance and preservation of cultures.

Unit IV:Control of Microorganisms- I

- Microbial death curve under adverse condition.
- Concept of sterilization, disinfection, asepsis and sanitation.
- Physical methods of control- Temperature, radiation, desiccation, osmotic pressure, filtration.

Unit V: Control of Microorganisms-II

- 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, Agar diffusion. Phenol coefficient.

Recommended Books (Semester-I)

1. Microbiology, Authors- Pelczar, Chan and Kreig.
2. Microbiology- an Introduction- (8th Edn), Authors- Tortora, G.J., Funke, B.R., Case, C.L.
3. General Microbiology, Authors- Stainer, Ingharam, Wheelis and Painter.
4. General Microbiology, Authors- Stainer RY. Ingharam JL. Wheelis ML. Painter PR
5. Biology of Microorganisms, Authors- Brock and Madigan.
6. Fundamental Principles of Bacteriology, Author- A.J. Salle.
7. Introduction to Microbiology, Authors- Ingraham and Ingraham.
8. Microbial Physiology, Authors- Moat and Foster.
9. Prokaryotic Development Authors- Brun, Y.V. and Shimkets, L.J. 2000, ASM Press.
10. Elementary Microbiology, Author- H. A. Modi
11. Textbook of Microbiology, Authors- Dubey and Maheshwari.
12. Microbiology, A Practical Approach. Authors- Patel and Phanse
13. Experiments in Biotechnology. Authors- Nighojkar and Nighojkar
14. General Microbiology, Authors- Powar and Daginawala.
15. Fundamentals in Microbiology, Authors- Frobisher and Hinsdinn.
16. Microbiology, Author- S.S. Purohit.
17. Immunology, Microbiology and Biotechnology, Author- K.C. Soni.
18. Microbiology, Author- R.P.Singh.

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

List of Experiments

1. Principles and working knowledge of instruments like autoclave, pH meter, incubator, hot air oven, centrifuge, microscope and colony counter.
2. Preparation of solid and liquid culture media and their sterilization.
3. Growth of bacteria on agar slant, agar stab, Petri plate and in broth.
4. Staining techniques- Simple staining, Gram staining, Negative staining, Endospore staining, Metachromatic granule staining, Spirochete staining.
5. Isolation of microorganisms by streak plate method.
6. Isolation of microorganisms by pour plate method.
7. Motility by hanging drop method.
8. Preparation of McFarland scale.
9. Use of counting chamber for bacterial count.
10. Effect of temperature on bacterial growth.
11. Effect of pH on bacterial growth.
12. Effect of osmotic pressure (salt and sugar concentration) on bacterial growth.
13. The oligodynamic action of heavy metals on bacterial growth.
14. One step growth of bacteriophage.

SCHEME OF PRACTICAL EXAMINATION

(Semester- I)

Q.1 - Isolation of microorganisms by Sector Plate/Pour plate method.	[12]
Q.2 - Differential staining.	[10]
Q.3 - Special staining.	[10]
Q.4 - Spotting	[08]
Q.5 - Viva voce	[05]
Q.6 - Practical record	[05]

	Total 50 Marks

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

Paper – I- Microbial biochemistry

Unit I: Carbohydrates

- Chemical structures, nature and properties.
- Classification and importance in biological cells.
- Aerobic and anaerobic metabolism.

Unit II: Amino acids and Proteins

- Amino acids- Classification and properties. Structure, Zwitterion nature.
- Proteins- Classification, Structure and function. Primary, secondary, tertiary and quaternary structure.
- Proteolysis, Transamination and Deamination.

Unit III: Enzymes

- General characteristics. Factors affecting enzyme activity.
- Regulation of enzyme activity.
- Enzyme kinetics, Km, activation and inhibition
- Coenzymes and cofactors. Non-protein enzymes
- Applications of enzymes.

Unit IV: Lipids, vitamins and hormones

- Saturated and unsaturated fatty acids.
- Structure, classification, properties and function of lipids and vitamins.
- Distribution and functions of lipids in microorganisms.
- Beta-oxidation of lipids.
- Hormones: Steroid hormones, Structure and function.

Unit V: Bioenergetics

- Principles of bioenergetics and high energy phosphate compounds.
- Mode of energy production- Photophosphorylation.
- Bacterial photosynthesis.

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

Paper – II- Environmental microbiology

Unit I: Soil Microbiology

- Formation and composition of soil.
- Estimation of soil microflora, Soil management.
- Rhizosphere- Positive and negative interactions among soil microflora.

Unit II: Food Microbiology

- Introduction to microbiology of food and milk
- Food intoxications, spoilage of food- Fresh food, canned food, vegetables and milk products.
- Preservation of food and milk.
- Composition of milk, grading of milk- MBRT, resazurin and phosphate tests.

Unit III: Water Microbiology

- Microbiology of water and water bodies.
- Water purification.
- Eutrophication.

Unit IV: Waste Water Treatment

- Primary treatment.
- Secondary treatment.
- Advanced and final treatment.

Unit V: Air Microbiology

- Composition and analysis of air.
- Aeromicroflora of different habitats.
- Aeroallergens.
- Biogeochemical cycles- Role of microbes in Nitrogen and Carbon cycles.

Recommended Books (Semester-II)

1. Principles of Biochemistry, Author- A.L. Lehniger
2. Fundamentals of Biochemistry, Author- J. L. Jain
3. Biochemistry, Author- Voet and Voet.
4. Textbook of Biochemistry- S.P. Singh.
5. Biochemistry, Author- Stryer.
6. Introduction to protein structure, Authors- Branden and Tooze.
7. Fundamental Principles of Bacteriology, Author- A.J. Salle.
8. Principles of Biochemistry, Authors – Zubey, Parson and Vance.
9. Microbial Diversity, Author- D. Colwd.
10. Microbiology A Practical Approach Authors- Patel and Phanse, .
11. Nighojkar and Nighojkar, Experiments in Biotechnology.
12. Food Microbiology, Authors- Frazier and Westhoff.
13. Food Microbiology, Authors- Adams and Moss
14. Introductory Food Microbiology. Author – H.A. Modi
15. Environmental Microbiology, Author- P.D. Sharma.
16. Environmental Microbiology, Author- K.G. Vijaya.
17. The nature and properties of soil. Authors- Harry buckman and Nyle C. brady.
18. Introduction to soil Microbiology Internationals. Authors- Martin Alexander.

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

List of experiments

1. Detection of carbohydrates, proteins and lipids.
2. Estimation of activity of enzymes like amylase, protease and lipase.
3. Effect of pH on enzyme activity.
4. Effect of temperature on enzyme activity.
5. Effect of substrate concentration on enzyme activity.
6. Effect of enzyme concentration on enzyme activity.
7. Quantitative estimation of protein by Folin Lowry's Mehod.
8. Quantitative estimation of carbohydrates by Nelson Smogyi's Method.
9. Isolation of organisms from air.
10. Isolation of organisms from water and sewage.
11. Isolation of organisms from food sources.
12. Isolation of Yeast.
13. Isolation of phosphorous solubilizing bacteria/fungus from soil sample.
14. Isolation of *Xanthomonas citri* from citrus canker.
15. Gradation of milk by Methylene Blue Reduction Test (MBRT).

SCHEME OF PRACTICAL EXAMINATION

(Semester II)

Q. 1 - Isolation of microorganisms from water / sewage / food / curd / canker/soil.	[12]
Q. 2 - Determination of enzyme activity-amylase / protease / lipase.	[10]
Q. 3 - Qualitative estimation of carbohydrates / proteins / lipids.	[10]
Q. 4 - Spotting	[08]
Q. 5 - Viva voce	[05]
Q. 6- Practical record	[05]

	Total 50 Marks

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

Paper – I- Microbial genetics

Unit I: Fundamentals of Genetics

- DNA as genetic material.
- Structure and types of DNA and RNA.
- Genetic code.
- Protein synthesis - Transcription and translation.

Unit II:DNA Replication and Gene Structure

- DNA replication.
- Cis-trans complementation test.
- Fine structure analysis of r II region of T4 by Benzer.

Unit III : Mutation

- Evidence for spontaneous nature of mutation.
- Molecular basis of mutation- Types of mutation.
- Types of bacterial mutants and their isolation.
- Mutagenic agents- Physical and chemical.
- Mutation rate and Ames test.

Unit IV: Genetic Recombination- I

- Gene transfer in bacteria.
- Transformation- Competence, DNA uptake, artificially induced competence, electroporation.
- Transposable elements.
- Plasmid- Structure, properties and types of plasmids.

Unit V :Genetic Recombination -II

- Transduction- U tube experiment, Generalized and specialized transduction, Abortive transduction.
- Conjugation- F factor, characters of donor and recipient.
- Steps in conjugation, sexduction, formation of Hfr and F prime cells.

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

Paper – II- Immunology

Unit I: Infection

- Normal flora of human body.
- Infection and its types.
- Mechanism of pathogenesis.

Unit II: Immune System

- Organs of Immune system- Spleen, thymus and lymph nodes
- Cells of Immune system- T cells- its types and receptors. B cells and its receptors.

Unit III: **Immune Response**

- Immunity- Innate and acquired
- Host defense mechanism- First, second and third line of host defense.
- Primary and secondary responses.

Unit IV: Antigens and Antibodies

- Antigens- Properties and types, Adjuvants.
- Immunoglobulins- Separation, structure and types.
- Generation of antibodies.
- Antibody diversity.

Unit V: Antigen and Antibody Reactions

- Agglutination and precipitation reactions.
- Hemagglutination and PHA, Immunofluorescence, ELISA, RIA, Coombs test (Direct and Indirect).
- Complement- Components and biological activities.

Recommended Books (Semester-III)

1. Genes XI, Author- B. Lewin.
2. Principles of Genetics, Authors- Gardner, Simmons and Snustad.
3. Concepts of Genetics, Authors- Klug and Cummings.
4. Microbial Genetics, Authors- Freifelder.
5. Genetics, Authors- Arora and Sandhu.
6. Text of Microbiology, Authors- Ananthanarayanan and Paniker.
7. Immunology, Author- J. Kuby.
8. Fundamental Immunology, Author– W.E. Paul.
9. Fundamentals of Immunology, Authors– Coleman, Lombord and Sicard.
10. Immunology – Weir and Steward.
11. Immunology, A Textbook, Author- C.V. Rao.
12. Lecture Notes in Immunology, Author- I.R.Todd.
13. Essentials of Immunology, Authors- Roitt, I.M.
14. Immunology-Understanding of Immune System, Author- Klaus D. Elgert (1996)
15. Text Book on Principles of Bacteriology, Virology and Immunology, Authors- Topley & Wilson's (1995)
16. The Experimental Foundations of Modern Immunology. Author- Clark, V.R.,
17. Cellular Microbiology, 1999.Authors- Henderson et.al..
18. Medical Microbiology, Vol. 1 : Authors- Mackie and McCartney,
19. Microbiology in Clinical Practice, Authors- D.C. Shanson, Wright PSG, 1982.
20. Bailey and Scott's, Diagnostic Microbiology. Authors- Baron EJ, Peterson LR and Finegold SM. Mosby, 1990.

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

List of experiments

1. Estimation of haemoglobin by Sahli's method.
2. Estimation of haemoglobin by Cyname haemoglobin mehod.
3. Total count of W.B.C.
4. Total count of R.B.C.
5. Differential W.B.C. count.
6. Flocculation reaction- VDRL
7. Agglutination reaction- Widal test, Blood Grouping.
8. Immuno-diffusion techniques- ODD and RID.
9. UV as a mutagenic agent.
10. Replica plating technique.
11. Estimation of skin microflora.

SCHEME OF PRACTICAL EXAMINATION

(Semester III)

Q.1 – Total count of RBC/WBC/Differential count of WBC/Hb estimation.	[12]
Q.2 – Antigen-antibody reactions – Widal /VDRL/ODD/RID.	[10]
Q.3 – Isolation of mutants by replica plating technique/gradient plate technique.	[10]
Q.4 – Spotting	[08]
Q.5 – Viva-voce	[05]
Q.6 – Practical record	[05]

Total 50 Marks

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

Paper I –Bioinformatics and Biostatistics

Unit I: Introduction to Bioinformatics

- Bioinformatics- Definition and relation to molecular biology.
- Potential of bioinformatics.
- Application of bioinformatics.

Unit II: Databases

- Nucleic acid and Protein databases.
- Structure databases.
- Enzyme databases.
- Specialized (organism and species) databases.

Unit III: Tools

- Sequence alignments- Pair-wise (T-coffee) and multiple sequence alignment (Clustal w).
- Sequence similarity search and homology algorithms (BLAST) for protein and nucleic acids.
- Visualization of protein structure (RASMOL).

Unit IV: Biostatistics I

- Measure of central tendency- Mean, mode and median.
- Measure of dispersion- Standard deviation and Standard error.
- Diagrammatic and graphic representation of frequency distribution.

Unit V: Biostatistics II

- Basic idea of probability- Addition and Multiplication laws.
- Test of significance- Chi square test.
- Normal distribution and departures from normality.

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

Paper – II- Medical microbiology

Unit I:Epidemiology of Infectious Diseases

- Epidemiological study.
- Transmission of diseases.
- Types of diseases- Epidemic, pandemic and sporadic.
- Nosocomial infections.

Unit II: Antimicrobial Agents

- Antibiotics- Mode of action.
- Development of resistance.
- Transmission of drug resistance.
- Antiviral and antifungal drugs.

Unit III: Hypersensitivity

- Hypersensitivity- Immediate and delayed type.
- Autoimmune diseases.
- Skin tests.

Unit IV: Microbial Diseases- I

- Gram Positive Cocci- *Staphylococcus aureus* and *Streptococcus pneumoniae*
- Gram Negative Bacilli- *Salmonella typhi* and *Vibrio cholarie.*
- Acid fast bacteria- *Mycobacterium tuberculosis.*

Unit V: Microbial Diseases-II

- Anaerobic, Gram positive bacilli- *Clostridium tetani*.
- Spirochaete- *Treponema pallidum*.
- Fungal skin infections- Dermatomycosis.
- Virus- Hepatitis and HIV.

Recommended Books (Semester-IV)

1. Bioinformatics, Author- Baxevanis.
2. Bioinformatics, Author- Higgins and Taylor.
3. The Internet and the New Biology: Tools for Genomic and Molecular Research, Author- Peruski and Peruski.
4. Functional Genomics- A Practical Approach, Author- Mark Schena.
5. Principles of Biostatistics, Authors- Pagano *et al.*
6. Introduction to Biostatistics, Authors- Forthoter and Lec.
7. Text of Microbiology, Author- Ananthanarayanan and Panikar.
8. Medical Microbiology, Vol. 1 : Microbial Infection, Vol. 2 : Practical Medical Microbiology, Authors- Mackie and McCartney.
9. Epidemiology and Infections, Author- Smith
10. Lecture Notes in Immunology, Author- I.R. Todd
11. Microbiology in Clinical Practice, Author- D.C. Shanson.
12. Diagnostic Microbiology, Authors- Baron, Peterson and Finegold.

B.Sc (Part-II) Semester-IV

List of experiments

1. Examination of urine – Physical, chemical, microscopic and bacteriological.
2. Isolation and identification of Gram positive bacteria
   (a) *Staphylococcus sp.*
   (b) *Streptococcus sp.*
3. Isolation and identification of Gram positive bacteria
   a. *E. coli*
   b. *Proteus sp.*
   c. *Salmonella sp.*
4. Antibiotic sensitivity test by disc diffusion technique.
5. Isolation of antibiotic resistant mutants by gradient plate technique.
6. Measure of central tendencies- Mean, Mode and Median.
7. Explore NCBI.
8. To read GenBank entries.
9. To read SWISSPROT entries.
10. To perform sequence similarity search using BLAST.
11. To perform multiple sequence alignment using Clustal W.
12. To visualize PDBIB 1AJE with the help of RASMOL.

SCHEME OF PRACTICAL EXAMINATION

(Semester IV)

Q.1 – Identification of medically important organisms *Staphylococcus / Streptococcus E.coli / Proteus / Salmonella*	[12]
Q.2 – Urine analysis / Antibiotic sensitivity testing / Gradient Plate Technique.	[10]
Q.3 –. Biostatistics / Bioinformatics excercise.	[10]
Q.4 – Spotting	[08]
Q.5 – Viva voce	[05]
Q.6 – Practical record	[05]

Total 50 Marks

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

Paper – I- Industrial microbiology

Unit I: Fundamentals of Industrial Microbiology

- General concepts of industrial microbiology.
- Primary and secondary screening
- Strain development strategies.
- Sterilization of fermentor, media and air.

Unit II: Fermentor Design

- Types of fermentations processes.
- Design of typical batch fermentor.
- Factors affecting fermentor design.
- Control of agitation, aeration, pH, temperature and dissolved oxygen.
- Types of fermentors.

Unit III: Scale up and DSP

- Inoculum development.
- Scale up of fermentation process.
- Raw material for media preparation.
- Harvesting and product recovery.

Unit IV: Industrial production - I

- Production of antibiotics- Penicillin and semi-synthetic penicillins.
- Production of enzymes- Amylase.
- Immobilization of enzymes and applications of immobilized enzymes.
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Unit V: Industrial production – II

- Production of solvent- Ethanol.
- Production of Vitamins- Cyanocobalamin.
- Production of Organic Acids- Acetic Acid.
- Production of Amino Acids- Glutamic Acid.

B.SC. (Part-III) Semester- V

Paper – II- Analytical microbiology

Unit I: Bioassays

- Bioassay of growth supporting substances- Amino acids and Vitamins.
- Bioassay of growth inhibiting substances- Antibiotics.
- Automation of bioassay.

Unit II: Quality Control

- Quality control tests- Sterility testing, Microbial Limit Test (MLT).
- Pyrogen testing (LAL test), Minimum Inhibitory Concentration(MIC).
- FDA and Good Manufacturing Practices.
- Quantitative and qualitative analysis of food, milk, water and sewage.

Unit III: Colorimetry and Spectrophotometry

- Lambert – Beer's Law.
- Ultraviolet, Visible, Infra red and Fluorescence spectroscopy.
- Atomic absorption, Raman spectrum, X-ray Crystallography and NMR.

Unit III: Separation Techniques- I

- Chromatography- Principle.
- Types of chromatography- Paper, Thin layer, Column, Ion exchange and Gas chromatography.
- Sedimentation and filtration.

Unit V: Separation Techniques -II

- Electrophoresis- Principle and working.
- Agarose gel, native PAGE and SDS-PAGE.
- Principle, working and applications of centrifuge.

Recommended Books (Semester-V)

1. Textbook of Industrial Microbiology, Author- A. H. Patel.
2. Industrial Microbiology, Author- L. E. Cassida
3. Industrial Microbiology, Author- G. Reed.
4. Industrial Microbiology, Author- Agarwal And Parihar.
5. Biology of Industrial Microorganisms. A.L. Demain.
6. Principles of Fermentation Technology, Authors- Standbary, Whitaker and Hall.
7. Principles of Physical Biochemistry, Authors- Van Holde *et.al*.
8. Biochemistry of Nucleic Acids, Authors- Adams et. al.
9. Bioseparation: Principles and Techniques, Author- B. Sivasankar.
10. Protein Analysis and Purification, Authors- I.M. Rosenberg.

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

List of Experiments

1. Isolation of antibiotic producer from soil sample.
2. Isolation of amylase producer from soil sample.
3. Estimation of soil microflora.
4. Qualitative and quantitative examination of Food.
5. Qualitative and quantitative examination of Milk.
6. Qualitative and quantitative examination of Water.
7. Qualitative and quantitative examination of Sewage.
8. Bioassay of penicillin.
9. Bioassay of vitamin.
10. Sugar estimation by Cole's Method.
11. Estimation of MIC.
12. Sterility testing of pharmaceutical products- injectibles, eye and ear drops.
13. Microbial Limit Test- Tablets and syrups.
14. Determination of Phenol coefficient.
15. Separation of amino acids by TLC.
16. Separation of sugars by Paper chromatography.

SCHEME OF PRACTICAL EXAMINATION

(Semester V)

Q.1 – Qualitative and Quantitative analysis of water/food/milk/sewage.	[12]
Q.2 – Microbial assay of Antibiotics/Vitamins/Phenol coefficient/MIC/Sugar estimation.	[10]
Q.3 – Isolation of industrially important microbes/Paper Chromatography/TLC	[10]
Q.4 – Spotting	[08]
Q.5 – Viva voce	[05]
Q.6 – Practical record	[05]

	Total 50

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

Paper – I- Applied microbiology

Unit I: Microorganisms in Agriculture

- Bacteria and fungi as biopestcides**.**
- Genetically modified crops containing insecticidal genes.
- Biofertilizers- Nitrogen fixers, PSB and Mycorrhiza.
- Fuel from microorganisms- Biogas technology, Microbial hydrogen production, Concept of gasohol.

Unit II: Geomicrobiology

- Microbial leaching of copper and uranium.
- Biorecovery of petroleum- MEOR.
- Bioremediation and Biodeterioration- Petroleum products, leather, textile and paper.

Unit III:Pharmaceutical Biotechnology

- Genetically engineered microorganisms.
- Production of heterologous proteins- Insulin, Growth hormones, Interleukins and t plasminogen activator.
- Recombinant vaccines.

Unit V: Food from Microbes

- Dairy products- Cheese, Butter, Yogurt.
- Microorganisms as food- SCP, *Spirullina* and Mushroom.
- Indian and Oriental fermented foods.

Unit V: Advanced Microbiology

- Biosensors and Biopolymers.
- Biochips, Biofilms and Bioplastics.
- Microorganisms as bioindicators

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

Paper II- Molecular biology and Genetic engineering

Unit I: Regulation of Gene Activity

- Operon concept- Induction, Repression and Attenuation.
- Inducible operon- *lac* operon.
- Repressible operon- *trp* operon.

Unit II: Genetic Engineering

- Tools and techniques in genetic engineering.
- Restriction endonucleases- Types and uses.
- Isolation of Genomic and Plasmid DNA.

Unit III:Gene Cloning

- Vectors- Plasmid, Phage, Cosmid and Yeast, *Agrobacterium* mediated gene transfer.
- Cloning techniques.
- Identification of clones.
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Unit IV:Techniques in Molecular Biology

- Introduction to PCR, RAPD, RFLP.
- Nucleic acid hybridization techniques- Southern, Northern, Western and Dot blots.
- Generation of cDNA libraries.

Unit V: Applications and Biohazards of Genetic Engineering

- Biosafety guidelines, Recombinant DNA safety guidelines, IPR.
- Biohazards and ethical issues of genetic engineering.
- Applications of transgenic plants, animals and microbes.

Recommended Books (Semester-VI)

1. Current protocols in molecular biology. 2000. Ausbel et. Al.
2. Molecular cloning Vol. 1-III. Sambrook & Russel. 2001. CSH press.
3. Molecular genetics of bacteria J.W. Dale 1994 John Wiley & Sones.
4. Molecular Cell Biology (W.H. Freeman) by Lodish, Berk, Zippursky.
5. Current protocols in molecular biology. 2000. Ausbel et. Al.
6. Molecular cloning Vol. 1-III. Sambrook & Russel. 2001. CSH press.
7. Principles of gene manipulation. 1994. Old & Primrose, Blackwell Scientific Publications.
8. Molecular Cloning. 3 volumes. Sambrose and Russell, 2000. CSH Press.
9. Genome analysis. Four volumes. 2000. CSH Press.

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

List of Experiments

1. Isolation of bacterial Genomic DNA.
2. Isolation of fungal Genomic DNA.
3. Isolation of Plasmid DNA.
4. Quantitative estimation of DNA by DPA method.
5. Quantitative estimation of RNA by oricinol method.
6. Electrophoretic analysis of DNA.
7. Restriction digestion and analysis.
8. Transformation of DNA.
9. Isolation of *Azotobacter*.
10. Isolation of *Rhizobium* from root nodules.
11. Isolation of phosphate solubalizing bacteria

SCHEME OF PRACTICAL EXAMINATION

(Semester VI)

Q.1 – Isolation of bacterial/fungal/plasmid DNA	[12]
Q.2 – Electrophoresis/ Restriction digestion/ Quantitative estimation of DNA/RNA	[10]
Q.3 – Isolation of *Azotobacter*/ *Rhizobium*/ PSB	[10]
Q.4 – Spotting	[08]
Q.5 – Viva voce	[05]
Q.6 – Practical record	[05]

	Total 50