RANI DURGAVATI VISHWAVIDYALAYA, JABALPUR
SYLLABUS PRESCRIBED FOR THE
DEGREE OF THE BACHELOR OF SCIENCE
B.Sc. FIRST YEAR
BIOTECHNOLOGY
Paper I- Cell Structure and Biology
(Paper 1 & 2 - MM Theory 80 + Internal 20)

UNIT I

Cell Structure & Theory, Structure and functions of prokaryotic cell, Eubacteria and Archaebacteria, Size, Shape and arrangement of bacterial cells, Gram's positive and Gram's negative cells.

Structure and functions of Eukaryotic cell, plants cells, animal cells. Difference between prokaryotic and eukaryotic cells.

UNIT II

Cellular Interactions: Extracellular matrix

Cell to ECM: Integrins, focal adhesions

Cell to Cell: Selectins, cadherins, Ig Superfamily

Gap Junction

Tight junction, Plasmodesmata

UNIT III

Cell cycle and cell division- mitosis, meiosis, cell cycle regulation, Anomalies in cell division and associated disease. Cell synchrony, Cell locomotion, Cell differentiation.

UNIT IV

Transport Process: Cell Membrane: Models of membrane structure. Membrane proteins and their properties, Membrane carbohydrate and their roles. Transport across membranes- active and passive diffusion, mechanisms.

UNIT V

Introduction to Necrosis, Senescence, Apoptosis- Programmed cell death, Mechanism of Apoptosis, Intrinsic and Extrinsic pathways of cell death, Apoptosis in relation to cancer, Oncogenes- Types of cancer.

Paper II- Microbiology

UNIT- I:

Introduction of Microbiology – History, Applications and status of Microbiology in India. Classification of Microorganisms – General Features, systems of Classification, Microbial Taxonomy. Classification and Identification of Bacteria, Bergey's manual.

UNIT- II:

Structure and Diversity of Bacteria and Virus, Microbes in extreme environment, Nutritional requirement of microbes.

Bacteriology: Morphology and ultra- structure of bacterio- morphological types. Archaebacteria. Structure and function of cell organelles.

UNIT- III:

Structure and Diversity of Algae, Fungi, Protozoans, Mycoplasmas and Extremophlies. General characteristics. Various methods of staining – simple, Gram, endospore, capsule, flagella and negative staining, Fungal stains, Algal stains.

UNIT- IV:

Microbial growth - mathematical expression of growth, growth curve, factors affecting growth. Batch, continuous, synchronous and diauxic growth. Quantification of microbial growth. Control of micro-organisms – physical and chemical. Evaluation of chemical disinfectants –tube dilution test, agar diffusion test and phenol – coefficient.

UNIT- V:

Microbial Nutrition and metabolism – Microbial Metabolism – Concept of Anabolism and catabolism processes, Nitrogen Fixation – Types and Mechanisms, Microbial disease in plants and animals (Only general concept).

Fermentation Process – Fermenter and its microbes of industrial importance.

BT-103 Laboratory

List of Practicals

1. To study the plant cell structure using various plant materials.
2. To study microbial cell by Monochrome staining and Gram staining.
3. To prepare and study the different stages of mitosis and meiosis.
4. Prepare slide for study of stomata.
5. Study of permanent slides like cell division, prokaryotic and eukaryotic cells, Muscles, and Nerve cells, T.S. of stomatal cells.
6. To study the animal cell structure using cheek cells.
7. Histochemical localization of flagellin.
8. Viable cell counting using haematocytometer
9. Measurement of cell by light microscope: Calibration of ocular micrometer, finding out average cell size.
10. Separation of cell types from blood by TLC/differential counting.
11. Methods of cell lysis: rupture osmotic/chemical/enzymatic.
12. Study of Human and animal chromosomes
13. Aseptic techniques, cleaning of glassware, Preparation of cotton plugging and sterilization.
14. Isolation of Microbes from Air, water and Soil.
15. Dilution and Plating by Pour plate, Spread plate Methods.
16. Staining Methods- Gram staining, Endospore Staining, Fungal Staining, Algal Staining.
17. Identification of Bacteria based on staining, shape and size.
18. Antibiotic sensitivity of Microbes by the Use of Antibiotic Discs.
19. Isolation and Identification of aquatic Fungi from Local water body.
20. Isolation and Characterization of green algae from Natural habitats
21. Measurement of water and soil, pH.

Note: 70% of the above list should be compulsorily performed

Suggested Readings

1. Cell and Molecular Biology: P.K.Gupta
2. Cell and Molecular Biology: S.C.Rastogi
3. Molecular Biology of the Cells, (2002): Albert's et . al.,
4. Cell Biology: P.S. Verma and Agrawal
5. Text book of Microbiology: R.C.Dubey
6. A Text book of Microbiology: Dubey & Maheshwari
7. Essentials of Microbiology: K.S.Bilgrami/ R.K.Sinha
8. Microbiology: P.D. Sharma
9. General Microbiology Vol I & Vol II: Pawar and Dagniwala.
10. Applied Microbiology: P.D.Sharma
11. Microbiology Fundamentals & Applications: S.S.Purohit
12. Experiments in Microbiology, Plant Pathology & Biotechnology: K.R.Aneja
13. Fundamentals of Microbiology & Immunology: A.K.Banerejee, Nirmalaya Benerjee
14. Modern Concept of Microbiology: H.D.Kumar & Swati Kumar

Practical Scheme for Final Examination

B.Sc. I Year

Time : 3 Hours **M. Marks : 50**

1.	Major	10
2.	Major	10
3.	Minor	05
4.	Minor	05
5.	Spotting	10
6.	Viva-Voce	05
7.	Practical Record	05
Total		**50**

B.Sc. SECOND YEAR
BIOTECHNOLOGY
Paper – I – Biophysics and Biochemistry
(Paper 1 & 2 - MM Theory 80 + Internal 20)

Unit-I

Thermodynamics: thermodynamic system, Equilibrium, thermodynamics law and their applications. Different type of processes, Thermodynamic variables and Entropy, Thermodynamics potentials and relations, Maxwell's Equation's, fundamentals equation of heat flow.

Unit-II

General biophysical methods: measurement of pH, radioactive labelling and counting, autoradiography. Diffusion, Sedimentation, Osmosis.

Viscosity- Definition, Factors influencing them and their applications in biology.

Bragg's equation, Reciprocal lattice, Miller indices and unit cell, concept of different crystal structure, determination of crystal structure.

Unit- III

Fundamental of Biochemistry: Biochemistry as Molecular logic of living beings. Axioms of living matter, Major compounds of animate objects as general view. Chemical elements, structure of atoms, molecules and chemical bonds. Ionic, covalent, co-ordinate and hydrogen bonds. Structure functions and properties of water, water as universal solvent, Acids, bases and salts pH and buffers.

Unit - IV

Biomolecules: Introduction and occurrence, classification, properties. Importance of carbohydrate, lipid proteins, amino acids and nucleic acids and various type of RNA's.

Unit - V

Enzyme structure classification and function - Active site, energy of activation, transition state hypothesis, lock and key hypothesis, induced fit hypothesis. Concept of Km- Michaelis Menten equation. Various type of enzyme inhibition and identification using double reciprocal plot. Introduction to Allosteric Enzymes. Definition of holoenzyme, apoenzyme. coenzyme, cofactor, prosthetic group and their examples. Concept of ribozyme, multiple forms, isozyme and abzymes.

Paper-II: Bioinstrumentation, Biostatics and Bioinformatics

Unit - I

Microscopy- Light, phase contrast, fluorescence and electron microscopy

Centrifugation technique. Principle, types and separation of biological molecules.

Unit - II

Chromatography and electrophoresis: Chromatography: principle and applications (Ion exchange and affinity chromatography), Principle and application of electrophoresis. Agarose gel electrophoresis, Immunoelectrophoresis, Blotting: Southern, Western and Northern blotting.

Unit - III

Colorimetery, Spectrophotometry (UV and visible), Radio and Non radiolabeling, Autoradiography

Unit - IV

Biostatics- Introduction, Scope, Application and use of statics collection and classification of data summarization and presentation of data. Arithmetic mean, median, mode and standard deviation. Probability, definition. Random variable and its distribution. Binomial probability distribution.

Unit - V

Computers: General introduction (Characteristics, capabilities, generations) hardware: organization of hardware (input devices, memory, control unit, Arithmetic Logic Unit. output devices); software; (System software; application software, languages- low level, high level), internet application.

Basic Bioinformatics: Introduction to internet, search engines (Google Yahoo, Entrez etc.)

Biological databases: sequence databases (EMBL, GenBank, DDBJ, UNIPORT. PIR, TREMBL), Protein family/domain databases (PROSITE, PRINTS, foam, BLOCK, Etc.)

Cluster databases -An Introduction, specialized database (KEGG Etc.) Database Technologies (flat-file), structure databases (PDB)

List of Practicals

1. Principle and working knowledge of instruments like colorimeter, pH meter. Centrifuge. Spectrophotometer, microscope etc.
2. Qualitative analysis of Carbohydrates, proteins and lipids.
3. Quantity estimation of proteins by Folin-Lowry method.
4. Quantitative estimation of sugar by Nelson smogyi's method.
5. Determination of enzyme activity by amylase.
6. Study the effect of pH on enzyme activity.
7. Study the effect of temperature on enzyme activity.
8. Separation of amino acid by TLC
9. Separation of leaf pigment by paper chromatography.
10. Estimation of hemoglobin.
11. RBC count by haemocytometer.
12. WBC counting by differential or total cell count.
13. Measurement of bleeding and clotting time.
14. Measurement of Hemingway crystals.
15. Estimation of Beta carotene in carrots.
16. Estimation of ascorbic acid in lemon juice.
17. Determination of iodine number of fat samples.
18. Determination of phosphorus content in plant material (Colorimetric method).
19. Computer input and output device.
20. Prepare a mark sheet of your class subjects.
21. Design of your class timetable.
22. To repair a bar chart, pie chart for analysis of election results.
23. Exercise based on PowerPoint presentation.
24. Design a presentation illustrating insertion of pictures, word art and Clipart.
25. Use MS Word to insert a table into document.
26. Problem based on Mean, Median, Mode.
27. Hardy Weinberg law applied on population genetics.
28. Problem based on probability.
29. Exercises on standard deviation
30. Biological data resources and data retrieval.
31. Introduction to NCBI

32. Retrieving DNA sequence from Genbank and analyzing various formats of data stored.
33. Analyzing protein sequences.
34. Analyzing DNA sequence.

Practical Scheme for Final Examination

B.Sc. II Year

Time: 3 Hours	**M. Marks: 50**
1. Major	10
2. Major	10
3. Minor	05
4. Spotting	10
5 - Minor	05
6. Viva voice	05
7. Practical record	05

Suggested Reading

1. A text book of Bioinformatics by Sharma & Munjal& Shankar.
2. Bioinformatics by CSV Murthy
3. Basic Bioinformatics by S.Ignacimuthu, S.J
4. Bioinformatics: Concepts, Skills and Application By S.C. Rastogi, N Mendiratta & Parag Rastogi
5. Practical Guide for basic Bioinformatics & Biostatistics By P. Tiwari Pandey
6. Biostatistics by B. Prasad
7. Statistical Methods By S.P. Gupta
8. Fundamentals of Statistics By S.C. Gupta
9. Biostatistics by P.N.Arora
10. Principles of Biochemistry, Lehninger
11. Fundamentals of Biochemistry, J.L. Jain
12. Biochemistry, Voet and Voet.
13. Textbook of Biochemistry - S.P. Singh.
14. Biophysics : Mohan P. Arora
15. Biophysics : Pattabh & Gautham
16. Biochemistry:A.C. Deb
17. Biomolecule:Mohan P.Arora
18. Principles of Biochemistry (2005), Nelson & Cox

BSc III Year

Paper-l: Molecular Biology and Genetic Engineering

Unit-1

DNA and RNA, Chemical Structure, Types and Properties, Experimental Proof of DNA as genetic material, Genome-- Concept. Plant, Animal. Bacterial and Viral Genome, DNA Replication. Types, Experimental proof of semi conservative replication. Replicon- Concept, proteins and enzymes involved in replication in prokaryotes and eukaryotes, Modes of DNA replication. Unidirectional, Bidirectional, Types of DNA replication, Y shaped, θ mode, rolling circle mechanism.

Unit-II

Eukaryotic chromosomal organization, Euchromatin, Heterochromatin, chromatin structure, nucleosomes, histone and non-histone proteins, Histone modifications. Introduction to epigenetics.

Unit-III

Origin of life: Classical experiments and current concepts. Evolution of biological macromolecules, Evolution of early forms. Mendelian genetics: Mendel's law, Chromosomal basis of heredity, Chromosomal analysis. Allelic variation, dominance. Linkage and crossing over.

Unit-IV

Introduction to Recombinant DNA technology, Scope & importance. Gene cloning. PCR. Introduction to Restriction endonuclease, Vectors for DNA transfer and their types: Plasmids, Phagemids, Cosmids, BAC, Gene amplification.

UNIT-V

Plasmids: Types Properties and cloning vectors. Recombinant DNA techniques and cloning with Restriction endonuclease, and recombinant DNA. Mutation, Types of mutations; Point mutation (Base pair change-frame shift, deletion). Transcription, translation and gene expression in eukaryotes (yeast), Alternate splicing.

Paper-II: Applied Biotechnology

Unit 1: Microbial Biotechnology

Food Microbiology-Microbial contamination & Spoilage. Food preservation. Industrial Production of Ethyl Alcohol. Penicillin. Cyanocobalamin, Glutamic Acid, Citric Acid. Amylase. Protease.

Unit-Il: Plant Biotechnology-

Introduction to plant tissue culture, Nutritional requirements. In vitro culture. Single cell culture, Anther culture, Ovule culture. Somatic embryogenesis. Organogenesis, Protoplast culture. Somatic hybridization. Genetic manipulation of plants using Agrobacterium tumefaciens.

Unit-Ill: Immunology and Animal Biotechnology

Immunity- Innate and Acquired, Host defense mechanism- Infection and its types, Organs and Cells of Immune system, Vaccines and its types. Antigens- Properties and types, Adjuvants.

Immunoglobulins-Structure types and functions. Generation of Antibodies, Primary and Secondary response, Agglutination and Precipitation reactions,

History, Equipment and materials for animal cell culture technology. Physical requirement for animal cell and their growth curve in culture-

Commonly used cell lines — their organization and characteristics, Differentiation of cells. Organ culture — techniques, advantage and applications.

Applications of animal biotechnology- Methods of Transfection and cell fusion of animal cells, selectable markers. HAT selection, Transgenic animals. Stem cell culture. Transplantation of cultured cells, Bioreactors for large scale production of animal cells.

Unit-IV: Fermentation Technology

Fermentation Technology, Primary and Secondary Screening, Strain Improvement, Inoculum Development, Industrial Sterilisation process, Scale-up and Harvest and Recovery.Types of fermentation — batch, continuous, fed batch process: Submerged and Solid State fermentation process, Basic design or a fermentor and factors affecting fermentor design. Types of fermentors- Fluidized, Packed Bed, Air lift Fermentor, Tray Fermentor and Tower Fermentor,

Unit-V: Environment Biotechnology

Environment: Basic concept, Significance, Public awareness, Environmental pollution, Assessment of water quality, Treatment of waste-water - Primary, secondary and tertiary treatment. Solid waste management (composting, vermi-composting, methane production).

Biopesticides- Bacterial and Fungal, Genetically modified crops, Biofertilizers -Nitrogen fixers, PSB,Mycorrhiza and VAM, Microbial leaching, Microbial Enhanced Oil Recovery. Bioremediation and Biodeterioration. Modern fuels- Methanogenic bacteria and biogas, microbial hydrogen production.

KT-303 Laboratory

List of Practicals

1. Chromosomal DNA isolation from Plant cells.
2. Chromosomal DNA isolation from Animal cells.
3. Genomic DNA isolation from Micro-Organisms.
4. Analysis of isolated DNA by Agarose gel electrophoresis.
5. Spectrophotometric analysis of DNA and DNA melting.
6. UV as a physical mutagen.
7. Gradient Plate Technique.
8. Estimation of DNA using diphenylamine method.
9. Estimation of RNA using orcinol method.
10. Isolation of RNA from Yeast.
11. Isolation of plasmid DNA from bacteria.
12. Effect of UV radiation on microbial cell.
13. Demonstration of repair mechanism in microbes.
14. Bacteriophage and determination of latent period of infection
15. Isolation of total RNA from Plant tissue by SDS phenol method,
16. Elution of DNA from agarose gel band.
17. Transformation in E-coli cell.
18. Growth of plant tissue into undifferentiated mass of callus.
19. Preparation of animal cell culture media.
20. Separation and culture of lymphocyte from blood.
21. Demonstration of fermentor.
22. Preparation of wine.
23. Extraction of citric acid from Aspergillus.
24. Production of ethanol by yeast.
25. Demonstration of PCR.

26. Immobilization of microbial cells.

27. Extraction and preparation of lactic acid.

28. Extraction and preparation of-citric acid.

29. Demonstration of Radial immuno diffusion analysis.

30. Isolation of microorganism from polluted site/ industrial waste.

31. Blood group analysis.

32. Differential count of WBC.

33. To examine flocculation reaction using VDRL test.

34. To observe the agglutination reaction using WIDAL test

35. Determine the concentration of unknown antigen using Radial immune Diffusion technique.

Note- 70% of the above list should be compulsorily performed.

Scheme of Practical

Examination MM: 50 **Duration: 3 Hours**

1. Major (10)
2. Major (10)
3. Minor (5)
4. Minor (5)
5. Spotting (10)
6. Viva- Voce (05)
7. Practical Record (05)

Suggested Reading

1. Industrial Microbiology by A.H.Patel
2. Microbial Biotechnology by Hazarre
3. Molecular biology: Avinash & Kakoli Upadhyay
4. Gene Biotechnology: Jogdand
5. Essential of Biotechnology: S.N.Das
6. Text book of Biotechnology: R.C.Dubey
7. Biotechnology & genomics: P.K. Gupta
8. Modern concept of Biotech: H.D.Menon
9. Problems of genetics, Molecular genetics & evolutionary genetics: Pranobh K. Banerjee
10. Fundamentals of Microbiology & Immunology: Banerjee& Banerjee
11. Immunology: Rao
12. Biotechnology & Genomics: P.K.Gupta
13. Biotechnology: Satyanarayan
14. Plant tissue culture: Bhojwani
15. Introduction to plant tissue culture:Razadan lb.
16. Introduction to Biotech: Chawla
17. Animal Biotechnology: Srivastava, Singh& Yaday.
18. Text book of Animal Biotechnology, Ramdas and Mecraya,
19. Biotechnology Animal cell, Satish M.K.
20. Animal Biotechnology, Ranga M.M.
21. Text Book of Biotechnology. B.D. Singh. Culture of Animal cell, Freshney.
22. Plant Biotechnology, Jitendra Parkash.
23. Biotechnology in plant science. Kumar N C.
24. Environmental Biotechnology Agrawal S.K.