

B.Sc Biotechnology Syllabus

RANI DURGA VATI 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 of prokaryotic cell, Eubacteria and Archaeobacteria, Size, Shape and arrangement of bacterial cells, Gram's positive and Gram's negative cells.

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

UNIT II

Structure and function of bacterial cells- flagella, pili, Cell wall, cytoplasmic membrane, nuclear region, mesosomes, ribosomes, vacuoles, metachromatic granules, spores and cysts.

Structure and function of eukaryotic cell- Cell wall, cell membrane, mitochondria, chloroplast, endoplasmic reticulum, Golgi bodies, nucleus, cytoskeleton, microbodies, Centriole, Lysosomes.

UNIT III

Cell cycle and cell division- mitosis, meiosis, Anomalies in cell division and associated disease.

Cell synchrony, Cell-cell interactions, 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. Archaeobacteria. Structure and function of cell organelles.

UNIT- III:

Structure and Diversity of Algae, Fungi, Protozoans, Mycoplasmas and Extremophiles. 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 haemocytometer
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.

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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

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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, Biostatistics 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, Principle and application of electrophoresis. Agarose gel electrophoresis, Immunoelectrophoresis, Blotting: Southern, Western and Northern blotting.

Unit - III

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

Unit - IV

Biostatistics- Introduction, Scope, Application and use of statistics collection and classification of data summarization and presentation of data. Arithmetic mean, median, 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, UNIPROT. PIR, TREMBL), Protein family/domain databases (PROSITE, PRINTS, Pfam, BLOCK, Etc.)

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

List of Practicals

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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.

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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. Biomolecules: Mohan P. Arora
18. Principles of Biochemistry (2005), Nelson & Cox

**B.Sc. FIFTH SEMESTER
BIOTECHNOLOGY
Paper-Genetics & Genetic Engineering**

(MM Theory 85 + CCE 15)

UNIT I

Genetic Material

Different forms of DNA(DNA topology):- B-form, Z-form, D-form; Gene structure-introns,exons and pseudogenes: Supercoiling of DNA, Melting curve of DNA and T_m value determination;

Buoyant density of DNA and its relationship with mole (G+C) content in DNA; Types of RNA: mRNA, rRNA, tRNA;

UNIT II

DNA Replication

Types of DNA replication: Conservative, Semi-conservative and Dispersive mode of replication; Mechanism of replication, Messelson and Stahl experiment; Enzymes involved in replication of DNA;

Replication of DNA in prokaryotes and eukaryotes, Models of chromosomal replication- Cairns model,Rolling Circle model.

UNIT III

Transcription, Translation and Gene regulation

The Relationship between genes and protein (Central Dogma)

The Transcription in Prokaryotic Cells: The basic process of Transcription, mRNA Processing (Post Transcriptional modification).

Translation to protein – Role of ribosome in protein synthesis, process of translation in prokaryotic cells.

The Genetic Code and its basic features, Wobble Hypothesis.

Regulation of Protein Synthesis: Lac Operon, **Trp Operon**.

UNIT IV

DNA mutation and repair

Types of mutation; evidence of spontaneous nature of mutation: Luria and Delbruck fluctuation test and replica testing; mode of action of physical, chemical and biological mutagens-UV rays, nitrous acid, 5-bromouracil, 2-aminopurin, EMS. Reversion in mutation, suppression and types of suppressor mutation; DNA repair mechanism, Photo reactivation, Excision, Mismatch, SOS repair.

UNIT V

Genetic engineering

Recombinant DNA Technology- Definition, principle, Molecular tools of genetic engineering: Cutting and joining of DNA, Cloning Vectors, Techniques of genetic engineering, Gene librarygenomic library and cDNA library. Application of PCR technology (Diagnosis of pathogen, DNA fingerprinting.) Basics of Site Directed mutagenesis and protein engineering.

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List of Practicals (MM: 50)

1. Demonstration on isolation of DNA.
2. Demonstration of agarose gel electrophoresis.
3. To study qualitative estimation of DNA by gel electrophoresis.
4. Quantitative estimation of DNA by DPA method.
5. Quantitative estimation of RNA by Orcinol method.
6. To study conjugation in bacteria.
7. To transfer bacterial colonies by replica plating method.
8. Effect of UV light on growth of bacteria.
9. Effect of mutagen on the growth of bacteria.
10. To study antibiotic resistance in bacteria.
11. To study the photoreactivation repair mechanism of mutation.
12. Problems on microbial genetics.

List of recommended books:

1. Biotechnology, Author- U. Satyanarayan, 2007, Books and Allied Pvt. Ltd.
2. Biotechnology, Author- B.D.Singh, 2010, Kalyani Publishers.
3. Biotechnology, Authors- R.C.Dubey, 2006, S.Chand& Company.
4. Principles of Biochemistry, Author- A.L. Lehniger
5. Fundamentals of Biochemistry, Author- J. L. Jain
6. Biochemistry, Author- Voet and Voet.
7. Microbial Genetics, Authors- Freifelder.
8. Textbook of Microbiology, Authors- Dubey and Maheshwari.
9. Powar C. B. and G. R. Chatwal (1994). Biochemistry, 3rd Edition; Himalaya Publishing House, New Delhi.
10. Powar C. B. and H. F. Dagainawala (2003). General Microbiology Vol.I; Himalaya Publishing House

Practical Scheme for Final Examination

B.Sc. V Semester

Time : 3 Hours

M.Marks : 50

1. Electrophoresis of DNA	10
2. Quantitative estimation of DNA/RNA	10
3. Effect of UV/Mutagen on growth of bacteria	05
4. Spotting	10
5. Numerical Problems	05
6. Sessionals	05
7. Viva	05
Total	50

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B.Sc. SIXTH SEMESTER BIOTECHNOLOGY Paper-Biotechnology and Applications

(MM Theory 85 + CCE 15)

UNIT I

Environmental Biotechnology

Microbial interaction: Neutralism, Commensalism, Synergism. Liquid waste disposal, characteristics of solid and liquid waste; Sewage treatment: Primary, Secondary and tertiary treatment. Bioremediation- Definition, principle and types, Biodegradation of Xenobiotics definition and mechanism.

UNIT II

Plant/Agriculture Biotechnology

Plant tissue culture- History and scope, preparation and sterilization, terms used in tissue culture, plant tissue culture media. Types of culture, basic technique of plant tissue culture:-Organ Culture; An introduction to transgenic plants- definition, gene transfer methods, Agrobacterium mediated gene transfer. General idea of IPR ,Definition, Benefits, Drawbacks, requirements for IPR, Patents, filing of Patent, Patenting of life forms, Development of Plant Variety, Role of NBPGR New Delhi in registering plant variety, Types and trial prior to register variety.

Animal Biotechnology-Animal cell culture- fundamentals, Organ culture-Technique, advantages, limitations. An introduction to transgenic animals:-Nude mice, pig and cattle

UNIT III Immunology- Immune system:, organization of immune system, cells and organs of immune system, Immunoglobulins-Their types and properties and structure, Complement System.

Antigen - Antibody reactions - Zone phenomenon (Lattice hypothesis); Precipitation test: Principle and applications of Radial immunodiffusion, Double immunodiffusion and Radioimmunoassay (RIA)., Agglutination: Bacterial agglutination, passive agglutination, Hemagglutination, , Agglutination inhibition and Complement Fixation.

UNIT IV

Industrial Microbiology

Fermentation- Definition, equipments and production process; Industrial production of alcohol and acetic acid.Microbes as source of microbial and single cell proteins (SCP) and its production and applications.

Basics of Food Spoilage and preservation- **General principle, preservation by use of high temperature, low temperature, drying and radiation. .**

Medical Biotechnology

Gene therapy: Definition, approaches, Recombinant vaccines- definition, Monoclonal antibodiesPrinciple, hybridoma technology.

UNIT V

Biostatistics and bioinformatics

Measurement of Central Tendencies- Mean, Mode, Median, Standard Deviation, Probability.

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Introduction to bioinformatics- Basic idea of Biological Databases wsr Nucleic Acid Data Base and Protein Database; Software in Bioinformatics:- BLAST & FASTA; Data retrieval tools – ENTREZ, PubMed, Taxonomy Browsers.

List of Practicals (MM: 50)

1. Sterilization of plant material: surface sterilization
2. Preparation of tissue culture media
3. To study the formation of callus from explants/embryo culture
4. To study the concentration of DO (Dissolved oxygen) in sewage sample
5. To study the concentration of BOD (Biological Dissolved oxygen) in sewage sample
6. Blood collection and plasma/serum separation.
7. Blood grouping – Rh typing – cross matching.
8. Estimation of hemoglobin content of human blood
9. Estimation of total leukocyte count of human blood
10. Estimation of deferential leukocyte count of human blood
11. Exercise on Outcherlony Double Diffusion.
12. Exercise on Radial Immunoassay.
13. Problems in biostatistics.
14. Exercise on SDS-PAGE

List of recommended books:

1. Biotechnology, Author- U. Satyanarayan, 2007, Books and Allied Pvt. Ltd.
2. Biotechnology, Author- B.D.Singh, 2010, Kalyani Publishers.
3. Biotechnology, Authors- R.C.Dubey, 2006, S.Chand& Company.
4. Soil microbiology by SubbaRao
5. Food microbiology by James M.J
6. Diary microbiology by Parihar and Parihar
7. Introductory food microbiology by H.A Modi.
8. Soil and microbes by Waksman and Starkey.
9. Plant pathology by Mehrotra.
10. Food Microbiology by Frazier.
11. Industrial Microbiology by A.H Patel.

Practical Scheme for Final Examination

B.Sc. VI Semester

Time : 3 Hours

M.Marks : 50

1. Blood Grouping	05
2. Perform inoculation of Plant tissue	10
3. Calculate DO (Dissolve Oxygen) in sewage sample	10
4. Problems in biostatistics	05
5. Spotting	10
6. Sessionals	05
7. Viva	05
Total	50