

**B.Sc. I YEAR (BIOTECHNOLOGY)**  
**Semester I**  
**Paper I: Biochemistry and Analytical Techniques**  
**MM: 85**  
**Session 2011-12**

**Unit I**

Carbohydrates: Introduction and biological importance.

Structure and properties of - Aldose, Ketose; open chain and ring structure pyranose and furanose, Monosaccharide sugars (glyceraldehydes, Di hydroxy acetone, erythrose, ribose, glucose, fructose, concept of reducing and non reducing sugars), Disaccharide (maltose, sucrose, lactose), Oligosaccharide (raffinose) and Polysaccharide (starch, amylose and amylopectin, glycogen, peptidoglycan, cellulose, proteoglycan matrix)

Lipids: Introduction, Classes, Fatty acids [saturated, unsaturated, branched, even chain and odd chain, essential fatty acids, Physical properties, Chemical properties, Saponification value, acid value, iodine number, rancidity]. Structure and function of phospholipids, Sphingolipids and cholesterol.

**Unit II**

Amino acids: Structural and nutritional classification, properties of amino acids. Acid base behavior, Zwitterions, Color reaction of amino acids (Ninhydrin test).

Protein structure: Peptide bond, outline of primary, secondary, tertiary and quaternary structure of proteins and their examples. Structural and functional proteins. Forces stabilizing secondary, tertiary and quaternary structure with examples.

**Unit III**

Enzymes: Outlines of enzyme classification. Active site, energy of activation, transition state hypothesis, lock and key hypothesis, induced fit hypothesis. Concept of  $K_m$ , Michaelis Menten equation. Enzyme activation, various types 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, isozymes and abzymes.

Watson Crick model of DNA structure. Types of DNA (A, B, Z and differences in their structure and occurrence) and RNA (hn RNA, m RNA, r RNA, t RNA).

**Unit IV**

Light Microscopy and Electron microscopy.

Colorimetry and UV- Visible Spectrophotometry,

Electrophoresis Techniques and applications: Agar gel, Starch gel, PAGE (native and denature) and Agarose gel electrophoresis.

**Unit V**

Concept and types of Chromatography; Paper chromatography, Thin layer chromatography, Gas chromatography, Gel filtration chromatography, Ion exchange chromatography, Affinity chromatography and HPLC.

## **EXPERIMENTS**

1. Principles and working knowledge of instruments like Colorimeter, pH meter, Centrifuge, Spectrophotometer, Microscope etc.
2. Qualitative analysis of Carbohydrates, Proteins and Lipids.
3. Quantitative estimation of Protein by Folin-Lowry unitary method.
4. Quantitative estimation of sugar by Nelson Somogy's unitary method.
5. Quantitative estimation of sugar by DNS method.
6. Analyzing the enzyme activity.
7. Study the effect of pH on enzyme activity.
8. Study the effect of temperature on enzyme activity.

## **EXAMINATION SCHEME**

- |  |      |
|--|------|
| 1. Quantitative analysis of by Proteins /Carbohydrates by unitary method | (12) |
| 2. Qualitative detection of carbohydrates, proteins and lipids. .        | (10) |
| 3. Study the effect of pH/temperature on enzyme activity.                | (10) |
| 4. Spotting  | (08) |
| 5. Viva- Voce  | (05) |
| 6. Practical Record  | (05) |

## **RECOMMENDED BOOKS**

1. Principles of Biochemistry, Author- 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. Principles of Biochemistry, Authors – Zubey, Parson and Vance.
8. Experiments in Biotechnology, Nighojkar and Nighojkar.

**B.Sc. I YEAR (BIOTECHNOLOGY)**  
**Semester II**  
**Paper II: Cell Biology & Metabolism**

**Session 2011-12**

**MM: 85**

**Unit I**

Discovery of Cell and Cell Theory; Cell, tissue, organ and organism and different levels of organization of otherwise genetically similar cells.

Comparison of prokaryotic and eukaryotic cells.

Cell division and Cell cycle. Anomalies in Cell Division.

**Unit II**

Cell synchrony and its applications.

Cell-cell interactions. Cell Signaling.

Cell locomotion.

Cell senescence and death.

Cell differentiation.

**Unit III**

Structure and function of prokaryotic and eukaryotic Cell wall and Plasma membrane;

Modification of plasma membrane and intracellular junctions; Cytoskeleton; Protoplasm;

Mitochondria; Chloroplast; ER; Golgi complex; Lysosome, Endosome and Microbodies; Ribosome; Centriole;

Nucleus; Chemical components of a cell.

**Unit IV**

Carbohydrate Metabolism – Aerobic & Anaerobic glycolysis, sequence of reactions in glycolysis, regulation in glycolysis, citric acid cycle, glycogenesis, glycogenolysis, Pentose-phosphate pathway, Oxidative Phosphorylation and ETC.

**Unit V**

Amino acid Metabolism – Amino acid breakdown (transamination, deamination, Urea cycle) diseases associated with defects in amino acid metabolism. Biosynthesis of essential & non-essential amino acids.

Lipid Metabolism – beta oxidation of saturated fatty acids, oxidation of unsaturated fatty acids, oxidation of odd chain fatty acids, energy yield, ketone bodies.

## **EXPERIMENTS**

- 1 To study the plant cell structure using various plant material.
- 2 Study the different stages of mitosis and meiosis.
- 3 Study of permanent slides like cell division, prokaryotic and eukaryotic cells, Muscles and Nerve cells, T.S. of stomatal cells
- 4 To study the animal cell structure using cheek cells.
- 5 Isolation of starch from potato.
- 6 Histochemical localization of lignin.
- 7 Observe various stages of mitosis in onion root tip.
- 8 Separation of amino acids by thin layer chromatography.

### **Scheme of Practical Examination**

1. Observe different stages of mitosis in the given sample.	12
2. Study of plant/animal cell structure.	10
3. Perform thin layer chromatography for the given sample.	10
4. Spotting	08
5. Viva.	05
6. Practical Record.	05

### **RECOMMENDED BOOKS**

1. Molecular biology of the cell, Alberts.
2. Molecular cell biology, Lodish Scientific American Books, Inc.
3. Cell in Development and Inheritance, EB Wilson.
4. Cell Biology, P.S. Verma and Agrawal.
5. Experiments in Biotechnology, Nighojkar and Nighojkar.

**B.Sc. II YEAR (BIOTECHNOLOGY)**

**Semester III**

**Paper: Molecular Biology**

**Maximum Marks: 85**

**Session 2012-13**

**Unit I**

DNA as the genetic material, organisation of Genomes-viral, Bacterial, organelles human.

DNA replication-experimental proof of semi conservative nature.

DNA replication in prokaryotes and eukaryotes (mechanism, accessory proteins and enzymes involved in replication).

Unidirectional and bidirectional mode of DNA replication, rolling circle mechanism.

**Unit II**

Eukaryotic genomes: Chromosomal organization and structure.

Euchromatin, heterochromatin, centromere, telomere. Chromatin structure (nucleosomes)- histone, non-histone proteins.

Definition of gene – introns/exons, Regulatory sequences, promoters, enhancers.

**Unit III**

Structure of Prokaryotic gene.

Prokaryotic transcription and regulation.

Eukaryotic transcription, transcription factors and regulation.

Post – transcriptional modifications- 5'-cap formation, 3'-end processing, polyadenylation and gene splicing.

**Unit IV**

Translation in Prokaryotes and Eukaryotes – Mechanism of initiation, elongation and termination.

Co and Post Translational modifications.

Regulation of gene expression in prokaryotes.

Induction and repression.

Operon model (*lac*, *his*, *ara* and *trp* operon), catabolite repression.

**Unit V**

DNA damage and repair, mutations.

Genetic code, Protein synthesis.

Post-translational modifications and transport of proteins.

Insertion elements and transposons. IS elements, Tn3 family, Yeast TY elements and P Extra chromosomal DNA in Prokaryotes-Plasmids.

### **RECOMMENDED BOOKS**

1. Benjamin Lewin, Gene IX, 9<sup>th</sup> Edition, Jones and Barlett Publishers, 2007.
2. J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Seitz & A.M. Weiner; Molecular Biology of the Gene, 6<sup>th</sup> Edition, Benjamin Cummings Publishing Company Inc, 2007.
3. Alberts et al; Molecular Biology of the Cell, 4<sup>th</sup> edition, Garland, 2002.
4. Glick BR & Pasternak JJ, Molecular Biotechnology, 3<sup>rd</sup> Edition, ASM Press, 1998.
5. Molecular Cell Biology, Authors-Lodish, Berk and Zippursky.
6. Gene Cloning, Author- T.A. Brown.
7. Nighojkar and Nighojkar, Experiments in Biotechnology.

### **SEMESTER III – EXPERIMENTS**

1. Chromosomal DNA isolation from Plant cells.
2. Chromosomal DNA isolation from Animal cells.
3. Genomic DNA isolation from Micro-Organisms.
4. DNA estimation by Diphenyl Amine method.
5. RNA estimation by Orcinol Method.
6. Plasmid isolation from Micro-Organism.
7. Analysis of isolated DNA by Agarose gel electrophoresis.
8. Screening of Antibiotic producing microorganism.

### **Scheme of Practical Examination (2 days minimum 3 hrs each day)**

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|--|----|
| 1. Isolation of DNA from Plant/Animal/Microbial source.  | 12 |
| 2. Microbiological assay of antibiotics/Minimum inhibitory concentration of antibiotics/Estimation of DNA. | 10 |
| 3. RNA estimation by Orcinol Method.   | 10 |
| 4. Spotting.   | 08 |
| 5. Viva.   | 05 |
| 6. Practical Record.   | 05 |

**B.Sc. II YEAR (BIOTECHNOLOGY)**

**Semester IV**

**Paper: Microbial Biotechnology**

**Maximum Marks: 85**

**Session 2012-13**

**Unit I**

Microbial Biotechnology – Historical perspectives.

Basic nutrition & metabolism. Novel pathways of Microorganisms.

Bacterial Nutrition-

Nutritional classes of microorganisms, Extremophiles.

Microbiological media and its types. Different methods of Cultivation of Microorganisms.

Control of Microorganisms.

**Unit II**

Microbial growth kinetics continuous culture, Batch fed culture, Cell constituents, quantification of growth, Thermodynamics of Growth, YATP,  $Y_{x/s}$ ,  $Y_{O_2}$  Effect of different factors on growth study of growth with respect to product formation.

Fermentation concept and types.

Sterilization, Disinfection, Sanitation, Pasteurization.

Physical and chemical methods of control, Phenol co-efficient.

**Unit III**

Microbial strain improvement, Bacterial genetics: Operon concept with examples(lac, tryptophan, arabinose).

Gene mapping-Transformation, conjugation & transduction.

Microbial & Viral diseases, Normal flora of the body.

Infection of different systems.

Chemotherapy – use of antibiotics, antiviral agents.

**Unit IV**

Food & Dairy Microbiology. Microbial flora.

Microbial spoilage, Preservation Microbes as single cell proteins, food borne Diseases, Microbial Analysis of food, Quality control, Food Hygiene.

## Unit V

Treatment schemes of Waste water. Assessment of waste water (water potability), Sewage treatment plants Aerobic & anaerobic treatment processes.

Integration of genetic engineering & applied microbiology.

Uses of genetically engineered microbes in Agriculture, Industries, Medicine.

### RECOMMENDED BOOKS

1. Text book of Microbiology, Prescott.
2. Physical Biochemistry, D Freifelder.
3. Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work.
4. Tools of Biochemistry, T. G. Cooper.
5. General Microbiology - Stanier
6. Food Microbiology –Frazier
7. Principles of Fermentation Technology - Whitaker, A. 2<sup>nd</sup> edition
8. Microbiology, Authors- Pelczar, Chan and Kreig.
9. Experiments in Biotechnology, Nighojkar and Nighojkar.
10. General Microbiology, Authors- Stainer, Ingraham, Wheelis and Painter.
11. Fundamental Principles of Bacteriology, Author- A.J. Salle.
12. Introduction to Microbiology, Authors- Ingraham and Ingraham.
13. Elementary Microbiology, Author- H. A. Modi
14. Textbook of Microbiology, Authors- Dubey and Maheshwari.
15. Microbiology, A Practical Approach. Authors- Patel and Phanse
16. General Microbiology, Authors- Powar and Dagainawala.
17. Microbiology, Author- S.S. Purohit.
18. Microbiology, Author- R.P.Singh.
19. Microbial Biotechnology, Hazarre.

### SEMESTER IV - EXPERIMENTS

1. Principles and working knowledge of instruments like Autoclave, Laminar Air Flow, Hot Air Oven, Colony Counter etc.
2. Isolation of Micro-organism by Sector plate method.
3. Cultivation of Micro-organism by pour plate method.
4. Techniques for the Cultivation of Anaerobic Microorganisms.
5. Determine the generation time of a bacterial culture from the bacterial growth curve.
6. Qualitative and Quantitative microbiological analysis of sewage water.
7. Estimation of soil microflora.
8. Analysis of air microflora.
9. Isolation of *Rhizobium* from root nodules.
10. Determination of quality of a milk sample by methylene blue reductase test.
11. Microbiological analysis of food products.
12. Detection of bacteria in spoiled tinned food.

### Scheme of Practical Examination (2 days minimum 3hrs each day)

- |   |    |
|---|----|
| 1. Isolation of microorganism by sector plate/pour plate technique        | 12 |
| 2. Qualitative and Quantitative microbiological analysis of sewage water. | 10 |



3. Determination of quality of a milk sample by methylene blue reductase test.	10
4. Spotting	08
5. Viva.	05
6. Practical Record.	05

## **B.Sc. III YEAR (BIOTECHNOLOGY)**

### **Semester V**

#### **Paper: Immunology and Animal Biotechnology**

**Maximum Marks: 85**

#### **Session 2013-14**

##### **Unit I**

Normal flora of Human body.

Infection and its types.

Mechanism of pathogenesis.

Organs of Immune system- Spleen, Thymus, Lymph nodes

Cells of Immune system- T cells- its types and receptors, B cells and its receptors.

Immunity- Innate and Acquired, Humoral and cell-mediated immunity.

Host defense mechanism- First, Second and Third Line of Host Defense.

Primary and Secondary response.

##### **Unit II**

Antigens- Properties and types, Adjuvants.

Immunoglobulins- Structure, types and functions.

Generation of Antibodies.

Agglutination and Precipitation reactions.

Hemagglutination and Passive Hamagglutination, Immunofluorescence, ELISA, RIA, Coombs test (Direct and Indirect), Latex agglutination, ODD and RID.

##### **Unit III**

Structure and organisation of animal cell.

Equipment and materials for animal cell culture Technology.

History and development of cell culture.

Culture media for animal cell culture – BSS, Serum containing and serum free media

Growth factors – EGF, ECF, PDGF, IL-1, IL-2, NGF and Erythropoitin.

##### **Unit IV**

Physical requirements for growing animal cells in culture.

Initiation of cell culture.

Isolation and disaggregation of explants.  
Development of primary culture.  
Commonly used cell lines – their organization and characteristics.  
Growth curve of animal cell in culture.  
Differentiation of cells.  
Organ culture – techniques, advantage and applications.

## **Unit V**

Methods of Transfection of animal cells.  
Methods of cell fusion.  
Selectable markers, HAT selection.  
Transgenic animals, Stem cell culture.  
Transplantation of cultured cells.  
Bioreactors for large scale production of animal cells.  
Design and Types of Bioreactors.

## **RECOMMENDED BOOKS**

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. Cell Biology and Genetics, P.S. Verma and Agrawal.
7. Text of Microbiology, Authors- Ananthanarayanan and Paniker.
8. Immunology, Author- J. Kuby.
9. Nighojkar and Nighojkar, Experiments in Biotechnology.
10. Fundamental Immunology, Author– W.E. Paul.
11. Fundamentals of Immunology, Authors– Coleman, Lombord and Sicard.
12. Immunology – Weir and Steward.
13. Immunology, A. Textbook, Author- C.V. Rao.
14. Lecture Notes in Immunology, Author- I.R.Todd.
15. Text book of Animal Biotechnology, Ramdas and Mecraya,
16. Biotechnology Animal cell, Satish M.K.
17. Animal Biotechnology, Ranga M.M.
18. Animal Biotechnology, Shashidhara R.
19. Text Book of Biotechnology, B.D. Singh. Culture of Animal cell, Freshney.

## **SEMESTER V - EXPERIMENTS**

1. UV as physical mutagen.
2. Gradient plate technique.
3. Antibiotic sensitivity test.
4. Blood group analysis.
5. Total count of WBC
6. Total count of RBC
7. To perform the differential count of WBC.
8. To examine Flocculation reaction using VDRL test.
9. To observe the agglutination reaction using WIDAL test
10. Determine the concentration of unknown antigen using Radial Immuno Diffusion technique.
11. To determine the antibody antigen reaction by performing ODD technique.
12. Enzyme Linked Immuno Sorbent Assay.

**Scheme of Practical Examination** (2 days minimum 3hrs each day)

1. Perform Immuno Assay- ELISA/ODD/ RID	12
2. Total Count of WBC/RBC/Differential WBC counts.	10
3. UV as a Physical mutagen/ Gradient Plate Techniques	10
4. Spotting	08
5. Viva.	05
6. Practical Record.	05

## **B.Sc. III YEAR (BIOTECHNOLOGY)**

### **Semester VI**

#### **Paper: Plant and Environmental Biotechnology**

**Maximum Marks: 85**

#### **Session 2013-14**

##### **Unit I**

Introduction to and history of plant tissue culture.

MS Media for plant tissue culture.

Use of Growth regulators.

Selection and maintenance of callus.

Single cell culture.

##### **Unit II**

Cytodifferentiation.

Micropropagation.

Organogenesis.

Somatic Embryogenesis.

Synthetic Seed and its application.

Haploid Plants- Anther and Ovary culture.

Production of haploids and their uses.

*In vitro* pollination.

*In vitro* fertilization.

##### **Unit III**

Protoplast isolation, testing of viability, regeneration of protoplast and protoplast fusion.

Markers for selection of hybrid cell.

Practical applications of somatic hybridization, Introduction to Cybrids.

Introduction to transgenic plants.

Genetic manipulation of plants-use of *Agrobacterium tumifaciens* and *A. rhizogenes*.

Transfection methods.

Advantages of Transgenic Plants.

##### **Unit IV**

Conventional fuels-firewood, plant, coal gas, animal oils and environmental impact.

Modern fuels-Methanogenic bacteria and biogas, microbial hydrogen production, gasohol experiment, solar energy.

Plant based petroleum industry.

Cellulose degradation for combustible fuels and their environmental impact.

Microbial leaching of copper and uranium.

Biorecovery of petroleum-MEOR

Bioremediation and Biodeterioration- Petroleum products, leather, textile and paper.

## **Unit V**

Biopesticides- Bacterial and Fungal.

Genetically modified crops containing insecticidal genes.

Biofertilizers-Nitrogen fixers, PSB, Mycorrhiza and VAM.

Biosensors and Biopolymers.

Biochips, Biofilms and Bioplastics.

Microorganisms as Bioindicators.

Biological weapons and bioterrorism.

## **RECOMMENDED BOOKS**

1. Plant Biotechnology, Jitendra Parkash.
2. Biotechnology in plant science. Kumar N C.
3. Trends in Plant tissue culture and biotechnology, Pareek L K
4. Biotechnology in Agriculture, Natesh S.
5. Genetic Engg. and Biotechnology, B.D. Singh.
6. Plant Biotechnology, Slater Scott.
7. Plant Biotechnology, Chawla.
8. Environmental Microbiology, Authors-Majer, Pepper and Gerba.
9. Environmental Microbiology, Authors-P.D. Sharma.
10. Environmental Microbiology, Authors- K.G. Vijaya.
11. Introductory Food Microbiology, Author –H.A. Modi.
12. Microbial Biotechnology, Hazarre.
13. Environmental Biotechnology, Vishista.
14. Text book of Environmental Biotechnology, Mahaptara, Pradeep T.A.
15. Environmental Biotechnology, Agrawal S.K.
16. Text book of Animal Biotechnology, Ramdas and Mecraya.
17. Biotechnology Animal cell, Satish M.K.
18. Animal Biotechnology- Ranga M.M.
19. Animal Biotechnology, Shashidhara R.
20. Text Book of Biotechnology, B.D. Singh. Culture of Animal Cell, Freshney

## **SEMESTER VI – EXPERIMENTS**

1. Introduction to plant tissue culture techniques.
2. Media preparation and sterilization.
3. Various method of surface sterilization of explants.
4. Seed germination in-vitro for aseptic collection of explants.

5. Micropropagation.
6. Callus induction from leaf, stem and roots.
7. Organogenesis.
8. Somatic embryogenesis.
9. Suspension culture propagation and uses.
10. Protoplast isolation and culture.
11. Demonstrate the enzymatic conversion of ammonia to nitrates by soil microorganisms.
12. Isolation of Rhizobium from root nodules.
13. Isolation of Azotobacter from soil.

**Scheme of Practical Examination**

- |   |    |
|---|----|
| 1. Protoplast isolation and culture.                                    | 12 |
| 2. Seed germination / Preparation of synthetic seeds.                   | 10 |
| 3. Another culture (check the viability) /Histological study of callus. | 10 |
| 4. Spotting   | 08 |
| 5. Viva.  | 05 |
| 6. Practical Record.  | 05 |