

## **B.SC., BIOTECHNOLOGY**

### **FIRST YEAR**

| <b>Sl. No.</b> | <b>Papers</b>                              | <b>Max. Marks</b> | <b>Exam Hrs.</b> |
|----------------|--|-------------------|------------------|
| <b>1.</b>      | <b>Hindi I</b>                             | <b>100</b>        | <b>3</b>         |
| <b>2.</b>      | <b>English</b>                             | <b>100</b>        | <b>3</b>         |
| <b>3.</b>      | <b>Cell Biology and Molecular Genetics</b> | <b>100</b>        | <b>3</b>         |
| <b>4.</b>      | <b>Bio-Chemistry</b>                       | <b>100</b>        | <b>3</b>         |
| <b>5.</b>      | <b>Practical 1 : Paper-III</b>             | <b>100</b>        | <b>3</b>         |
| <b>6.</b>      | <b>Practical 2 : Paper-IV</b>              | <b>100</b>        | <b>3</b>         |

### **SECOND YEAR**

| <b>Sl. No.</b> | <b>Papers</b>   | <b>Max. Marks</b> | <b>Exam Hrs.</b> |
|----------------|---|-------------------|------------------|
| <b>1.</b>      | <b>Hindi II</b>   | <b>100</b>        | <b>3</b>         |
| <b>2.</b>      | <b>English</b>  | <b>100</b>        | <b>3</b>         |
| <b>3.</b>      | <b>General Microbiology and Immunology</b>                    | <b>100</b>        | <b>3</b>         |
| <b>4.</b>      | <b>Bio Statistics and Computer<br/>Application in biology</b> | <b>100</b>        | <b>3</b>         |
| <b>5.</b>      | <b>Practical 3 :</b>  | <b>100</b>        | <b>3</b>         |
| <b>6.</b>      | <b>Practical 4 :</b>  | <b>100</b>        | <b>3</b>         |

### **THIRD YEAR**

| <b>Sl. No.</b> | <b>Papers</b>                               | <b>Max. Marks</b> | <b>Exam Hrs.</b> |
|----------------|---|-------------------|------------------|
| <b>1.</b>      | <b>Recombination DNA Technology</b>         | <b>100</b>        | <b>3</b>         |
| <b>2.</b>      | <b>Enzyme and Enzyme Technology</b>         | <b>100</b>        | <b>3</b>         |
| <b>3.</b>      | <b>Plant Bio-Technology</b>                 | <b>100</b>        | <b>3</b>         |
| <b>4.</b>      | <b>Bio-Engineering Technology</b>           | <b>100</b>        | <b>3</b>         |
| <b>5.</b>      | <b>Major Practical (XIII paper XIV)</b>     | <b>100</b>        | <b>3</b>         |
| <b>6.</b>      | <b>Paper XIV Allied Practical IV (paper</b> | <b>100</b>        | <b>3</b>         |

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|--|--------------------|--|--|
|  | <b>XV and XVI)</b> |  |  |
|--|--------------------|--|--|

## **FIRST YEAR**

**Paper – 1**

**HINDI- I**

**Paper – 2**

**ENGLISH PAPER – I**

### **Detailed Text**

#### **PROSE**

1. In Prison – Jawaharlal Nehru
2. What is Science? – George Orwell
3. On Marriages – Nirad Chaudari
4. The Luncheon – N. Somerset Maugham
5. The Mourners – V. S. Naipaul
6. The Plane Crash – Juliane Koepcke
7. Better Late – R.K. Narayan

#### **POETRY**

1. Polonius' Advice to his Son – William Shakespeare
2. Every Town a Home Town - Kaniyan Purkunran
3. The Village Schoolmaster – Oliver Goldsmith
4. The Solitary Reaper – William Wordsworth
5. On his Blindness – John Milton
6. The Tyger – William Blake

### **Non-Detailed**

**Text :** THE GIFTS AND OTHER STORIES abridged and simplified by Anthony Toyne – Oxford University Press, 1997.

The following stories

1. The Gifts – O. Henry

2. The Two Friends – Guy de Maupassant
3. The Bear Hunt – Leo Tolstoy
4. The Goblins and the Grave Digger – Charles Dickens
5. The Nightingale and the Rose – Oscar Wilde

### **GRAMMER**

1. Articles and Prepositions
2. Infinitives and Gerunds
3. Five basic sentence patterns (SV SVC, SVO, SVOO, SVOC(A))
4. Arranging the component parts so as to form a sentence
5. Language work at the end of all lessons
6. Language work at the end of all lessons
7. Question Tag, Active and Passive Voice
8. Degrees of Comparison

### **COMPOSITION**

1. Letter Writing (Formal and Informal)
2. Developing the hints
3. Comprehension
4. Writing Telegram
5. Completion of a passage
6. Precis Writing

## **Paper – 3**

### **CELL BIOLOGY AND MOLECULAR GENETICS**

#### **UNIT – I**

Introduction to Cell Biology – Evolution – classification – Applications – Definition of Cell Biology – its branches – Objectives.

#### **UNIT – II**

Viruses – History – Classification of Viruses – Structure – Nucleic Acid – Viral Chromosomes – DNA – RNA – Life cycle – Mapping of Genes in Phages – Genetic Map of Phage Lambda – RNA phages – Tumor viruses and cancer.

### **UNIT – III**

Genetics – DNA as a genetic material – Nucleic acid structure semi conservative DNA replication – Genetic code – Transcription – Initiation promoter and Enhancers – Elongation – Termination – RNA processing – Proteins Synthesis.

### **UNIT – IV**

Translation – Initiation – Elongation – Termination – Relationship between genes and phenotypes – Mutations and Phenotype – Gene Expression and Phenotype.

### **UNIT – V**

Regulation of Gene Expression – The Lac operon – The trp operon – Transcriptional Gene – Regulation in Eukaryotes – Transposable Elements – Eukaryotic Transposons Corn and Drosophila – Genetics Applications.

## **Paper – 4**

### **BIOCHEMISTRY**

#### **UNIT – I**

Introduction to Biochemistry - Carbohydrates - Monosaccharide, Disaccharides, Polysaccharides, Glycoconjugates- Proteoglycans and Importance, Glycoprotein and Glycolipids - Amino Acids – Fats - Nucleic Acids

#### **UNIT – II**

Introduction to Basic biochemical cycles - Biochemical Techniques Diffusion, chromatography, Centrifugation - Carbohydrates - General structure of monosaccharide – Importance, Nomenclature & definition, classification, Asymmetry, Isomerism, Optical isomerism, formulation – Linear form, Ring form, Haworth's projection formula.

### **UNIT – III**

Properties of monosaccharide – reactions of glycosidic OH group, Reaction of both glycosidic & alcoholic OH group, Reactions of CHO/CO Group, reactions of CHO/CO group- Oligosaccharides – Occurrence, Chemistry & properties of source, Lactose, Maltose, Cellobiose, Isomaltoses & Trehalose - Polysaccharides – Homopolysaccharides – Occurrence, Chemistry & properties of starch, glycogen, inulin, cellulose, pectin, chitin, Hemicellulose. Heteropolysaccharides

### **UNIT – IV**

Fatty acids - General structure – Importance, definitions, Two components – Alcohols – Saturated & unsaturated fatty acids nomenclature, Saturated fatty acids, Cyclic fatty acids, Biological roles of lipids - Classification – Simple lipids – Fats, oils, waxes, compound lipid – phospholipids - Properties of lipids – physical properties, chemical properties - Nucleic acids : Definition, three components.

### **UNIT – V**

Amino acids & Proteins - General structure – Importance, amino acids, - structure, electrochemical properties, classification, peptide & peptide bond, Chemical bonds involved in protein structure, protein configuration, Biological roles of proteins - Classification – General properties Introduction to basic biochemical cycles - Biochemical techniques

## **SECOND YEAR**

**Paper – 5**

**HINDI- I**

**Paper – 6**

**ENGLISH PAPER – II**

**Syllabus for II B.A., / B.Com., / B.Sc., Students**

## **Detailed Text**

### **PROSE**

8. A Visit to India – Julian Huxley
9. University Days – James Thurber
10. I Have a Dream – Martin Luther King
11. The Story Teller – H.H. Munro (Saki)
12. George Bernard Shaw – Bertrand Russel
13. Only then shall we find Courage – Albert Einstein

### **POETRY**

7. The Day is Done – Henry Wadsworth Longfellow
8. King Arthur's Farewell – Alfred Tennyson
9. O Captain! My Captain! – Walt Whitman
10. My Last Duchess – Robert Browning
11. Ode to a Nightingale – John Keats
12. Lochinvar –Walter Scott

## **Non-Detailed**

A collection of One Act Plays -

1. Remember Ceasar – Gordon Daviot
2. The Proposal – Anotn Chekov
3. The Miracle Merchant – Saki
4. The Stepmother – Arnold Bennet
5. The Mahatma – Rama Sarma

## **GRAMMER**

1. Relative Clauses
2. Conditional Sentences
3. Modal auxiliaries
4. Reported Speech
5. Transformation of Sentences
  - a. Affirmative, Negative and Interrogative Sentences

- b. Simple, Compound and Complex Sentences
- 6. a,b,r clauses
- 7. Correction of Sentences based on
  - a. Subject, Verb and Concord
  - b. Tenses
  - c. Articles and Prepositions.
  - d. Question Tags

### **COMPOSITION**

- 7. Paraphrasing
- 8. Dialogue Writing
- 9. Report Writing
- 10. Note Making
- 11. General Essay
- 12. Expansion of Idea.

## **Paper – 7**

### **GENERAL MICROBIOLOGY AND IMMUNOLOGY**

#### **UNIT 1 HISTORY OF MICROBIOLOGY**

Spontaneous generation The Germ theory of disease of disease. Contributions of Louis Pastuer, Robert Koch and others to the field of microbiology.

#### **UNIT 2 MICROSCOPY**

Light microscope, compound microscope, Phase contrast microscope, Fluorescent microscope, Electron microscope.

#### **UNIT 3 ASEPTIC TECHNIQUE AND CULTURE MEDIA**

Sterilization and Disinfection- Physical and chemical methods , Filtration, Radiation, and Gases. Culture media- Preparation of culture media, aerobic and anaerobic culture methods, Types of media. Bacterial colony morphology. Staining- preparation of smears, Gram's staining, Acid fast staining, Capsular staining, Spore staining, Flagellar staining. Biochemical characteristics of microbes. Antibiotics and their mode of action, Antibiotic sensitivity test.

#### **UNIT 4 IMMUNITY**

History of Immunology; structures, composition and function of cells and organs involved in immune system; host parasite relationships; microbial infections; Virulence and host resistance; Immune responses-innate immunity, acquired immunity

#### **UNIT 5 ANTIGENS AND ANTIBODIES**

Antigens - structure and properties- types - iso and allo - haptens, adjuvants-antigen specificity. Structure , heterogeneity, types and properties of antibodies.Compliment : structure- components - properties and functions of complement components; Complement pathway and biological consequences of complement activation.

#### **UNIT 6 IMMUNOLOGICAL REACTIONS**

In vitro methods - Agglutination, precipitation, complement fixation. Immuno fluorescence, ELISA, Radio Immune Assays.

#### **TEXT BOOK**

TEXT BOOK OF MICROBIOLOGY – R.Ananthanarayan and C.K.Jayaram Paniker, Orient Longman

#### **REFERENCES:**

1. Immunology by Kuby, J. 1997. Third Edition, W.H. Freeman & Co. New York.
2. Fundamentals of Immunology by Roy.
3. Immunology - An Introduction by Tizard, I.R. 1995. Fourth Edition, Saunders College Publishing, New York.
4. Essential Immunology by Ivan Roitt, 1997., 9 th edition. Blackwell Science,USA.



## **(THEORY)**

### **BIOSATISTICS**

#### **UNIT – I**

1. Biostatistics – definition, principles, scope, limitations and uses. Collection of data - Sample, Population, Sampling techniques. Types of representation – Graphic and bar diagrams.

#### **UNIT – II**

1. Central values and dispersions – mean, mode, median – coefficient of variations, Probability, Standard deviations, Correlations.
2. Distribution – Binomial, Poisson and normal distribution.

#### **UNIT – III**

Hypothesis testing – Test of Significance, test in large samples and small samples, t-test, F-test, Chi square test.

### **COMPUTER APPLICATIONS IN BIOLOGY**

#### **UNIT – IV**

Computer – Introduction and the application of computers in biology – Characteristics - Hardware & software – types – generation of computers – Input, output and storage devices.

#### **UNIT – V**

Fortran Programming. Basis – Representation of integer and real constants – variable s– expression – assignment and Input, output statements. Design control statements – Loops – Subscripted variable – Files.

#### **UNIT – VI**

1. Data processing – Introduction – Records, files, data collection, preparation, verification, editing and checking , backup and file recovery procedure – sorting searching and merging.
2. Ms office – Data entry – graphs and processing.

#### **UNIT – VII**

Foxpro – Introduction to Foxpro environment – Database creation and insertion, deletion and modification – managing multiple database – display of data – Foxpro programming – memory variables – date, time, string and math functions – report generations.

**Reference: Biostatistics:**

1. Palanisamy .S and Manoharan M.1994. Statistical methods for Biologists. Palani paramount publications, Tamil Nadu.
2. Arota P.N. and Malhan P.K. 1996. Biostatistics Himalaya publishing House – Mumbai.
3. S.P. Gupta. Statistical method.
4. Sokal and Rohlf 1973 – Introduction to Biostatistics – Toppan co, Japan.
5. Bishop O.N. Statistics for Biology . Bostan Houghtan Miltim.

### **MAJOR PRACTICAL III**

**Microbiology:**

Sterilization of glasswares, Preparation of culture media, Cultivation of bacteria and observation of colony morphology. Smear preparation and Staining techniques: Simple staining, Gram's staining, Endospore staining, Negative staining, Fungal staining . Hanging drop technique to observe motility. Identification of microbes by biochemical tests. Antibiotic sensitivity assay to different microbes (disc method)

**Immunology:**

Precipitation test by Agar diffusion method. Agglutination test - Identification of blood group, Salmonella slide agglutination (kit method). Pregnancy test – Gravindex test (kit method). VDRL TEST (Kit method )

## **ALLIED PRACTICAL IV - BIOSTATISTICS AND COMPUTER APPLICATIONS IN BIOLOGY**

1. Brief description and tabulation of data and its graphical representation.
2. Measures of central tendency and dispersion: mean, median, mode, range, standard deviation, variance, Idea of two types of errors and level of significance, tests of significance (F&t test); chi-square tests.
3. Simple linear regression and correlation.
4. Introduction of digital computers: Organization; low-level and high-level languages; binary number system.
5. Flow charts and programming techniques, programming in Basic and C.
6. Introduction to data structures and database concepts, introduction to Internet and its applications.
7. Introduction to MS-OFFICE software, covering Word Processing.

### **THIRD YEAR**

#### **Paper – 9 RECOMBINANT DNA TECHNOLOGY**

##### **UNIT-I**

Introduction to Gene tech:- Methods and tools for rDNA technology, application of Enzymes- Restriction Endonucleases, Ligases- Categories of reactions, DNAases, Phosphatases, Polymerases, Exonucleases, Methylases.

##### **UNIT-II**

Prokaryotic cloning vectors:- Plasmids, Basic and desirable properties of plasmids, natural and artificially derived plasmid vectors, Improved pBR322 derived vectors, low copy number. Expression vectors of Bacillus and Streptomyces. Phage lambda vectors, Surface display vectors, cosmids, phagemids, uses of Bacteriophage, M13 and P1 in cloning.

##### **UNIT-III**

Eukaryotic Cloning Vectors:- Yeast derived plasmid vectors, Yeast episomal plasmids, YAC, Yeast integrative plasmids, Yeast replicative plasmids. Ti plasmids & Plant viruses as vectors. Animal viruses as Vectors.

#### **UNIT-IV**

Cloning Hosts: - Bacteria, Fungi, Plant cell & Animal cell as cloning host. Gene Transfer in Bacteria, plants and animal cells by natural and artificial transformation methods.

#### **UNIT-V**

DNA library:- Genomic DNA library and cDNA library and their applications. DNA sequencing, chemical cleavage and dideoxy method. Automation of DNA sequencing.

#### **References:**

1. Molecular Cloning: a Laboratory Manual, J.Sambrook, E.F.Fritsch and T.Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
2. Applied Molecular genetics, Roge L Miesfeld, John Wiley & sons, Inc. Publications, 1999.
3. Recombinant DNA principles and Methodologies, James J. Greene, Venigalla B. Rao, Marcel Dekkar Publications. 1998.
4. DNA cloning a practical approach, D.M.Glover and B.D.Hames, IRL Press, Oxford 1995.
5. Molecular and Cellular methods in Biology and Medicine, P.B.Kaufman, W.Wu, D.Kim and L.J.Cseke, CEC Press, Florida 1995.
6. Methods in Enzymology Vol. 152, guide to molecular techniques, S.L.Berger and A.R.Kimmel, Academic Press, Inc, San Diego, 1998.
7. Methods in Enzymology, Vol, 185, Gene Expression Technology, D.V.Goeddel, Academic Press, Inc., San Diego, 1990.
8. DNA Science, A first course in Recombinant Technology, D.A.Mickloss and G.A.Freyar, Cold Spring Harbor Laboratory Press, New York, 1990.

## **UNIT-I**

Enzymes: Introduction, International classification of enzymes, six main classes of enzymes. Extraction, purification and characterization of enzymes.

## **UNIT-II**

Coenzymes: Definition, structure and functions of Thiamine pyrophosphate, Nicotinamide coenzymes, Flavin nucleotides, coenzyme A, lipoic acid, biotin and folate coenzymes. Metal cofactors (Mechanism of action of coenzyme not required) Mechanism of action of Chymotrypsin. Allosteric enzymes. Aspartate transcarbamylase (Mechanism) Model.

## **UNIT-III**

Enzymatic actions: Single substrate, factors affecting rate of enzyme activity. Enzymatic reactions - Acid base, electrostatic, and covalent reactions. Michaelis-Menten equation-Derivation, transformation of MM equation to Lineweaver Burk plot. Enzyme Inhibition: Competitive, Non-Competitive and Un-competitive enzyme inhibition.

## **UNIT-IV**

Enzyme technology: Immobilized enzymes; sources and techniques of immobilization. Effect of immobilization of enzyme activity. Applications of immobilized enzymes in industry.

## **UNIT-V**

Instruments in enzyme analysis; calorimetric, Potentiometric, optical and immunosensors Recent research of enzyme engineering.

### **References:**

1. Trevor Plamer, understanding Enzymes, Ellis Horwood limited. 3 rd edition, 1991.
2. Enzymes- Dixon and Web.
3. Enzymes Technology- Chapline & Bucke
4. Alan Weissman, Hand Book of Enzyme Biotechnology: 2 nd edition.

**Paper – 11**  
**PLANT BIO-TECHNOLOGY**

**UNIT I**

Plant Kingdom : General Characters of: Algae and Fungi, Bryophytes, Pteridophytes, Gymnosperms, Angiosperms.

**UNIT II**

Taxonomical classification : - Aims and Objectives of Taxonomy - Binomial nomenclature, - Need of Bionomical Nomenclature - Advantages - Principles of ICBN.

**UNIT III**

Structure and physiology of plants: - Flower : Parts, Functions, Floral whorls, Flower as a modified shoot. Fruits : ormination, Types, parthenocarp. Seed : Structure, Formation, Seed Physiology - Dormancy, Breaking of dormancy, Germination, vigour and Viability. Roots and their modified structure. Physiology of plants: Photosynthesis and chloroplast lowering

**UNIT IV**

Plant genome organization, Organization and expression of chloroplast genome and mitochondrial genome. Cytoplasmic male sterility. Intergenomic interaction.

**UNIT V**

Genetic engineering in plants:- Markers used in plant genetics. Reporter genes and Promoters used in plant vectors. Genetic engineering of plants for bacteria, fungi, virus, pest and herbicide resistance. Production of antibodies, viral antigens and peptide hormones in plants.

**References**

1. Metabolic activities of plant cells, John W. Anderson and John Beandall, Blackwell Scientific Publishers First Edition.1991.
2. Principles of gene manipulation, Old,R.W. and Primrose,S.B., Blackwell Scientific Publishers, Fifth Edition, 1995.
3. DNA technology - The awesome Skill - Alcomo, Wm.C.Brown, Publishers, 1996. Pergarian Press, Second Edition, 1983.
4. Plant Biochemistry and Molecular Biology – Hans, Walter and Heldt, Oxford UniversityPress,1997.
5. plantbiochemistry ,Bonner&Varner,Academic press , Third Edition. 1976.

## **Paper – 12**

### **BIO ENGINEERING TECHNOLOGY**

#### **UNIT I**

Introduction to Classical Genetics: Mendelian principles, segregation and independent assortment, dominant relations and multiple alleles in diploids, environmental effects and gene expression, sex-determination and sex- linkage in diploids, cytoplasmic heredity, quantitative inheritance, linkage and recombination, principle of gene mapping, recombination in bacteria and viruses –Population Genetics.

#### **UNIT II**

Structure of Genetic Material Chromosome variation in number, changes in chromosome structure, polyploidy and selective breeding, gene mutation.

#### **UNIT III**

Genetic control of proteins : Inborn errors of metabolism in humans, flower pigment mutations, insect eye pigments, biochemical mutations and pathways in microorganisms. Gene regulation: lac operon in E.coli, the operon, the promotor, catabolic repression, repressible enzyme systems, control by attenuation, positive control, gene regulation in eukaryotes, transcriptional regulation, post-transcriptional regulation.

#### **UNIT IV**

Principles of Cell and Tissue Culture: advantages and disadvantages of tissue culture methods – cell markers – types of cells – primary and established cell lines – kinetics of cell growth – genetics of cultured cells – metabolism – applications of Animal Tissue Cultures.

## **UNIT V**

Plasmids as vectors – properties, and uses. Restriction endonuclease - types and function Nucleic acid hybridisation Polymerase chain reaction DNA finger printing technique DNA foot printing technique. monoclonal antibody production.

### **References:**

1. Molecular Cloning: a Laboratory Manual, J.Sambrook, E.F.Fritsch and T.Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
2. Applied Molecular genetics, Roge L Miesfeld, John Wiley & sons, Inc. Publications, 1999.
3. Recombinant DNA principles and Methodologies, James J. Greene, Venigalla B. Rao, Marcel Dekkar Publications. 1998.
4. DNA cloning a practical approach, D.M.Glover and B.D.Hames, IRL Press, Oxford 1995.
5. Molecular and Cellular methods in Biology and Medicine, P.B.Kaufman, W.Wu, D.Kim and L.J.Cseke, CEC Press, Florida 1995.
6. Methods in Enzymology Vol. 152, guide to molecular techniques, S.L.Berger and A.R.Kimmel, Academic Press, Inc, San Diego, 1998.
7. Methods in Enzymology, Vol, 185, Gene Expression Technology, D.V.Goeddel, Academic Press, Inc., San Diego, 1990.
8. DNA Science, A first course in Recombinant Technology, D.A.Mickloss and G.A.Freyar, Cold Spring Harbor Laboratory Press, New York, 1990.
9. Molecular Biotechnology (2<sup>nd</sup> Edition)d, S.B.Primrose, Blackwell Scientific Publishers, Oxford, 1994.
10. Genetic Engineering, An introduction to gene analysis and exploitation in Eukaryotes, S.M.Kingsman and A.J.Kingsman, Blackwell Scientific Publications, Oxford, 1998.
11. Molecular Biotechnology – Glick
12. Human Molecular Genetics, Tom Strachan and Andrew P. Read, Bios Scientific Publishers, 1996.



## **Paper XVII Major Practical (Paper XIII and XIV)**

### **Paper XIII - Recombination DNA technology**

### **Paper XIV – Enzymes and Enzyme technology**

#### **I. Demonstrations**

1. Thin layer chromatography
2. Isolation of RNA
3. Southern Blotting
4. Cloning in plasmid vectors
5. Northern Blotting

#### **II Practicals**

1. Agarose gel electrophoresis
2. Extra cellular enzymes of bacteria
3. Paper chromatography.
4. Polyacrylamide Gel Electrophoresis
5. Restriction Digestion
6. Ligation
7. Western Blotting
8. PCR
9. Isolation of Genomic DNA.
10. Isolation of plasmid DNA
11. Transformation
12. Isolation of Human DNA

#### **References.**

1. Sadasivam S. and Manickam A., Biochemical Methods, II Edition, New Age International Private Ltd. Publishers, New Delhi.
2. A Biologist's Guide to Principles and Techniques of Practical Biochemistry, K. Wilson and K.H. Goulding, Elbs Edition, 1986.

## **Paper XVIII Practical IV (Paper XV and XVI)**

### **Paper XV –Plant biotechnology**

### **Paper XVI – Bioengineering technology**

1. Observation of Prokaryotic and Eukaryotic cells and cell types –
2. Living Cells/Temporary/ Permanent preparations.
3. Cytochemical study of cells/cell types using specific dyes/reagents.
4. Tissue Culture Techniques.
5. Media composition and preparation.
6. Micropropagation through node and shoot tip explants.
7. Phytochemical analysis of total protein, sugar in cultured tissue.
8. Microbial antibiosis and antibiotic assay.
9. Isolation of nitrogen fixing bacteria, mycorrhizal fungi and single cell protein.
10. isolation of bacterial mutants by UV, and chemical methods(NTG).

**References:**

1. Sadasivam.S and Manickam,A. Biochemical Methods II Edition. New Age International Private Ltd. Publishers.
2. Laboratory techniques in Biochemistry and Molecular Biology, Work and Work.
3. A Biologist's Guide to Principles and Techniques of Practical Biochemistry, K.Wilson and K.H.Goulding, ELBS Edition, 1986.
4. Boyer, R, Modern Experimental Biochemistry, III edition, Benjamin Cummings Publishers.