

# MSC. BIO-TECHNOLOGY

## FIRST YEAR

PAPERS	Subject	Max. Marks	Exam Hrs
1	Cytogenetics & Molecular Biology	100	3
2	Biological Techniques & Instrumentation	100	3
3	Enzymology & Enzyme Technology	100	3
4	General Micro-Biology & Bio-Chemistry	100	3
5	Immunology & Medical Bio-Chemistry	100	3
Practical 1	Paper I & II	100	6
Practical 2	Paper III, IV & V	100	6

## SECOND YEAR

PAPERS	Subject	Max. Marks	Exam Hrs
1	Bio-Information & Environmental Bi-Technology	100	3
2	Plant & Animal Bio-Technology	100	3
3	Bio-Engineering Technology	100	3
4	Recombinant DNA Technology	100	3
Practical 3	Paper VI & VII	100	6
Practical 4	Paper VIII & IX	100	6
	Project Work	200	-

## **FIRST YEAR**

### **PAPER I CYTOGENETICS AND MOLECULAR BIOLOGY**

#### **UNIT I**

Chromosomes : Prokaryotic and eukaryotic chromosomes. Viral chromosomes. Chemical and molecular structure of chromosomes. Types of chromosomes- polytene chromosomes, lampbrush chromosomes, B-chromosomes. Genetic significance of chromosomes.

#### **UNIT II**

Variation in chromosome number : Euploidy-monoploidy, diploidy, polyploidy- examples of polyploidy in plants. Examples of polyploidy in animals. Induction of polyploidy, kinds of polyploidy, effects of polyploidy on the organism.

#### **Unit III**

Cytological mapping: construction of linkage map or genetic mapping- determination of linkage groups, determination of map distance, determination of gene order. Uses of genetic maps. Genomic study of HIV, Mycobacterium sp., and Hepatitis virus.

#### **UNIT IV**

Organization of DNA into chromosomes Histones – Association of histones to the DNA (Nucleosomes) – Position of nucleosomes, chromatin. DNA molecules in a series of looped domains – units of function. Extra nuclear DNA Mitochondrial and Chloroplast DNA.

Cell Signaling – Communication between the cells and their environment : Characteristics of the cell signaling system, Second messenger (Plant and animal cells ) and G protein coupled receptors. Receptors of tyrosine kinases, Signals that originate from contact between cell structure and substratum, Convergence, divergence and crosstalk among different signaling pathways, other signaling pathways.

## **UNIT V**

Regulation of gene action: Regulation of gene action in Prokaryotes – enzyme regulation of gene action, operon hypothesis, example of lac operon. rRegulation of gene expression in simple eukaryotes. Eukaryotic gene control, hormonal regulation, regulations by histones, regulation by heterochromatin.

Recombination: Mechanism; forms of recombination

### **References:**

1. Weaver, F. Robert, Hedrick, W. Philip. (1997) 3 rd ed. Genetics. Wm.C.Brown publishers.
2. David Freifelder (1983) Jones & Bartlett publishers. 2ed Molecular biology. Reprint (1993) Narosa Publishing House.
3. Gardner, Simmons 8 ed. Principles of Genetics.
4. Karp, G. 1999. Cell and Molecular Biology – Concepts and experiments. 2 nd edn. Harris, D (ed.), John Wiley & sons, New York.
5. Kleinsmith, L. J. & Kish, V.M. 1995. Principles of Cell and Molecular Biology. 2 nd edn., McLaughlin, S., Trost, K., Mac Elree, E. (eds.), Harper Collins Publishers, New York.
6. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D. (eds.) 1994. Molecular Biology of the Cell. 3 rd edn., Garland Publishing, Inc., New York.
7. De Robertis, E.D.P. and De Robertis, E. M.F. 1995. Cell and Molecular Biology. 8 th edn., B.I. Waverly Pvt. Ltd., New Delhi.

## **PAPER II BIOLOGICAL TECHNIQUES AND INSTRUMENTATION**

### **UNIT I**

Chromatography – Principle, operative technique and applications of paper, TLC, adsorption chromatography, GLC, and HPLC. Ion-Exchange, molecular sieve.

### **UNIT II**

Electrophoretic techniques - Principle and technique of gel, SDS, high voltage and discontinuous electrophoresis, Isoelectric focussing. Pulsed field gel electrophoresis and capillary electrophoresis.

### **UNIT III**

Spectrophotometry- Basic principles, instrumentation and applications of UV, Visible, IR spectrophotometers and Mass Spectrometry. Flame Photometry - Principles and applications.

### **UNIT IV**

Centrifugation techniques – Principle, methodology and application of analytical centrifugation, differential centrifugation, density gradient centrifugation, ultra- centrifuge.

### **UNIT V**

X-Rays - X-Ray diffraction, crystals and detectors, quantitative analysis and applications. Radio chemical methods - Basic concepts, counting methods and applications. Autoradiography.

### **UNIT-VI**

Tracer and other techniques- radioactive decay, units of radioactivity, detection and measurement of radio activity, Geiger-Muller counter, Scintillation counter. Applications of radioisotopes in biology.

### **References:-**

- 1.An introduction to practical biochemistry by David T. Plummer.
- 2.Laboratory Manual in biochemistry by Pattabiraman and Acharya.

3. Practical biochemistry by J. Jayaraman.
4. Analytical Biochemistry, D.J. Homie and Hazel Peck, Longman group, 3rd edition, 1998.
5. Physical Biochemistry - Application of Biochemistry and Molecular Biology, David Friefelder, W.H. Freeman and Co., Second Edition, 1999.
6. Experimental Biochemistry, Robert Switzer and Liam Garrity, W.H. Freeman and Co., Third Edition, 1999.

## **PAPER III ENZYMOLOGY AND ENZYME TECHNOLOGY**

### **Unit I**

Enzyme Techniques : Activity of enzymes, Handling of enzymes, Enzyme assays. Analysis of enzymes activity(methods), expression of the activity coupled reactions. Isolation and purification of enzymes. Importance of pure enzymes. Separation of Isoenzymes.

### **Unit II**

Enzyme Kinetics : Velocity of a reaction, order of a reaction, progress curve for enzyme catalysed reactions. Factors influencing velocity of enzyme catalysed reaction. Michaelis Menten Kinetics,  $K_m$  and  $V_{max}$ . Effect of pH, temperature on enzymatic reactions. Anomalous kinetics of competitive and non-competitive inhibition. End product inhibition with examples.

### **Unit III**

Coenzymes : Coenzymes & Cofactors, substrate enzyme relationship. Classification of coenzymes as group transfer, hydrogen transfer, coenzymes, structure of coenzymes function of nucleotide coenzymes, CoA, NAD/NADP, FMN/FAD, Biotin, Folic acid, vit. B12, Biosynthesis of puridine and flavin nucleotides and CoA.

### **Unit IV**

Mechanism of Enzyme action : Enzyme specificity, Active site, Study of Mechanism of enzyme reaction – pathway of enzyme catalysed reactions. Mapping of active site,. Mechanisms at active site of enzymes – Covalent – catalysis, acid base catalysis. Proximity and orientation effect. Structure and mechanism of action of representative enzymes. Chymotrypsin and Ribonuclease.Regulation of enzyme activity – Covalent modulated regulatory enzymes. Allosteric regulation.

### **Unit V**

Enzyme Technology : Application in Food and Pharmaceutical industries- large scale enzyme extraction, purification and stabilisation. Industrial application of carbohydrates, proteolytic enzyme, lignocellulose degrading enzyme, pectin and pectic enzyme. Applications of enzymes

in food industry. Clinical enzymology – Serum enzymes in health and diseases. Immobilised enzyme technology – designer enzymes – Abzymes Biosensors – Ribozymes.

## References

1. Enzymes - Dixon & Webb
2. Biological Chemistry - Mahler & Cordes
3. Principles of Biochemistry - Lehninger
4. Human Nutrition - Biochemical Basis of Inherited Diseases Fredrickson et. al.
5. Alan Weissman, Hand Book of Enzyme Biotechnology: 2 nd edition.

## **PAPER IV GENERAL MICROBIOLOGY AND BIOCHEMISTRY**

### **Unit 1:**

Definition and historical account of microbiology. Diversified microbial world- Classification of microbes based on Whittaker's five kingdom system of classification. Structures of Bacteria, viruses, Fungi, and algae.

### **Unit 2:**

Nutritional requirements and growth cycles of the above mentioned groups. Media for growth: Types, preparation, methods of sterilization. Isolation and enumeration of microorganisms in soil, water and air. Isolation of microorganisms from contaminated food. Techniques of pure culture, maintenance and preservation; Staining: stains and dyes, types of staining; General techniques involved in Virology and Protozoology.

### **Unit 3:**

Microbial physiology: Factors influencing the growth of microbes- classification based on that. ( Temperature, pH, Nutrition ). Symbiotic associations, commensals, Saprophytes, etc.. Microbiology of fermented foods-dairy products, meat and fish, alcoholic beverages-beer, wine etc. Food spoilage and preservation processes. Microbes as source of food. Application of microbes in industries production of antibiotics, amino acids organic acids, bioconversion process, microbial insecticides.

### **Unit 4:**

Biochemistry of Metabolism : Carbohydrates and energy metabolism- fermentation or glycolysis, TCA cycle and oxidative phosphorylation, Ammonia metabolism. Biosynthesis of glutamate. Purine and pyrimidine biosynthesis. Synthesis of DNA and RNA. Biosynthesis of cell wall - Peptidoglycan, and Teichoic acid.

### **Unit 5 :**

Microbes as components of the environment-nutrient cycles-carbon-nitrogen, sulphur and phosphorus cycles, Degradation of industrial wastes, petroleum hydrocarbons, pesticides, biofouling and corrosion. Bacterial photosynthesis, symbiotic and non-symbiotic nitrogen fixation. Antimicrobial agents-structure of antibiotics, antibacterial and antiviral (function & mechanism of action).



### Reference Books :

1. Fundamental principles of Bacteriology - A.J. Salle
2. Microbiology - Michael J. Pelchar, E.C.S.  
Chan Noel R. Krieg.
3. Microbial physiology--Albert G.Moat and John W. Foster- Wiley-interscience publication
4. Food microbiology- W.C. Frazier and D.C. Westhoff, tata Mcgra Hill publication.
5. Microbial Biotechnology – Alexander N.Glazer, Hiroshni - Kaido, W.H.Freeman and Co.1995.
6. Chemical Microbiology, Antony H.Rose, Butterworths,Third Edition, Plenum Press,1976.
1. Principles of fermentation technology, P.F. Stanbury, A. Whitaker, S.J.Hall, Second Edition, Pergamon Publishers, 1995.
2. Biotechnology, A text of “Industrial Microbiology, Wulf Crueger and Anneliese Crueger , Second Edition, Sinauer Associates Inc, Sanderland, 1989c.

## **PAPER V IMMUNOLOGY AND MEDICAL BIOTECHNOLOGY**

### **UNIT I**

Immunity- definition, innate immunity-Mechanisms of innate immunity. Acquired immunity- active and passive immunity with examples. Antigens- definition and determination of antigenicity. Antibodies- definition, types, and functions of antibodies. Hybridoma techniques in monoclonal antibody production and their applications.

### **UNIT II**

Antigen - antibody interaction *in vitro* - precipitation, agglutination, RIA, ELISA, complement fixation techniques and applications. Preparation of antigens for animal inoculation. Purification of antibodies from serum for agglutination and precipitation tests.

Principles and methods of vaccine preparation.

### **UNIT III**

Structure and functions of immune system: Central thymic organs and peripheral lymphoid organs. Cells of lymphoreticular system- lymphocytes, T-cell maturation, B-cell maturation. Null cells, phagocytic cells. Antigen processing and presentation. MHC - Organization, MHC molecules and genes, cellular distribution, regulation of MHC and immune Antigens. MHC and disease. Transplantation and rejection.

### **UNIT IV**

Complement system - general properties of complement. Complement activation. Classical pathway and alternative pathway. Regulation of complement activation. Biological effects of C. Hypersensitivity – classification –Immediate and delayed types. Type I, II, III and IV Hypersensitivity reactions and its mechanisms.

### **UNIT V**

Autoimmunity – Classification of auto immune disease – haemolytic auto immune disease, localized auto immune disease, and systemic auto immune disease. Pathogenesis of auto immune disease. Immunology of transplantation- autograft, allograft, isograft and xenograft.

Immunological techniques: RIA, ELISA, Immunocytochemistry, Immunoblotting , Fluorescence antibody techniques.

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**Reference:-**

1. Immunology-An Introduction, Tizard R.Jan, 1995.
2. Immunology- Roitt Ivan, Jonathan Brastoff, David male, 1993
3. Text book of microbiology- AnanthanarayananR. And Jayaraman Panikar, 1996.
4. Immunology- Janis kuby, 3 rd edition.
5. Weir, D.M. and Stewart, J.,1997, Immunology, 8 th Edn. Churchill Livingstone, New York.
6. Eryl Liddell and Ian Weeks.,1995, Antibody Technology, BIOS Scientific Publishers.

## **PRACTICAL I – PAPER I, II, and III**

1. Instrumentation methods of cell biology
2. Microtomy
3. Observation of Prokaryotic and Eukaryotic cells and cell types.
4. Living Cells/Temporary/ Permanent preparations. Histochemical techniques
5. Squash preparation of giant chromosome of salivary gland of Chironomous larva.
6. Squash preparation of onion root tip.
7. Subcellular fractionation and biochemical/enzymyological analysis.
8. Cytochemical study of cells/cell types using specific dyes/reagents.
9. Immunocytochemical analysis for specific cellular constituents.
10. Metaphase chromosome preparations and preliminary banding techniques.
11. Isolation, determination, purification and separation of protein, carbohydrates,
12. lipids, DNA and RNA.
13. Production of enzyme (amylase)
14. Immobilization of cells and enzymes by Calcium alginate method
15. Kinetic analysis of enzymes
16. Thin layer chromatography
17. Paper chromatography
18. Poly acrylamide gel electrophoresis

### **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.

## **PRACTICAL II – PAPER IV, AND V**

1. Culture media preparation liquid and solid medium
2. Selective differential Media
3. Methods of sterilization and testing of sterility
4. Enumeration of bacteria, fungi and actinomycetes from soil
5. Pure culture technique – pour plate, spread plate and looping method
6. Maintenance and preservation of cultures.
7. Staining of Bacteria – gram, spore and AFB, Fungal wet mount – LPB
8. Motility test-hanging drop and soft agar inoculation
9. Water quality test – MPN
10. Effect of different parameters on bacterial growth kinetics (Substrate, pH, Temperature)
11. Batch and Fed Batch fermentation
12. Continuous fermentation
13. Medium optimization for bacterial growth by statistical method.
14. Production of alcohol from molasses.
15. Production of organic acid (citric acid).
16. Purification of a fermentation product by Chromatography
17. Quantitation of total free amino acids
18. Quantitation of cholesterol
19. Quantitation of proteins
20. Quantitation of sugars
21. Immunization and collection of serum.
22. Radial immunodiffusion.
23. Ouchterlony double diffusion.
24. Immunoelectrophoresis.
25. Rocket Immunoelectrophoresis.
26. Immunodiagnosics (ELISA and Western Blotting).
27. Hemolysis.
28. Hemagglutination.

**References:**

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

## **Paper VI Bioinformatics and Environmental biotechnology**

### **UNIT – I**

Introduction – Goals – Scope – Fundamentals of Biological system – cells – cell transport through plasma membrane – energetic and respiration – Cell cycle – Fundamentals of genetics – Immune system – triology of environment – basic principles and population ecology – Food chain, Food web in ecosystem.

### **UNIT – II**

Molecular modeling – Introduction – Molecular structure and internal energy – application macromolecular modeling – Molecular mechanics and molecular dynamics of oligopeptides, Nucleotides, Proteins, Drug molecules, molecular design – emerging areas in Bioinformatics – Bio-computing.

### **UNIT III**

Study of microbial population in soil, water, and air: – isolation, screening, and enumeration. Food microbiology – types of microorganisms in meet, and meat products. vegetables, dairy products; production of baker's yeast, and other dairy products.

### **UNIT IV**

Industrial– microbial synthesis of commercial products, organic acids, alcohols, alcoholic beverages and industrial enzymes; biofertilizers and bioinsecticides. vaccine production from microbes; antibiotics production.

### **UNIT V**

Waste water treatment – Physical, chemical and biological treatment processes. Activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic digestion, anaerobic filters. Bioremediation of contaminated soils and waste lands. Soil waste; - composting, vermiculture and methane production

### **References:**

1. Microbial biotechnology, Fundamentals of applied microbiology by A.N.Glazer and H.Nikaido, W.H.Freeman and Company.

2. P.F.Stanbary and A.Whittaker, Principles of Fermentation Technology, Pergamann Press.
3. Casida, Industrial Microbiology
4. Prescott, Industrial Microbiology
5. Alan and Scragg, 1999, Environmental Biotechnology. Pearson Education Ltd. England.
6. S.N.Jogdand, 1995, Environmental Biotechnology Himlaya Publishing House Bombay.
7. Waste Water Engineering – Treatment, Disposal and reuse. Metcalf and Eddy, Inc., TATA McGraw Hill, New Delhi.
8. A.K.De, Environmental Chemistry Willey Eastern Ltd. New Delhi.
- 9.D.Allsopp and K.J.Seal, Introduction to Biodeterioration, ELBS/Edward Arnold.



## **Paper VII Plant and animal biotechnology**

### **UNIT I**

Plant genome expression. Interaction between nuclear and organellar genome. Plant genes.

### **UNIT II**

Cultivation: Tissue culture media. Different types of culture methods: Primary culture cell line; cell clones; callus and suspension culture. Embryo culture. Protoplast fusion and somatic hybridization. Micropropagation; organogenesis; Somatic embryogenesis; Protoplast fusion and somatic hybridization. Cybrids; Anther, pollen and ovary culture for production of haploid plants and homozygous lines. DNA banking for germplasm conservation.

### **Unit III**

Vectors and genetic transfer: Characteristics of Ti and Ri plasmids, Use of Ti and Ri as vectors, viral vectors. binary vectors, Use of promoters for foreign gene expression in plants, genetic markers, use of reporter genes, receptor gene with intron. Viral vectors and their applications. Gene transfer methods in plants: multiple gene transfers, direct DNA transfer. Transformation of monocots. Transgene stability and gene silencing. Chloroplast transformation and its advantage. Developing pest resistant species - Biocontrol methods - Bioengineered biocontrols – Biotechnology of weed control – Bioremediation and Biofertilizers.

### **Unit IV**

Animal cell culture: Different types of Culture media. Factors affecting the cell growth( nutrition, growth factors, temperature, pH, etc..). Cell transformation; Physical, chemical and Biological methods; manipulation of genes; Hybridoma technology and its applications.

### **Unit V**

Application of biotechnology: Transgenic animals in livestock improvement, Transgenic animals as models for human diseases; transgenics in industry.

### **Text book**

Slater Andrian (2003) Plant biotechnology: The genetic manipulation of plants. Oxford

University Press

Donal Grierson and S.V.Convey 1984 Plant molecular biology. Blackie & Son Ltd. New York

**References:**

1. R.A.Dixon and R.A.Gonzales, 1994. Plant cell culture. A practical approach. Second Edition. Oxford University Press, Oxford.
2. Monica. A. Hughes, 1999, Plant Molecular Genetics. Pearson Education Ltd. England.
3. Mantell,S.H. and Smith,H. 1983, Plant biotechnology . Cambridge University Press.
4. M.J.Chrispeels and D.F.Sadava. 2000, Plants genes agriculture. The American Scientific Publishers.
5. R.J.Henry, 1997 Practical application of plant molecular biology. Chapman and Hall.
6. P.K.Gupta. 1996 Elements of Biotechnology Rastogi and Co. Meerut.
7. J.Hammond, P. Mc Garvey and V.Yusibov (Eds) 2000 Plant biotechnology. Springer Verlag.
8. Ta, Fu, G.Singh and R.Curtis Plant cell and tissue culture in the production of food ingredients Kluwer Academic / Plenum Press.
9. H.S.Chawla. 1998, Biotechnology in crop improvement. International Book Distributor Company.
10. Freshney, R .I, Animal cell culture; A practical approach, 4 th edition, John Wiley publications.
11. Jennie Mather, David Barnes, Methods in cell biology; volume 57.Animal cell culture methods, Academic press.
12. M.Butler, Mammalian cell biotechnology; A practical approach, Oxford university press.
13. Maxine Singer and Paul Berg, Exploring Genetic Mechanism,
14. Old and Primrose, Principles of genetic manipulations .6th edition, Blackwell science publications.

## **Paper VIII Bioengineering technology**

### **UNIT I**

Introduction to genetics - Mendelian analysis of inheritance. Genes, chromosomes and mechanism of Mendelian inheritance. Multiple alleles and gene interaction Linkage and gene mapping in eukaryotes. Extranuclear inheritance.

### **UNIT II**

Restriction endonuclease - types and function, restriction mapping . Nucleic Acid probes - cloned probes, oligonucleotide probes and labeling of nucleic acid probes. Nucleic acid hybridisation blotting - liquid and dot blot technique; southern, northern and western hybridisation reactions, *In situ* hybridisation, Polymerase chain reaction - applications. DNA finger printing technique - paternity testing, use of VNTR, DNA foot printing technique. Comet Assay and Ames test. Chemical synthesis of genes. Human Genome project -human genome mapping and sequencing.

### **UNIT III**

Genetic carriers - Plasmids as vectors - properties, Natural plasmids, pSC 101, pBR 322, vectors pUC vectors . Bacteriophage vectors - Lamda phage packing of  $\phi$  - *in vitro*. Cosmid vectors, cosmid cloning SS DNA vectors -development of M13 vector, PEMPL vector, Lambda ZAP. Viral vectors - SV40, retrovirus, adenovirus, recombinant vaccinia virus vectors. Baculo virus vector for insects, Transposons as vectors.

### **UNIT IV**

Genomic library and chromosome walking: cDNA - Cloning cDNA, library Expression of cloned genes in *E. coli* .Cloning in *Bacillus subtilis*. Cloning in yeasts Recombination. selection and screening - methods and probes.

### **UNIT V**

Animal cell: Transfer, Co-transfer, selectable markers like TK, PSV and PRSV and reporter genes. Gene targeting in animal cells. Animal expression eg. Transfer of cloned genes - *Drosophila*, *Xenopus* oocytes. Transgenic mammals, Gene Knockout. Pharm animals (animal

bioreactors). Application in diagnosis of genetic disorders - Cystic fibrosis, muscular dystrophy, Huntington's disease. Gene therapy.

**Reference Books:**

- (1) Strickberger, M.W. Genetics (Third Edition), 1996, Printice Hall of India Ltd., New Delhi.
- (2) Alberts, B. et. al., 1994, Molecular Biology of the Cell (Third Edition), Garland Publishing Inc., New York.
- (3) Gilbert, S.F., 1997, Developmental Biology (Fifth Edition), Sinauer Associates, Inc. Sutherland.
- (4) Levine, B., 2000, Genes VII. Oxford University Press.
- (5) Weaver, R.F. & Hedrick, P.W., 1992, Genetics (Second Edition), Wm. C. Brown Publishers, USA.
- (6) Hartl, D.L. & Jones, E.W., 2001, Genetics: Analysis of Genes and Genomes (Fifth Edition), Jones and Bartlett Publishers, Sudbury, Massachusetts.
- (7) Peter Westhoff, Molecular Plant Development from Gene to Plant.
- (8) Howell, S.H. Molecular Genetics of Plant Development.

## **Paper IX Recombination DNA technology**

### **UNIT I**

Introduction: vectors as cloning vehicles – plasmids, cosmids, Ti and Ri plasmids, BAC, YAC, expression vectors, shuttle vectors, Transposons. Enzymes – exonucleases, endonucleases – restriction endonucleases, ligases, polymerases; DNA modification enzymes – methylase, alkaline phosphatase; reverse transcription ; topoisomerase; Vector host cells like – E. coli, Bacillus, yeast, plant cells and animal cells.

### **UNIT II**

Vector preparation and genetic transfer: Preparation of plasmid DNA – alkaline lysis, boiling preparation; DNA quantification – spectrophotometric technique; gene transfer techniques – transformation, transduction and conjugation; transformation – competence preparation, heat shock method, electroporation. Development of transgenic animals and plants.

### **UNIT III**

Genetic expression analysis of cloned genes: Selection of cloned genes – antibiotics, GUS expression; blotting techniques – Southern blot and Northern blot; PCR; DNA Finger printing – Restriction fragment length polymorphism (RFLP); Random amplified polymorphic DNA (RAPD); DNA Foot printing; genomic library construction – cDNA, genome mapping.

### **UNIT IV**

rDNA Technology in plants : Transgenic plants with reference to virus and pest resistances, herbicide tolerance and stress tolerance (cold, heat and salt); fruit ripening; resistance to pathogenic fungi and bacteria

### **UNIT V**

rDNA Technology for human welfare: Transgenic animals – insulin, interferon and other pharmaceutical production; recombinant bovine growth hormone; farm animal protection; Gene therapy – haemopoietic cells, genetically engineered bone marrow cells, skin fibroblasts, hepatocytes, myoblast and genetically modified lymphocytes – Recombinant Technology in the production

of vaccines. In industry- amino acid synthesis, vitamin production, and other secondary metabolite synthesis.

**Reference Books:**

- (1) OLD & PRIMROSE , 1989, Principles of gene manipulation 3 rd EDITION PUBLISHERS BUSINESS SERVICE .
- (2) J.D. WATSON, M.GILMAN, J.WITKOWSKI & M.ZOLLER,1992, Recombinant DNA Technology, 2 nd EDITION, SCIENTIFIC AMERICANS BOOKS, NEWYORK.
- (3) S. MAULIK AND S.D. PATEL,1997, Molecular Biotechnology, WILEY– LISS.
- (4) K.KREUZER & A.MASSEY, 1996, r - DNA technology and Biotechnology ,ASM PRESS, WASHINGTON. D.C
- (5) D.BERG & M.SINGER,1992,Dealing with genes,BLACKWELL SCIENTIFIC PUBLICATION
- (6)B.R.GLICK J.J.PASTERNAK,1994,MolecularBiotechnology,ASM PRESS,WASHINGTON
- (7) B.LEWIN, 2000, Gene VII ,OXFORD UNIVERSITY PRESS, NEWYORK.
- (8) T.KOSUGE, C.P. MEREDIT,1989, Genetic engineering of plants HOLLAENDER PLENUM PRESS .
- (9) BUTTERWORTH – HEINEMANN, 1993 , Genome management in prokaryotes , OPEN UNIVERSITEIT NEDERLAND
- (10) BUTTERWORTH – HEINEMANN,1993, Techniques for Engineering Genes, OPEN UNIVERSITEIT NEDERLAND.
- (11) W.WU., M.J. WELSH, P.B. KAUFMAN & H.H. ZHANG, 1997, Methods in Gene Biotechnology, CRC PRESS, NEWYORK .

### **Practical III for**

#### **Paper VI - Bioinformatics and environmental biotechnology**

#### **Paper VII - Plant and animal biotechnology**

1. Isolation and characterization of industrially important microorganisms.
2. Determination of Thermal Death Point (TDP) and Thermal Death Time (TDT) of microorganisms of design of a sterilizer.
3. Determination of growth curve of a supplied microorganisms
4. Comparative studies of Ethanol production.
5. Microbial production of Citric Acid using *Aspergillus niger*
6. Biogas production using simple fermenters.
7. Analysis of water samples (pH, turbidity, color, total solids, suspended solids, dissolved solids) Estimation of BOD and COD, Turbidity & Viscosity and Electrical Conductivity of different effluents.
8. Quality of milk checking (Methyl blue dye reduction test).
9. Microbial analysis of food products.  
Microbial spoilage of food.
10. Tissue Culture Techniques
11. Media composition and preparation
12. Micropropagation through node and shoot tip explants
13. Organ development from cultured tissue
14. Initiation and maintenance of callus
15. Measurement of plant cell growth, (PCV, cell number, Wet and Dry Weights)
16. Detecting antibacterial secondary metabolite production by cultured tissue
17. Preparation of Tissue culture medium and membrane filtration.
18. Preparation of primary cells from Chick embryo.
19. Cell counting and cell viability.
20. Isolation of DNA from animal cells.

## **Practical IV for**

### **Paper VIII – Bioengineering technology**

### **Paper IX - Recombination DNA technology**

1. Plasmid extraction : Alkaline lysis, *E. coli* and *Agrobacterium* .
2. Chromosomal DNA Isolation in blood by agarose gel electrophoresis method.
3. Chloroplast DNA Isolation in plant tissue such as Mulberry, Cotton by submerged agarose gel electrophoresis method.
4. Quantification of DNA in *E. coli* by spectrophotometric method.
6. Estimation of DNA in animal tissue such as Blood, Liver, Spleen and thymus (Laboratory Rat).
7. DNA Restriction.
8. DNA Digestion.
9. DNA Ligation.
10. DNA Transformation.
11. Southern and Northern Blotting.

### **Reference Books:**

1. Kalyan Kumar De, 1992, Plant Tissue Culture , New Central Book Agency , Calcutta
2. Robert N. Trigiano, Dennis J. Gray, 1996 ,Plant Tissue Culture Concept and Laboratory Exercises , CRC Press , London.
3. P.S. Srivasta , 1998 , Plant Tissue Culture and Molecular Biology , Narosa Publishing House , New Delhi.
4. David W. Galbraith, Hans J. Bohnert and Don P. Bourque , 1995 , Methods in Plant Cell Biology , Academic Press , New York.
5. John H. Dodds and Lorrin W. Roberts , 1995 , Experiments in Plant Tissue Culture, Cambridge University Press , USA.
6. D.C. Darling and S.J. Morgan, 1994, Animal Cells Culture and media , BIOS Scientific Publishers Limited.
7. Jennie P. Mather and David Barnes, 1998, Methods in Cell Biology, Volume 57:
8. Animal Cell Culture Methods Academic Press.
- Ann Harris, 1996, Epithelial Cell Culture , Cambridge University Press .