

**THIRUVALLUVAR UNIVERSITY**

**MASTER OF SCIENCE**

**M.Sc. BIOTECHNOLOGY**

**DEGREE COURSE**

**CBCS PATTERN**

(With effect from 2012-2013)

**The Course of Study and the Scheme of Examinations**

S.NO	Part	Study Components		Ins. hrs /week	Credit	Title of the Paper	Maximum Marks		
		Course Title					CIA	Uni. Exam	Total
<b>SEMESTER I</b>									
1		MAIN	Paper-1	6	4	Cell and Molecular Biology	25	75	100
2		MAIN	Paper-2	6	4	Microbiology and Microbial Technology	25	75	100
3		MAIN	Paper-3	5	4	Advanced Biochemistry	25	75	100
4		MAIN	Practical	10	0	Core Practical (Out of Papers 1, 2 and 3) 1. Lab in Cell and Molecular Biology 2. Lab in Microbiology and Microbial Technology 3. Lab in Advanced Biochemistry	0	0	0
5		Elective I	Paper-1	3	3	Bio Processing Technology	25	75	100
				<b>30</b>	<b>15</b>		<b>100</b>	<b>300</b>	<b>400</b>
<b>SEMESTER II</b>									
6		MAIN	Paper-4	5	4	Biophysics, Bio-Statistics and Computer Applications	25	75	100
7		MAIN	Paper-5	5	4	plant Molecular Biotechnology	25	75	100
8		MAIN	Paper-6	5	5	Animal Biotechnology	25	75	100
9		MAIN	Practical-1	0	4	Core Practical (Out of Papers 1, 2 and 3) 1. Lab in Cell and Molecular Biology 2. Lab in Microbiology and Microbial Technology 3. Lab in Advanced Biochemistry	40	60	100
10		MAIN	Practical-2	10	4	Core Practical (Out of Papers 4, 5 and 6) 5. Lab IN Plant Molecular Biotechnology	40	60	100

## M.Sc. Biotechnology: Syllabus (CBCS)

11		Elective II	Paper-2	3	3	Bioinformatics	25	75	100
12		Compulsory paper		2	4	Human Rights	25	75	100
				<b>30</b>	<b>27</b>		<b>205</b>	<b>495</b>	<b>700</b>
<b>SEMESTER III</b>							<b>CIA</b>	<b>Uni. Exam</b>	<b>Total</b>
13		MAIN	Paper-7	5	4	Recombinant DNA Technology	25	75	100
14		MAIN	Paper-8	5	4	Immunology and Immunotechnology	25	75	100
15		MAIN	Paper-9	4	4	Enzyme and Enzyme Technology	25	75	100
16		MAIN	Practical-3	5	0	Core Practical (Out of Papers 7 and 8) 1. Lab in Recombinant DNA Technology 2. Lab in Immunology and Immunotechnology	0	0	0
17		MAIN	Practical-4	5	0	Core Practical (Out of Papers 9) 1. Lab in Enzymology and Enzyme Technology	0	0	0
18		Elective III	Paper-3	3	3	Natural Products and Intellectual Property Rights	25	75	100
19		Elective IV	Paper-4	3	3	Vermicomposting Technology	25	75	100
				<b>30</b>	<b>18</b>		<b>125</b>	<b>375</b>	<b>500</b>
<b>SEMESTER IV</b>							<b>CIA</b>	<b>Uni. Exam</b>	<b>Total</b>
20		MAIN	Paper-10	5	4	Research Methodology	25	75	100
21		MAIN	Practical-3	0	4	Core Practical (Out of Papers 7 and 8) 1. Lab in Recombinant DNA Technology 2. Lab in Immunology and Immunotechnology	40	60	100
22		MAIN	Practical-4	0	4	Core Practical (Out of Papers 9) 1. Lab in Enzymology and Enzyme Technology	40	60	100
23		MAIN	Paper-1	22	15	Project / Dissertation with Viva Voce	50	150	200
24		Elective V	Paper-5	3	3	Biotechnology Biosafety and Bioethics	25	75	100
				<b>30</b>	<b>30</b>		<b>180</b>	<b>420</b>	<b>600</b>

<b>Subject</b>	<b>Papers</b>	<b>Credit</b>	<b>Total Credits</b>	<b>Marks</b>	<b>Total marks</b>
MAIN	10	4-5	40	100	1000
MAIN PRACTICAL	4	4-5	16	400	400
ELECTIVE	5	3	15	100	500
MAIN PROJECT	1	2	15	200	200
COMPULSORY PAPER	1	4	4	100	100
<b>Total</b>	<b>21</b>		<b>90</b>		<b>2200</b>

**THIRUVALLUVAR UNIVERSITY**

**M.Sc. BIOTECHNOLOGY**

**SYLLABUS**

**UNDER CBCS**

**(with effect from 2012 -2013 )**

**SEMESTER I**

**PAPER – 1**

**CELL AND MOLECULAR BIOLOGY**

**UNIT-I**

Cell Theory, Emergence of modern cell biology, Structure of Prokaryotic and Eukaryotic cells-Cell-wall, Membrane, Cell organelles-organization and functions, Chromosome-Structure and functions-Giant chromosomes.

**UNIT-II**

Central dogma of molecular Biology.DNA Replication. Prokaryotic and Eukaryotic DNA replication, Mechanism of DNA replication,Enzymes and accessory proteins involved in DNA replication.DNA Repair – light and dark mechanisms. Recombination. Regulation of gene expression-lac and trp operons.

**UNIT-III**

Transcription-Prokaryotics transcription,Eukaryotics transcription,RNA polymerase,General and specific transcription factors, Regulatory elements and mechanisms of transcription regulation, Transcriptional and post-transcriptional gene silencing.Modifications in RNA.5' cap formation, transcription, 3'-end processing and polyadenylation,splicing,Editing,Nuclear export of mRNA.

**UNIT-IV**

Translation-Prokaryotic and eukaryotic translation, the translation machinery,Machanisms of initiation,elongation and termination,Regulation of translation,co- and post-translational modifications of proteins.Protein Localization.Synthesis of Secretory and membrane proteins,import into nucleus, mitochondria and chloroplast.Receptor mediated endocytosis.

**UNIT-V**

Molecular Mapping of Genome-Genetic and physical maps,physical mapping and map based cloning, Southern and fluorescence in situ hybridization in genome analysis,RFLP,RAPD and AFLP

analysis, Molecular markers linked to disease resistance genes, Application of RFLP in forensic, disease prognosis, genetic counseling, and pedigree, varietal etc.

**References:**

1. Molecular cloning: A Laboratory Manual, J.Sambrook, E.F.Ritsch and I.Maniatis, Cold Spring Hratbor Laboratory Press, New York, 2000.
2. Introduction to Practical Molecular Biology, P.D.Dabre, John Wiley and Son Ltd. New York, 1988.
3. Molecular Biology, Labfax, T.A.Brown, Bioscientific publishers ltd, Oxford, 1991.
4. Molecular Biology of gene(4th Edition), J.D.Watson, N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner. The Benjamin/Cummings publications C Inc.California, 1987.
5. Molecular Cell Biology(2nd Edition, J.Darnell, H.Lodish and D.Baltimore, Scientific American Book, USA, 1994.
6. Molecular Biology of the Cell (2nd Editiion) B.Aberts, D.Bray, J.Lewis, M.Raff, K.Roberts and J.D.Watson, Garland Publishing, Inc.New York, 1994.
7. Gene VII Benjamin Lewin. Oxford University Press. U.K.
8. Molecular Biology and Biotechnology. A comprehensive dies reference. R.A.Meyers (Edition).VCH Publishers, Inc., New York, 1995.
9. Genomes, T.S.Brown.
10. Molecular Biology and Biotechnology. J.M.Walker and R.Rapley. 2005.
11. Molecular Biology of the cell, Alberts, B et al. (1994)
12. Molecular Cell Biology , Lodish et al.
13. Reproduction in Eukaryotic cells, D.M.Presco, Academic Press.
14. Developmental Biology, SF.Gillbert, Sinauor Associates Inc.
15. Cell in Development and Inhertiance, EB Wilson, MacMillan, New York.
16. Molecular Biology of steroid and nuclear hormone receptors, LP Freema Birkhuser.
17. Cell and Molecular Biology- DeRoberties and DeRoberties (2004)
18. Cell and Molecular Biology, Gerald Karp (1999)
19. Cell and Molecular Biology, P.K.Gupta, (2002)
20. The world of Cell-Becker,W.M *et.al*.6th edition.Pearson Education.2007.

## **PAPER – 2**

### **MICROBIOLOGY AND MICROBIAL TECHNOLOGY**

#### **UNIT-I**

Classification of microorganism - Kingdom - protista, prokaryotic and eukaryotic microorganisms, the five-kingdom concept of classification, archaeobacteria, eubacteria and eukaryotes; History of Microbiology;

Microscopy - light, electron and laser optic system; micrometry.

#### **UNIT-II**

Prokaryotic and Eukaryotic cell structures; pure culture techniques- isolation, cultivation, enumeration and preservation of microbes; staining techniques- simple and differential staining.

Nutritional requirements and nutritional grouping of microorganisms; Different media (simple, complex and defined) - Growth curve; Axenic culture, Synchronous culture, Continuous culture; Different; Effects of physical and chemical factors on microbial growth.

Microbial genetics-recombination - transformation, transduction, conjugation, regulation of gene expression.

#### **UNIT-III**

Microbial diversity - Methods to assess microbial diversity, Merits and demerits of culture dependent and culture independent methods. Molecular analysis of bacterial community: Denaturing Gradient Gel Electrophoresis (DGGE), Terminal Restriction Fragment Length Polymorphism (T-RFLP), Amplified Ribosomal DNA and Restriction Analysis (ARDRA).

#### **UNIT-IV**

Microbes in natural habitats - air, water & soil. Industrial application of microbes - Wine, Beer, Cheese, Yogurt. Primary and secondary metabolites and their applications; preservation of food; biogas; bio-fertilizers and bio-pesticides; leaching of ores by microorganisms; microorganisms and pollution control-bioremediation; biosensors.

#### **UNIT-V**

Microbial Pathogenicity - toxins, mode of action. Bacterial pathogens - Staphylococcus, Streptococcus, Escherichia, Salmonella & Mycobacterium. Viral pathogens - Influenza, Rabies, Enterovirus, Retrovirus, Oncogenic viruses.

Control of microorganisms - physical and chemical methods - antibiotics and chemotherapeutic agents - anti microbial susceptibility test.

**Books for Reference:**

1. Microbiology, L.M. Prescott, J.P. Harley and D.A. Klein, 7/e, 2007. McGraw Hill, Boston.
2. Microbiology, L.M. Prescott, J.P. Harley and D.A. Klein, 6/e, 2005. McGraw Hill, Boston.
3. Fundamental Principles of Bacteriology, A.J. Salle, 1999. Tata McGraw - Hill Publishing Company Limited, New Delhi.
4. Medical Microbiology, D. Greenwood, R. Slack and J. Peutherer, 1997. ELST with Churchill Livingstone, Hong Kong.
5. Microbial Ecology. Fundamentals and Applications, R. M. Atlas and R. Bartha, 2000.
6. Microbiology, M.J. Pelzer Jr., E.C.S. Chan and N.R. Kreig, 1993. McGraw Hill Inc., New York.
7. Microbial Functional Genomics, J.Zhou, D.K. Thomson. Y.Xu. J.M. Tiedje. J.Wiley, 2004.

**PAPER – 3**

**ADVANCED BIOCHEMISTRY**

**UNIT-I**

Chemical foundations of biology - pH, pK, acids, bases, ionic bonds, covalent bonds and secondary bonds (hydrogen bonds and Vander Waal's bonds).

**UNIT-II**

Definition, nomenclature, classification, structure, chemistry and properties of Carbohydrates, Proteins, Amino acids, Lipids and Nucleic acids - Polynucleotides, protein like haemoglobin, myoglobin and plasma proteins - classification of porphyrines: structure and properties - structure of metalloporphyrines- haeme and chlorophyll.

**UNIT-III**

Metabolism of Carbohydrates, Proteins, Amino acids, Lipids and Nucleic acids-their biosynthesis and degradation; mechanism of oxidative phosphorylation and its inhibitors, and photophosphorylation, urea cycle.

**UNIT-IV**

Heterocyclic compounds and secondary metabolites - prostaglandins, interferons and interleukins, antibodies, alkaloids, plant and animal pigments.

Isolation and separation techniques: chromatography - gas chromatography and high - performance liquid chromatography.

**UNIT-V**

Enzymes: general aspects (classification and structure), allosteric mechanism, regulatory and active sites, isoenzymes, enzyme kinetics, enzymatic catalysis.

**Books for Reference:**

1. Biochemistry, 4th edition, L.Stryer., 1999. W.H, Freeman & company, New York.
2. Molecular Biomethods Handbook, R.Rapley & J.M. Walker, 1998. Humana press.
3. Principles of Biochemistry, AL. Lehninger, D.L. Nelson and M. M. Cox., 1993. Worth Publishers, New York.
4. Biochemistry 4th edition, G. Zubay, 1998. Mc Millan Publishing Co. New York.



**ELECTIVE**

**PAPER – 1**

**BIO-PROCESSING TECHNOLOGY**

**UNIT-I**

Introduction to fermentation : rate of microbial growth and death. Fermentation - types, classification, basic requirements, design of a fermentor, factors involved in fermentor design - basic functions - containment body construction - temperature control-stirring and mixing.

**UNIT-II**

Isolation and preservation of industrially important microorganisms - strain development mutation and recombination - upstream processing. Media for industrial fermentation - characteristics of an ideal production medium - raw material - screening for production media - media formulation - sterilization - (batch and continuous) - addition of antifoaming agents.

**UNIT-III**

The development of inoculums for various fermentation processes - operation, measurement and control in fermentation - aeration and agitation in fermentation - oxygen requirement - measurement of adsorption coefficients - bubble aeration, mechanical agitation. Sterilization-air sterilization, media sterilization - recovery and purification of intracellular and extra cellular products.

**UNIT-IV**

Fermentation kinetics of batch, continuous and fed batch fermentation - cell recycle - scale up window - principle types of fermentor: tower fermentor, cylindro conical, airlift fermentor, deep jet fermentor, photo bioreactor, membrane bioreactor and Micro carrier reactors. M

**UNIT-V**

Biological waste treatment and in-plant sanitation - principle and use of biosensor - production of vitamins, amino acids, organic acids, enzymes and antibiotics, alcohols. Enzyme technology - production and recovery of enzymes, enzyme immobilization - application of enzyme in industries. Biosensors - types and application in various industries.

**Suggested Readings:**

1. Stanbury P.P. and Whitaker, A. 1984. Principles of Fermentation Technology. Pergamon Press, Oxford UK.
2. Steinkraus, K.H. 1983. Handbook of Indigenous Fermented Foods. Marcel Dekker, New York.
3. Casida, J.E., 1968. Industrial Microbiology, Wiley Eastern Publication
4. Cruegar, W. and Cregar, A., 1989. Biotechnology: A text book of industrial Microbiology, 2nd edition. Panima Publishing corpotation, New Delhi.
5. Patel. A.H. 1966. Industrial Microbiology, Mac Millan India Ltd.
6. Stanbury, A.H., A. Whittaker and Hall S.J. 1995. Principles of fermentation technology 2nd edition, Pergamon Press.

## SEMESTER II

### PAPER – 4

## BIOPHYSICS, BIOSTATISTICS AND COMPUTER APPLICATIONS

### UNIT-I

Definition, scope and methods of biophysics - biological individuality, finalism and causality.

Physics of atoms and molecules - atomic structure - atomic orbital, wave functions - electronic structure of atoms, spin of particles - relationship between atomic structure and chemical properties. Formation of molecules from atoms: bonds - different types - properties and strength - molecular orbital - molecular chirality in biological systems.

### UNIT-II

Biological macromolecules - physics of proteins, three dimensional structure and confirmation using physical methods (principles and applications of electrophoresis, chromatography, viscosity, spectrophotometry, ORD, CD, NMR, ESR to study biomolecules). Nucleic acids - physical structure, intramolecular interactions, melting of double helix, unwinding and other reactions. Biological membranes - structure, conformation, transport, electrical properties and molecular reception.

### UNIT-III

Definition - scope of biostatistics - Population and Sample - collection, classification, and tabulation of data - graphical and diagrammatic representation - scale diagram - histograms - pie diagrams - frequency polygon - frequency curves.

### UNIT-IV

Measures of central tendency - arithmetic mean, median, and mode - calculation of mean, median and mode in series of individual observation, discrete series continuous open - end classes. Measure of dispersion - standard deviation and standard curves.

### UNIT-V

Fundamentals of computers: classification - computer organization - parts of computers (input & output) - computer peripherals (mouse & modem); A basic knowledge of networking - internet and e-mail facilities- language- flow charting examples.

### Books for Reference:

1. Physical Biochemistry, Applications to Biochemistry and Molecular Biology - D, Freifelder.
2. General Biophysics, Vol. I & II - H.V. Volkones.
3. Molecular Biophysics - B. Pullman & M. Voino.
4. Bio statistics, Arora .P. N, Malhan .P .K. Himalaya Publishing House.

5. Statistical methods in Biology, 3rd Edition, Baily Norman T.J., 1959. Cambridge University Press.
6. Elements of Bio statistics, Prasad. S. Rastogi Publications.
7. An Introduction to Bio statistics. A manual for students in health science practice Sundar Rao, P.S.S, Richard, J. - Hall Publications.
8. Digital Computer Fundamentals, Bartee, 6th Edn.
9. Fundamentals of Computer algorithms, Horowitz, Shahni, Rajasekaran.

**PAPER – 5**

**PLANT MOLECULAR BIOTECHNOLOGY**

**UNIT-I**

Plant genome organization, structural features of a representative plant gene. Organization of chloroplast genome and mitochondrial genome - Plant genetic diversity - variation allozyme, RFLP and RAPD techniques - A general account of IBPGR and NBPGR.

**UNIT-II**

Cell and tissue culture - plant tissue culture media, plant hormones and growth regulators in tissue culture, preparation of suitable explants - Immunodiagnosics and molecular diagnostics in selection of elite plant species - Callus culture, suspension cultures, embryo culture; anther, pollen and ovary cultures. Micropropagation of plants - somatic embryogenesis, protoplast culture, somatic hybridization and synthetic seeds.

**UNIT-III**

Symbiotic nitrogen fixation in legumes by rhizobia - biochemistry and molecular biology; Agrobacterium and crown gall tumours - mechanism of T-DNA transfer to plants - Ti plasmid vectors for plant transformation - Agroinfection - molecular biology of plant stress response (stress genes).

**UNIT-IV**

Genetic engineering in plants, selectable markers, reporter genes and promoters used in plant vectors - direct transformation of plants by physical methods.

Application of DNA technology - transgenic plants with reference to virus and pest resistances - herbicidal resistance - stress tolerance (heat & salt) - cytoplasmic male sterility - resistance to fungi and bacteria - delay of fruit ripening - secondary metabolite production.

**UNIT-V**

Gene regulation - inducible enzymes, regulatory mutations, repressor, operon, promotor, catabolic repression, repressible enzyme systems, control by attenuation, positive control, gene regulation in eukaryotes, transcriptional regulation, post transcriptional regulation, hormones & gene expression; viruses & gene expression, genetic control of pattern formation in plant development.

## PAPER – 6

### ANIMAL BIOTECHNOLOGY

#### UNIT-I

Structure and organization of animal cell, cell physiology. Equipments and materials for animal cell culture technology. Aseptic Technique for cell cultures. Cryopreservation.

#### UNIT-II

Preparation and Sterilization of cell culture media and reagents. Introduction to the balance salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide.

#### UNIT-III

Role of serum and supplements, Serum & protein free defined media and their applications. Measurement of viability and cytotoxicity. Biology and characterization of cultured cells, measuring parameters of growth.

#### UNIT-IV

Basic techniques of mammalian cell culture in vitro; disaggregation of tissue and primary culture; maintenance of cell culture; cell separation. Scaling – up of animal cell culture, Cell synchronization. Cell cloning, micromanipulation and types of cloning. Cell transformation. Application of animal cell culture.

#### UNIT-V

Stem cell culture, embryonic stem cells and their applications. Cell culture based vaccines. Somatic cell genetics. Organ and histotypic cultures. Measurement of cell death. Apoptosis. Three dimensional culture and tissue engineering. 18

#### References:

1. Culture of Animal cells, 3rd Edition, R. Ian Freshney. A John Wiley & Sons, Inc., publications.
2. Animal Cell Culture- Practical Approach, R.W. Masters, Oxford. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
3. Animal Cell Biotechnology, Methods and protocols, Nigel Jenkins, Humana Press.
4. Biotechnology of Animal Tissue. P.R.Yadav & Rajiv Tyagi. 2006. Discovery Publishing House. New Delhi.
5. From Genes to Clones Introduction to Gene Technology - **Winnacker, E.L.**1987., Panima Educational Book Agency, New Delhi.
6. Gene VII -**Benjamin Lewin**, 2000. Oxford University Press, UK.
7. Principles of Gene Manipulation and Genomics - **Primrose, S.B. and Twyman, R.M.** 2006. 7th Edition. Blackwell Publishing Company. .
8. Recombinant DNA Second Edition - **James D. Watson, Micheal Gilman,MarkZoller**, 2001. W.H. Freeman and Company, New York.
9. Biotechnology,**Satyanarayana.** U, (2008), Books and Allied (p) Ltd.

## **LAB IN CELL AND MOLECULAR BIOLOGY**

1. Observation of prokaryotic and eukaryotic cells and cell types - Living Cells / Temporary / Permanent Preparations.
2. Squash preparation of giant chromosome of salivary gland of chironomous larva.
3. Squash preparation of onion root tip, testis and anther lobes.
4. Preparation of buccal smear.
5. Isolation, determination, purification and separation of protein, carbohydrates, lipids, DNA and RNA.

## LAB IN MICROBIOLOGY AND MICROBIAL TECHNOLOGY

1. Sterilization and preparation of media, Enumeration of bacteria and fungi from environmental samples - soil, water and air. Techniques for pure culture - streaking, pour plate and spread plate.
2. Stains and staining techniques, simple staining, negative staining & differential staining techniques. Motility studies.
3. Bacterial growth - Growth curve, factors affecting bacterial growth - pH, Temperature and Salinity.
4. Biochemical tests for identification of bacteria.
5. Antimicrobial assay, phenol coefficient, agar plate sensitive method.
6. Cultivation and morphology of molds and yeast
7. Microbiological analysis of urine and blood specimens
8. Water quality analysis - MPN method.
9. Microbial analysis of food samples, methylene blue reduction test for milk.
10. Microbial production of food and beverages by fermentation-wine and yogurt
11. Isolation of UV-mutant, isolation of antibiotic resistant strains and tryptophan mutant. Ames test to screen for chemical carcinogens.

### Books for Reference:

1. Microbiology: A Laboratory Manual, J.G. Cappuccino and N. Sherman, 2002. Addison-Wesley.
2. Laboratory Manual of Experimental Microbiology, R.M. Atlas, A.E. Brown and L.C. Parks, 1995. Mosby, St. Louis.
3. Laboratory Manual in General Microbiology, N. Kannan, 2002. Panima Publishers.
4. Bergey's Manual of Determinative Bacteriology. Ninth edition J.G.Holt, N.R.Krieg, Lippincott Williams, 2000. Wilkin Publishers. 7



### LAB IN ADVANCED BIOCHEMISTRY

1. pH measurements and preparation of buffers.
2. Determination of Chl.a, Chl.b & total Chl. by Arnon method.
3. Qualitative tests for carbohydrates, alkaloids, terpenoids, fatty acids, phenolics.
4. Estimation of total soluble sugars.
5. Estimation of proteins by Lowry's method.
6. Determination of saponification number of lipids.
7. Estimation of amino acids.
8. Separation and identification of sugars and amino acids by chromatography.
9. Biochemical estimation of DNA/RNA using spectrophotometer.

#### Reference:

1. Physiology Chemistry, Oser.B.L.Hawks, 1965. TATA McGrew Hill.
2. Laboratory manual in biochemistry, Strolve, B.L.A., Mzka vora, V.C., 1989. MIR Publisher, Moscow.
3. Biochemical methods, Sadasivam and Manikam, 1996. New age international publishers, Second Edition. New Delhi
4. Biochemical methods, Sridhar and Mahadevan. Madras University, Chennai.

## LAB IN PLANT MOLECULAR BIOTECHNOLOGY

1. Assessment of genetic variation related to plant taxa using allozyme method.
2. Tissue culture methods-media preparation, sterilization, inoculation of explants, callus culture, suspension cultures, anther and ovule cultures.
3. Isolation of protoplasts, viability test for protoplasts, protoplast culture.
4. Working gel documentation system and analysis of electrophoretic gels.
5. Quantification of DNA and RNA in plant tissues by spectrophotometer method.

### Books for Reference:

1. Plant molecular biology, Grierson and S.N. Convey, 1988. Blackie.
2. Genetic engineering of crop plants, G.W. Lycett and D. Grierson (Eds.), 1990.
3. Plants, Genes and Agriculture, M. J. Chrispeeds and D.F. Sadava, 1994. Jones and Barlett.
4. Molecular Biotechnology - Principles and Applications in Recombinant DNA, Glick and Paster mark, 2002. Panima Publishing Co-operation.
5. Molecular cloning- a lab manual, Manites Vol I-III.
6. Biotechnology - V, Rajeshwari S. Setty and G. R. Veena, 2003. New age International Publishers (p) Ltd., New Delhi.
7. Genetic engineering of plants, Kosuage, T. and Meredith, C.P., 1989. Hollaender Plenum Press.
8. Conservation and genetic resources, Virchow, D., 1998. Springer Verlag, Berlin.
9. Molecular plant development from gene to plant, Pester Westhoff.
10. Molecular genetics of plant development, Howell, S. H.
11. Methods in Plant molecular biology. A laboratory course manual by (Ed.) Oak Nakuga, 1995. Cold spring Harbour Laboratory Press.
12. Plant Genetic Transformation and Gene expression, (Eds.) J. Draper et al., 1988. Blackwell scientific publications, Oxford.
13. Plant molecular biology. Manual, S.B. Gelvin, R.A. Sehil Peroort and D.P.S. Verma (Eds.), 1991. Kluwer Academic Publishers, Doredrect.

**ELECTIVE**

**PAPER – 2**

**BIOINFORMATICS**

**UNIT-I**

Bioinformatics - definition, history, web servers, computer systems, languages - machine, high level and assembly.

Internet basics - internet connection, web browsing and URL. Role of bioinformatics in Human Genome Project.

**UNIT-II**

Introduction to biological databases - sequence databases, structural databases, specialized databases, sequence retrieval system from net - SRS, ENTREZ

**UNIT-III**

Protein structure prediction - gene and protein expression data, protein interaction data, similarity and database searching tools - FASTA, BLAST

**UNIT-IV**

Sequence analysis and phylogeny - sequence and similarity, sequence alignment - local, global, pair wise and multiple sequence, introduction to scoring matrices - PAM and BLOSSUM, introduction to phylogenetic trees.

**UNIT-V**

Introduction to drug discovery - history of drug discovery, analogue and structural drug discovery, ligand designing and optimization, docking, applications of molecular modeling in drug discovery.

**Books for Reference:**

1. Introduction to computers by Alexis leon and Mathews Leon
2. Fundamentals of computers, Rajaraman, V.
3. Bioinformatics for the beginners, Mani and Vijayaraj.
4. Bioinformatics basic skills and applications by Rastogy.
5. Introduction to bioinformatics, AH wood, T.K. Parry Smith DJ, Pearson education Asia, 2001.
6. Developing bioinformatics in computer skills, Gibas C, Jambeek P., 2001. Oreilly & associates inc. Shrott publishes.

## SEMESTER III

### PAPER – 7

## RECOMBINANT DNA TECHNOLOGY

### UNIT-I

Enzymes in genetic engineering - restriction endonucleases - ligases - alkaline phosphatase - polynucleotide kinase - terminal deoxynucleotidyl transferase - S1 nuclease - DNA polymerase I, holoEnzyme - DNA polymerase III, Klenow fragment - TAQ DNA polymerase - RNases - ribonuclease - reverse transcriptase – poly (A) polymerase - deoxyribonuclease.

### UNIT-II

Vectors - plasmids - replication - size - copy number - amplification - types - isolation of plasmid DNA - criteria for plasmid cloning; cloning vectors based on bacterial plasmids - plasmid pBR322 - origin - advantage - Col E1 plasmid DNA - Col E1 Amp plasmid DNA - pBR325 plasmid DNA - pMB9 plasmid DNA - pTZ plasmids; bacteriophage vector for E. coli - phage - as a vector - lambda replacement and insertion vectors - M13 bacteriophage - genetic organization & construction; cosmid vectors and their use; virus vectors for animal cells; vector for plant cells; shuttle vectors; expression vectors.

### UNIT-III

Cloning strategies - core techniques is gene manipulating; cutting and joining DNA - introduction of DNA into cells - Cloning strategies - construction of genomic libraries and cDNA libraries - probe construction, labeling.

### UNIT-IV

Methods of selection and screening of recombinant DNA - gene transfer techniques - molecular mechanism of anti sense technology - inhibition of splicing - poly adenylation & translation, disruption of RNA structure & capping - application of anti sensing technology.

### UNIT-V

Genetic engineering technique and its applications - RAPD, RFLP, micro array & sequencing and PCR and their applications.

### Books for Reference:

1. Principles of gene manipulations, R.N. Old and S.B. Primrose, 1994. Blackwell Scientific Publications.
2. DNA Cloning I & II, D.M. Glover & B.D. Hames, 1995. IRL Press.
3. PCR Strategies, M.A. Innis, D.H. Gelfant & J.J. Sninsky, 1995. IRL Press.
4. Recombinant DNA (2nd Ed), J.D. Watson, M. Gillman, J. Witknowski and M. Zoller, 1992. Scientific Americans books, N.Y.
5. Genetic Engineering of Animals, A. Puhler, 1993. VCH Publishes, Weinheim FRG.
6. Gene Transfer and expression protocols - methods in molecular biology volume 7, E.T. Murray, 1991. Humana Press.

## PAPER – 8

### IMMUNOLOGY AND IMMUNOTECHNOLOGY

#### UNIT-I

History and scope of immunology - types of immunity - anatomy of lymphoid organs; primary and secondary lymphoid organs - immunoglobulin structure - function and synthesis; memory cells, idiotypic network, lymphocyte differentiation.

#### UNIT-II

Biology of complement systems - structure and function of MHC class I and II molecules - antigen recognition and presentation - humoral and Cell mediated immune responses - hypersensitivity reaction - immune suppression and immune tolerance - auto immune disorders.

#### UNIT-III

Antigen - isolation, purification and characterization of various antigens and haptens - antibodies - production, purification and quantification of immunoglobulins; antigen - antibody reaction; hybridoma and monoclonal antibody production; immuno-diagnosis and applications - human monoclonal antibodies; catalytical antibodies - complement fixation - assessment of immune complexes in tissues.

#### UNIT-IV

Purification of mononuclear cells from peripheral blood - isolation and characterization of T cells subsets; B cells and macrophages; fluorescent activated cell sorter - mitogen and antigen induced lympho-proliferation assay - cell mediated lympholysis - mixed lymphocyte reaction - assessment of delayed hypersensitivity reactions - macrophage cultures - assay of macrophage activation - isolation of dendritic cells - In situ and In vivo characterization of cells from tissues - generation of T cell clones - HLA typing.

#### UNIT-V

Biology and assay of cytokines - Vaccine technology including DNA vaccines - identification of T and B epitopes for vaccine development - immunodiagnosis of Infectious diseases - immuno screening of recombinant library.

#### Books for Reference:

1. Immunology, Richard A. Goldsby, Thomas J. Kindt. Barbara, A. Osborne, Janis Kuby 5th Edition, 2003. W. H. Freeman & Company.
2. Immunology, L.M. Roitt, J. Brestoff and D.K. Male, 1996.
3. Immunology, V Edition - Richard A.Goldsby, Thomas. J. Kindt, A. Osborne, JanisKuby, 2003. W.H. Freeman and company.

4. Immuno-biology, Janeway CA and Paul Travers 1994.
5. Immunological techniques, D.M. Weir, 1992.
6. Immunology, I. Roitt, 1960
7. Current Protocols in Immunology 3 Volumes, Wiley Publications 1994.
8. Monoclonal Antibodies: Principles and Practice, J. W. Goding, 1983. Academic Press
9. Hybridoma Technology in the Biosciences and medicine, T.A. Springer, 1985. Plenum Press NY.
10. Vaccines, New Approaches to immunization, F.Brown, R.M.Chanock, KA Lerner, 1986. Cold spring Harborlab.
11. Topley and Wilson principles of bacteriology, Virology and immunology, G. Wilson, A.Miles, M.T.Paker, 1984. Arnold, Heineman.
12. Basic and Clinical Immunology, D.P. Stities and J.D. Stobo.

## PAPER – 9

### ENZYME AND ENZYME TECHNOLOGY

#### UNIT-I

Enzyme classification & nomenclature of enzymes (IUB); extraction, isolation and purification of enzyme by various methods.

#### UNIT-II

Mechanism of enzyme action - concept of active site and energetic of enzyme substrate complex formation - specificity of enzyme action; kinetics of single substrate reactions - turnover number - estimation of Michaelis - Menten's parameters; multi-substrate reactions - mechanisms & kinetics; allosteric regulation of enzymes.

#### UNIT-III

Enzyme inhibitions - kinetics of competitive, non-competitive & uncompetitive inhibitions; nucleophilic & electrophilic attack; role of metal ions in enzyme catalysis.

#### UNIT-IV

Immobilized enzymes - principles & techniques of immobilization - commercial production of enzymes; amylases, proteases, cellulose, artificial enzymes, industrial applications, fermentation, enzymes modification, site directed mutagenesis; immobilized enzyme in industrial processes.

#### UNIT-V

Structure and function of coenzyme - reactions involving TPP, pyrodoxal phosphate, nicotinamide, flavin nucleotide, coenzyme A and biotin. Industrial utilization of enzymes, food, detergents, energy, waste treatment, pharmaceuticals and medicine.

#### Books for Reference:

1. Biological chemistry, H.R Mahier & E. Cordes 1986.
2. Enzymes, Dizon & Webb.
3. Genes VII, Benjemin Lewin, 1994. Oxford University Press. Oxford
4. Principles of Biochemistry, AL. Lehninger, D.L. Nelson and M. M. Cox. 1993. Worth Publishers, New York.

**ELECTIVE**

**PAPER – 3**

**NATURAL PRODUCTS AND INTELLECTUAL PROPERTY RIGHTS**

**UNIT-I**

Classification of crude drugs - Scheme for pharmacognostic studies of a crude drug; Phytopharmaceuticals - commercial significance of herbal products - current trend of market.

**UNIT-II**

Herbal products: carbohydrates and derived products - drugs containing glycosides, tannins, lipids (fixed oils, fats and waxes), volatile oils and terpenoids, enzymes and proteins, alkaloids - Marine drugs.

**UNIT-III**

Analytical pharmacognosy: Drug adulteration - types - methods of drug evaluation; Biological testing of herbal drugs - Preliminary phytochemical screening for plant products - Qualitative chemical tests - Chromatography (TLC, GLC, and HPLC).

**UNIT-IV**

Intellectual property rights -TRIP International conventions patents and methods of application of patents - legal implications biodiversity and farmer rights - beneficial applications and development of research focus of the need of the poor - Identification of directions for yield effect in agriculture - aquaculture and bioremediation

**UNIT-V**

Objectives of the patent system - basic principles and general requirements of patent law-biotechnological inventions and patent law - legal development - patentable subjects and protection in biotechnology - The patentability of microorganisms - IPR and WTO regime - consumer protection and plant genetic resources-GATT and TRIPS.

**Books for Reference:**

1. A Lexicon of medicinal plants in India, D.N.Guhabakshi, P.Sensarma and D.C.Pal, 1999. Naya prokash - publications.
2. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.
3. Ethnobotany The Renaissance of Traditional Herbal Medicine, Rajiv K.Sinha, 1996. INA SHREE publishers.



4. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book Distributors.
5. Herbal plants and Drugs, Agnes Arber, 1999. Mangal Deep Publications.
6. Contribution to Indian Ethnobotany by Editor S.K.Jain, 1991 Scientific Publishers.
7. New Natural products and Plants drugs with Pharmacological, Biological (or) Therapeutical activity, H.Wagner and P.Wolff, 1979. Springer, New Delhi.
8. Ayurvedic drugs and their plant source, V.V.Sivarajan and Balachandran Indra, 1994. Oxford IBH publishing Co.
9. Ayurveda and Aromatherapy, Miller, Light and Miller, Bryan, 1988. Banarsidass, Delhi.
10. Principles of Ayurveda, Anne Green, 2000. Thorsons, London.
11. Pharmacognosy, Dr.C.K.Kokate et al.1999. Nirali Prakashan.
12. Biotechnology and Patent protection, Beier, F.K., Crespi, R.S. and Straus, T., 1985. Oxford and IBH Publishing Co, New Delhi.
13. Intellectual Property rights on Biotechnology, Singh K, BCIL, New Delhi
14. [www.ipr-helpdesk.org/](http://www.ipr-helpdesk.org/)
15. [www.patentoffice.nic.in/ipr/patent/patents.htm](http://www.patentoffice.nic.in/ipr/patent/patents.htm)
16. [www.bangalorebio.com/GovtInfo/ipr.htm](http://www.bangalorebio.com/GovtInfo/ipr.htm)

**ELECTIVE**

**PAPER – 4**

**VERMICOMPOSTING TECHNOLOGY**

**UNIT-I**

Earthworms: morphological and economic importance of earthworms - need for earthworm culture.

**UNIT-II**

Vermiculture: definition, scope and importance - common species for culture - Environmental requirements - culture methods - wormery breeding techniques - indoor and out door cultures - monoculture and polyculture - relative merits and demerits.

**UNIT-III**

Applications of vermiculture - Vermiculture Bio-technology: vermin-composting, use of vermicastings in organic farming / horticulture - earthworms for management of biomedical solid wastes - feed / bait for capture / culture fisheries - forest regeneration.

**UNIT-IV**

Marketing the products of vermiculture - quality control, market research, marketing techniques - creating the demand by awareness, demonstration, and advertisements - packaging and transport - direct marketing.

**UNIT-V**

Future perspectives - Predator / pathogen control in wormeries - Cost-benefit analysis of vermicomposting - Potentials and constraints for vermiculture in India.

**Books for References:**

1. Sultan Ahmed Ismail, 2005, The Earthworm Book, Second Revised Edition. Mother India Press, Goa.
2. Edwards, C.A. and Bohlen, P.J 1996, ecology of earthworms - 3rd Edition, Chapman and hall.
3. Jsmail, S.A., 1970, Vermicology, The biology of earthworms, Orient Longman, London.
4. Lee, K.E., 1985. Earthworms - Their ecology and Relationship with Soil and Land use, Academic Press, Sydney.

## SEMESTER IV

### PAPER – 10

#### RESEARCH METHODOLOGY

1. **Research:** selection of problems - stages in the execution of research; preparation of manuscript - report writing - format of journals - proof reading - sources of information; journals, reviews, books, and monographs-bibliography.
2. **Journals:** standard of research journals - impact factor - citation index. Information retrieval - access to archives and databases, search engines - google, pubmed - national informatics center network services. Online data base library.
3. **Measures of dispersion:** sampling methods: random sampling - types of variables: qualitative and quantitative variables - continuous and discontinuous variables - scaling method – mean - standard deviation- standard error - coefficient of variation: elucidation with model sums.
4. **Comparison of means:** chi square test, students t test, ANOVA with interpretation of data- introduction to MANOVA- statistical tables and their use - significance test and fixing levels of significance - use of statistical software like COSTAT and STATISTICA.
5. **Bivariate relationships:** Use of correlation and regression, correlation and coefficient - components of regression equation - confidence intervals of regression line. Fitting simple regression lines: model sums - calculations of equation and fitting of regression line.

#### Books for Reference:

1. Writing the doctoral dissertation. Barrons Educational series, 2nd edition, Davis, G.B. and C.A. Parker, 1997. pp 160.
2. Authoring a PhD, thesis: how to plan, draft, write and finish a doctoral dissertation, Duncary, P. 2003. Macmillan, pp 256.
3. MS office, Sexena, S. 2001. Vikas Publishing House Pvt. Ltd., New Delhi M

#### REFERENCES:

1. Sultan Ahmed Ismail, 2005, The Earthworm Book, Second Revised Edition. Mother India Press, Goa.
2. . Edwards, C.A. and Bohlen, P.J 1996, ecology of earthworms - 3rd Edition, Chapman and hall.
3. Jsmail, S.A., 1970, Vermicology, The biology of earthworms, Orient Longman, London.
4. Lee, K.E., 1985. Earthworms - Their ecology and Relationship with Soil and Land use, Academic Press, Sydney.

**ELECTIVE**

**PAPER – 5**

**BIOTECHNOLOGY, BIOSAFETY AND BIOETHICS**

**UNIT-I**

Biotechnology - Society, Risks, Ethics and Patenting. Benefits of biotechnology, ELSI of biotechnology, Recombinant therapeutic products for human health care. Genetic modifications- recombinant foods, safety of GM foods. Release of genetically engineered organisms-Human embryonic stem cell research-cloning.

**UNIT-II**

Patents - Introduction - Basis of Patentability - Non Patentable Inventions - Patent Application Procedure in India - Treaties and Conventions of Patents - Patent Cooperation Treaty - TRIPS and Pharmaceutical Industry - issues and prospects. Other Forms of IPR: Copyright - Trade Mark - designs - Know How-Patenting of biotechnology products and processes.

**UNIT-III**

Biosafety - definitions - biosafety levels - framework of biosafety regulation in India; Structure and functions of Committees; DBT guidelines on biosafety in conducting research in biology / biotechnology. - Regulations of Genetically modified Organisms in India - Biosafety regulation for transgenic plants and animals - labeling of GM foods

**UNIT-IV**

Bioethics - definition - Bioethics of IPR - ethical criteria in biotechnology- animal ethics; Guidelines for use of lab animals in medical Colleges - Licensing of animal house - Human cloning - Ethical issues - Ethical clearance norms for conducting studies on human subjects. M.Sc. Biotechnology: Syllabus (CBCS)

**UNIT-V**

IPR - Definition- Different forms of IPR - Benefits of IPR system. WTO - Definition, GATT - Definition - Objectives - Structural format of WTO - Economic Impact of WTO - WTO Agreements - Benefits of WTO in relation to biotechnology.

**Books for Reference:**

1. Biosafety, Traylor, Fredric & Koch, 2002. Michigan state University pub., USA
2. Contemporary issues in Bioethics, Beauchamp & Leroy, 1999. Wardsworth Pub. Co. Belmont, California
3. [www.ipr-helpdesk.org/](http://www.ipr-helpdesk.org/)
4. [www.patentoffice.nic.in/ipr/patent/patents.htm](http://www.patentoffice.nic.in/ipr/patent/patents.htm)
5. [www.bangalorebio.com/GovtInfo/ipr.htm](http://www.bangalorebio.com/GovtInfo/ipr.htm)
6. Manual of patent practice and procedure. IPR India, 2005. Ministry of commerce and industry, New Delhi, pp.163.
7. Biotechnology and safety assessment, John.A.Thomas, 2004. pp.333

## **LAB IN RECOMBINANT DNA TECHNOLOGY**

1. Isolation of DNA.
2. Isolation of plasmid
3. Isolation of phages.
4. Extraction of total DNA from plant/animal tissue
5. Restriction digestion
6. Isolation of restriction enzyme
7. Blotting techniques - demonstration
8. PCR amplification - demonstration
9. Ligation
10. RFLP

## LAB IN IMMUNOLOGY AND IMMUNOTECHNOLOGY

1. Blood grouping
2. Blood cell analysis
3. Lymphocyte subset identification and enumeration.
4. Handling of laboratory animals.
5. Routes of inoculation
6. Preparation of antigen - protocol of immunisation
7. Methods of bleeding
8. Preparation of serum components
9. Immunodiffusion
10. Radial immuno-diffusion test.
11. Immuno electrophoresis
12. Complement fixation test
13. ELISA
14. Western blotting - demonstration.
15. Haemagglutination.
16. Serum electrophoresis.
17. Antigen-antibody reaction (precipitation and agglutination reaction tests).

## LAB IN ENZYMOLOGY AND ENZYME TECHNOLOGY

1. Isolation of extra cellular enzymes.
2. Isolation of intra cellular enzymes.
3. Isolation of membrane bound enzymes.
4. Purification of enzymes.
5. Assay of enzyme (protease) activity
6. Enzyme kinetics ( $V_{max}$  and  $k_m$  values)
7. Immobilization of enzyme

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