

THIRUVALLUVAR UNIVERSITY

MASTER OF SCIENCE

DEGREE COURSE

M.Sc. BIOTECHNOLOGY

UNDER CBCS

[with effect from 2008-2009]

The Course of Study and the Scheme of Examinations

Year / Semester	Subject	Paper	Title of the Paper	Ins. Hrs/ Week	Credit	Exam hrs	Max.Marks		
							IA	Uni. Exam.	Total
I Year I Semester	Core	Paper I	Advanced Biochemistry	6	5	3	25	75	100
	Core	Paper II	Cell and Molecular Biology	6	5	3	25	75	100
	Core	Paper III	Microbiology and Microbial Technology	6	5	3	25	75	100
	Core Practical	-	Core Practical (Out of Papers I, II and III)	9	4	-	-	-	-
	Elective I	Paper I	Natural Products and Intellectual Property Rights	3	3	3	25	75	100
I Year II Semester	Core	Paper IV	Biophysics, Bio-statistics and Computer Applications	6	5	3	25	75	100
	Core	Paper V	Plant Molecular Biotechnology	6	5	3	25	75	100
	Core	Paper VI	Animal Cell Culture Technology	6	5	3	25	75	100
	Core	Practical I	Core Practical (Out of Papers I, II and III)	-	-	3/6	40	60	100
	Core	Practical II	Core Practical (Out of Papers V and VI)	9	4	3/6	40	60	100
			Human Rights	2	2	3	25	75	100
	Elective II	Paper II	Bioinformatics	3	3	3	25	75	100
II Year III Semester	Core	Paper VII	Recombinant DNA Technology	5	4	3	25	75	100
	Core	Paper VIII	Immunology and Immunotechnology	5	4	3	25	75	100

M.Sc. Biotechnology: Syllabus (CBCS)

Year / Semester	Subject	Paper	Title of the Paper	Ins. Hrs/ Week	Credit	Exam hrs	Max.Marks		
							IA	Uni. Exam.	Total
	Core	Paper IX	Enzyme and Enzyme Technology	5	4	3	25	75	100
	Core Practical	-	Core Practical (Out of Papers VII, VIII and IX)	9	4	-	-	-	-
	Elective III	Paper III	Bio Processing Technology	3	3	3	25	75	100
	Elective IV (Non-major Subject)	Paper IV	Vermi-Composting Technology	3	3	3	25	75	100
II Year IV Semester	Core	Paper X	Research Methodology	6	5	3	25	75	100
	Core	Practical III	Core Practical (Out of Papers VII, VIII and IX)	-	-	3/6	40	60	100
	Core	Practical IV	Core Practical course: Research Methodology	9	4	3/6	40	60	100
	Elective V	Paper V	Biotechnology, Bio-safety and Bio-ethics	3	3	3	25	75	100
	Core	Paper XI	Core Project/Dissertation with <i>viva voce</i>	12	10	3	75	175	200
Total				120	90				2200

THIRUVALLUVAR UNIVERSITY

M.Sc. BIOTECHNOLOGY

SYLLABUS

UNDER CBCS

(with effect from 2008-2009)

I SEMESTER

PAPER I

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). Classes of organic compounds and functional groups - atomic and molecular dimensions, space filling and ball and stick models.

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, hormonal regulation of mammalian metabolism.

UNIT-IV

Heterocyclic compounds and secondary metabolites - prostaglandins, leukotrienes, thromboxanes, 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.

Cell fractionation by Agarose and Polyacrylamide gel electrophoresis, disc and slab - gel electrophoresis and by differential centrifugation - ultra-centrifugation, density gradient centrifugation.

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.

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, tannins, fatty acids, phenolics, and volatile oils.
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.
10. Determination of amylase, peroxidase, catalase activity 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.

PAPER II

CELL AND MOLECULAR BIOLOGY

UNIT-I

The dynamic cell - the molecules of life - the architecture of cells - cell cycle events - cells into tissues - molecular cell biology - Protein structure and function - Hierarchical structure of proteins - folding, modification and degradation of proteins - functional design of proteins - membrane proteins - purification, detection, and characterization of proteins.

UNIT-II

Molecular structures, biosynthesis of macromolecules (proteins, polysaccharides, nucleic acids) - Biomembranes and subcellular organization of eukaryotic cells - microscopy and cell architecture - purification of cells and their parts - biomembranes organelles of eukaryotic cell.

UNIT-III

Nucleus (structure including ultra structure and functions) - chromosome structure and types - Programmed Cell Death (PCD), DNA - Denaturation and renaturation, C-value paradox and the reasons, circular and spherical DNA - Gene amplification - PCR, DNA finger printing - DNA replication - polymerases, primers and mechanism - molecular methods of DNA replication.

UNIT-IV

RNA - types - molecular organization - genetic code - transcription mechanism in prokaryotes and post transcription processing - enzyme system in transcription - transcription process in eukaryotes.

UNIT-V

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 cross talk among different signaling pathways.

Books for Reference

1. Cell and molecular biology-Concept and experiment. 2nd edn., Harris,D(Ed.), Karp, G.1999. John wiley & sons, New York.
2. Principles of cell and molecular biology. 2nd edn., Mclaughlin,S., Trost,K., Mac Elree,E.(eds.), Kleinsmith,L.J.& Kish, V.M., 1995. Harper Collins Publisher, New York.
3. Molecular biology of the cell.3rd edn., Alberts,B., Bray,D., Lawis,J., Raff,M., Roberta, K., Watson, J.d(eds.), 1994. Garland Publication, Inc., New York.
4. Cell and Molecular Biology. 8th edn., De Robertis, E.D.P. and De Roberts, E, M.F.1995. B.I.Waverly Pvt. Ltd., New Delhi.
5. Introduction to Molecular Biology, Peter Paoella, 1998. Mc Graw-Hill.
6. Molecular Cell Biology, Media connected W.H.Freeman and company.

LAB IN CELL AND MOLECULAR BIOLOGY

1. Observation of prokaryotic and eukaryotic cells and cell types - Living Cells/Temporary/Permanent Preparations.
2. Study of cell organelles adopting preparations/models.
3. Squash preparation of giant chromosome of salivary gland of chironomous larva.
4. Squash preparation of onion root tip, testis and anther lobes.
5. Preparation of buccal smear.
6. Red blood cell as osmometer.
7. Subcellular fractionation and biochemical/enzymological 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, lipids, DNA and RNA.

PAPER III

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.

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.

ELECTIVE

PAPER I

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/
15. www.patentoffice.nic.in/ipr/patent/patents.htm
16. www.bangalorebio.com/GovtInfo/ipr.htm

II SEMESTER

PAPER IV

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 TJ., 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 V

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 - Immunodiagnostics 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, promoter, 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.

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 Meredit, 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.

PAPER VI

ANIMAL CELL CULTURE TECHNOLOGY

UNIT-I

Tissue and organ culture - advantages and limitations - medical/pharmaceutical products of animal cell culture-genetic engineering of animal cells and their applications. Risks in a tissue culture laboratory and safety - biohazards.

UNIT-II

Facilities for animal cell culture-infrastructure, equipment, culture vessels. Biology and characterization of cultured cells-cell adhesion, proliferation, differentiation, morphology of cells and identification.

UNIT-III

Primary cell culture techniques - mechanical disaggregation, enzymatic disaggregation, separation of viable and non-viable cells. Mass culture of cells - manipulation of cell line selection - types of cell lines -maintenance of cell lines - immobilization of cells and its application - synchronization of cell cultures and cell division - production of secondary metabolites - biotransformation - Induction of cell line mutants and mutations - cryopreservation - germplasm conservation and establishment of gene banks.

UNIT-IV

Animal cell culture scale up: Scale up in suspension - stirrer culture, continuous flow culture, air-lift fermentor culture; Scale up in monolayer - Roller bottle culture, multisurface culture, multiarray disks, spirals and tubes - monitoring of cell growth. Organ culture - whole embryo culture - specialized culture techniques - measurement of cell death.

UNIT-V

Tissue engineering: Design and engineering of tissues - tissue modeling. Embryonic stem cell engineering - ES cell culture to produce differential cells - Human embryonic stem cell research.

Transgenic animals-transgenic animals in xenotransplantation

Books for Reference

1. Animal Cells Culture and Media, D.C.Darling and S.J.Morgan, 1994. BIOS Scientific Publishers Limited.
2. Methods in Cell Biology, Volume 57, Jennie P.Mathur and David Barnes, 1998. Animal Cell Culture Methods Academic Press.
3. Epithelial Cell Culture, Ann Harris, 1996. Cambridge University Press
4. Animal Biotechnology, M.M. Ranga, 2000. Agrobios, India.
5. Biotechnology, Satyanarayana, U., 2006. Books and Allied (P) Ltd.

LAB IN ANIMAL CELL CULTURE TECHNOLOGY

1. Primary cell culture
2. Continuous cell culture
3. Drug/Toxicity testing
4. MTT assay
5. Morphological characterization of cell death
6. Acridine orange/Ethidium bromide staining
7. Biochemical characterization of cell death
8. DNA laddering assay.

CORE PRACTICAL I
(Out of Papers I, II and III)

CORE PRACTICAL II

(Out of Papers V and VI)

HUMAN RIGHTS

COMPULSORY PAPER

UNIT-I

Definition of Human Rights - Nature, Content, Legitimacy and Priority - Theories on Human Rights - Historical Development of Human Rights.

UNIT-II

International Human Rights - Prescription and Enforcement upto World War II - Human Rights and the U.N.O. - Universal Declaration of Human Rights - International Covenant on Civil and Political Rights - International Covenant on Economic, Social and Cultural Rights and Optional Protocol.

UNIT-III

Human Rights Declarations - U.N. Human Rights Declarations - U.N. Human Commissioner.

UNIT-IV

Amnesty International - Human Rights and Helsinki Process - Regional Developments - European Human Rights System - African Human Rights System - International Human Rights in Domestic courts.

UNIT-V

Contemporary Issues on Human Rights: Children's Rights - Women's Rights - Dalit's Rights - Bonded Labour and Wages - Refugees - Capital Punishment.

Fundamental Rights in the Indian Constitution - Directive Principles of State Policy - Fundamental Duties - National Human Rights Commission.

Books for Reference:

1. International Bill of Human Rights, Amnesty International Publication, 1988.
2. Human Rights, Questions and Answers, UNESCO, 1982
3. Mausice Cranston - What is Human Rights
4. Desai, A.R. - Violation of Democratic Rights in India
5. Pandey - Constitutional Law.
6. Timm. R.W. - Working for Justice and Human Rights.

7. Human Rights, A Selected Bibliography, USIS.
8. J.C.Johari - Human Rights and New World Order.
9. G.S. Bajwa - Human Rights in India.
10. Amnesty International, Human Rights in India.
11. P.C.Sinha & K. Cheous (Ed) - International Encyclopedia of Peace, Security Social Justice and Human Rights (Vols 1-7).
12. Devasia, V.V. - Human Rights and Victimology.

Magazines:

1. The Lawyer, Bombay
2. Human Rights Today, Columbia University
3. International Instruments of Human Rights, UN Publication
4. Human Rights Quarterly, John Hopkins University, U.S.A.

ELECTIVE

PAPER II

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.

**III SEMESTER
PAPER VII
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. Witkowski and M. Zoller, 1992. Scientific American books, N.Y.
5. Genetic Engineering of Animals, A. Puhler, 1993. VCH Publishers, Weinheim FRG.
6. Gene Transfer and expression protocols - methods in molecular biology volume 7, E.T. Murray, 1991. Humana Press.

LAB IN RECOMBINANT DNA TECHNOLOGY

1. Cell - cell types
2. Cell division
3. Isolation of DNA.
4. Isolation of plasmid
5. Isolation of phages.
6. Extraction of total DNA from plant/animal tissue
7. Restriction digestion
8. Isolation of restriction enzyme
9. Blotting techniques - demonstration
10. PCR amplification - demonstration
11. DNA - sequencing.
12. Estimation of nucleic acids (DNA and RNA)
13. Ligation
14. RFLP
15. Protein characterization by coomassie blue and silver staining

PAPER VIII

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.

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)

**PAPER IX
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, pyridoxal 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, Benjamin Lewin, 1994. Oxford University Press. Oxford
4. Principles of Biochemistry, AL. Lehninger, D.L. Nelson and M. M. Cox. 1993. Worth Publishers, New York.

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

ELECTIVE

PAPER III

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 - viscosity - Newtonian and Non Newtonian fluids.

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.

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. Stanburry 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 corporation, 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.

ELECTIVE

PAPER IV

NON MAJOR SUBJECT

VERMI-COMPOSTING TECHNOLOGY

UNIT-I:

Earthworms: Taxonomic position and diversity - Types: morphological and ecological grouping - Ecological roles 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 vermi-composting - Potentials and constraints for vermiculture in India.

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.

IV SEMESTER

PAPER X

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

4. Statistical methods, Snedecor, G, W. and W.G. Cochran, 1978. Oxford and IBH publishing CO Pvt. Ltd.
5. Biometry, Sokal, R.R. and F.J.Rohlf, 1981. W.H. Freeman, NewYork.
6. Biostatistical analysis, Zar, J.H., 1996. Prentice Hall, Uppar Saddle River, newjersy, USA.
7. Scientific courses and presentations, Martha Davis, 2005. Academic press, Tokyo.pp.356
8. How to write publish a scientific COURSE 5th edition, Robert A. Day, the Oryx Press, 88 Post Road West, West Port, CTO6881, pp.275

CORE PRACTICAL III

(Out of Papers VII, VIII and IX)

CORE PRACTICAL IV

RESEARCH METHODOLOGY

1. Prepare flat file in NCBI, DDBJ & EMBL format for the given query sequence.
2. Search for similar DNA sequence of the query DNA using BLAST.
3. Retrieve a query sequence from NCBI and predict the secondary structure of the query using PDB & PEP TOOL.
4. Retrieve a query sequence from NCBI and predict the tertiary structure and Motifs of the query using PDB, CATH & SCOP
5. Find out the isoelectric point, molecular weight, atomic composition and total number of atoms using PROT-PARAM.
6. Retrieve any five microbial gene sequence from any DNA data bank and using the server 123 Genomics and malign program found in 123 genomics construct a phylogenetic tree.
7. Methods involved in writing a research paper
8. Presentation of a research paper.

Books for Reference

1. Programming in ANSIC, E. Balagurusamy, 1992. Tata Mcgraw Hill.
2. Introduction to bioinformatics, AH wood, T.K. Parry smith DJ, 2001. Pearson education Asia.
3. C & Unix programming; A conceptual perspective, Kulti, 1995. Tata Mc Graw Hill.
4. Developing bioinformatics in computer skills, Gibas C. and Jambeek P. Oreilly, 2001. associates inc. Shrott publishes.
5. Biometry, W.H. Freeman, Sokal, R.R. and F.J.Rohlf, 1981. New York.
6. Scientific papers and presentations, Martha Davis, 2005 Academic press, Tokyo. pp.356.
7. How to write publish a scientific paper 5th edition, Robert A. Day. The Oryx Press, 88 Post Road West, West Port, CT06881, pp.275
8. www.sfeddit.net

ELECTIVE

PAPER V

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.

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/
4. www.patentoffice.nic.in/ipr/patent/patents.htm
5. 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
