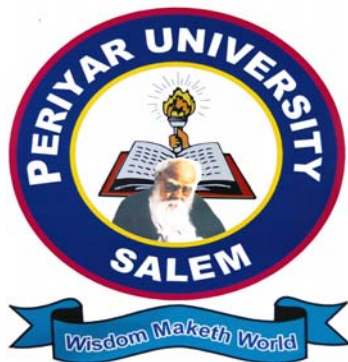


**PERIYAR UNIVERSITY  
PERIYAR PALKALAI NAGAR  
SALEM – 636 011**



**DEGREE OF MASTER OF SCIENCE  
CHOICE BASED CREDIT SYSTEM  
SYLLABUS FOR M.SC. BIO TECHNOLOGY  
FOR THE STUDENTS ADMITTED FROM THE  
ACADEMIC YEAR 2012 – 2013 ONWARDS**

**List of Core Courses:**

1. Cell Biology
2. Biological Chemistry
3. Molecular Biology
4. Practical-I
5. Practical-II
6. Immunology
7. Genetic Engineering
8. Practical-III
9. Practical-IV
10. Plant Biotechnology
11. Animal Cell science and Technology
12. Bioprocess and Enzyme Technology
13. Practical-V
14. Practical-VI
15. Environmental Biotechnology

**List of Elective Courses:**

1. Microbiology
2. Biophysics and Instrumentation
3. Bioinformatics, IPR and Bioethics
4. Nano Biotechnology

**List of Extra Disciplinary Courses (To be selected by other department students)**

1. Applied Biotechnology
2. Concepts of Biotechnology
3. Microbial Technology

**PERIYAR UNIVERSITY, SALEM – 636 011**

**M.Sc., BIOTECHNOLOGY**

**CHOICE BASED CREDIT SYSTEM**

**SEMESTER - I**

<b>Semester</b>	<b>Core</b>	<b>Course Title</b>	<b>Hrs/Wk</b>	<b>Credits</b>	<b>Marks</b>		
					<b>CIA</b>	<b>EA</b>	<b>TOTAL</b>
<b>I</b>	Core I	Cell Biology	5	5	25	75	100
	Core II	Biological Chemistry	5	5	25	75	100
	Core III	Molecular Biology	5	5	25	75	100
	Core IV	Practical I	5	3	40	60	100
	Core V	Practical II	5	3	40	60	100
	Elective I	Microbiology	5	4	25	75	100

## **CORE -I CELL BIOLOGY**

### **UNIT I**

Cell Theory, Emergence of modern cell biology, Structure of Prokaryotic and Eukaryotic cells- Cell-wall, Membrane, Cell organelles-organization and functions, Nucleus, Mitochondria, Plastids; Endoplasmic Reticulum, Golgi complex, Lysosomes, Microtubules, Centriole, Vacuole, Cytoskeleton, Cilia and Flagella.

### **UNIT II**

Chromosome structure and functions – Giant chromosomes, Lamp brush and Polytene Chromosomes, Karyotype analysis, Chromosome abnormalities.

### **UNIT III**

Cell cycle control and cell death: overview of cell cycle-control system, Regulation of the Cell Cycle, Mitosis, Meiosis, Molecular control involving checkpoints in cell division cycle. Differentiation, Cellular senescence.

### **UNIT IV**

Cell signaling – types , Chemical signals and cellular receptors ,G Protein-linked receptors, Protein Kinase-associated receptors, Growth factors as messengers, Cell signals and Apoptosis, Cytoskeleton: microfilaments-intermediate filaments-microtubules.

### **UNIT V**

Development of Multicellular organisms- yeast, *Caenorhabditis elegans* and *Arabidopsis thaliana*, *Drosophila melanogaster*, Stem cells, types, use of stem cells to repair damaged tissues.

**References:**

1. Molecular Biology of the cell, Alberts, B et al. (1994)
2. Molecular Cell Biology , Lodish et al.
3. Reproduction in Eukaryotic cells, D.M.Presco, Academic Press.
4. Developmental Biology, SF.Gillbert, Sinauor Associates Inc.
5. Cell in Development and Inheritance, EB Wilson, MacMillan, New York.
6. Molecular Biology of steroid and nuclear hormone receptors, LP Freeman, Birkhuser.
7. Cell and Molecular Biology- DeRoberties and DeRoberties (2004)
8. Cell and Molecular Biology, Gerald Karp (1999)
9. Cell and Molecular Biology, P.K.Gupta, (2002)
10. The world of Cell-Becker,W.M *et.al.*6<sup>th</sup> edition.Pearson Education.2007.
11. Molecular Biology – Understanding the genetic revolution . Clark,D.1<sup>st</sup> edition Elsevier. 2005
12. The Cell-A molecular approach- Cooper,G.M. and Hausman,R.E.4<sup>th</sup> edition.Sinauer Associates Inc.USA.2007

**CORE-II**  
**BIOLOGICAL CHEMISTRY**

**UNIT I**

Principles of thermodynamics- First and second laws of Thermodynamics. Free energy – Concepts of metabolism: Types- Catabolism and anabolism with reference to pathways- pH, pK, acids, bases, buffers. Bonds in biomolecules – weak and strong bonds.

**UNIT II**

Sugars-Classification and reactions, polysaccharides-types, structural features, methods for compositional analysis. EMP pathway, TCA cycle. Lipids-Classification, structure and functions. Beta oxidation of fatty acids cholesterol biosynthesis

**UNIT III**

Aminoacids -Classification, chemical reactions. Proteins-Classification, hierarchy in structure, Ramachandran plot. Protein sequencing, Glyco and Lipoproteins- Structure and function. Biosynthesis of purines and pyrimidines, de Novo and salvage pathway.

**UNIT IV**

Macromolecules and super molecular assemblies like membranes, ribosome and chromosomes. Secondary metabolites in living systems: Alkaloids, Steroids and Flavonoids.

**UNIT V**

Vitamins-Fat soluble and water soluble vitamins, Minerals, role of vitamins and minerals in human health. Hormones: Definition, Classification of hormones. Biological functions and disorders of pancreatic hormone (Insulin), thyroid hormone (Thyroxin), Hypothalamus and pituitary hormone (GH,TSH,GTH,ADH) and Adrenal gland (Adrenaline, Nor adrenaline). Hormones and reproduction-Hormones in pharmaceuticals.

**References:**

1. Biochemistry, D.Voet and J.G.Voet, John Wiley and Sons.
2. Biochemical Calculations, Irwin H.Segal, John Wiley and Sons Inc.
3. Text Book of Biochemistry.Devlin,T.M.,John Wiley and Sons.Inc.
4. Understanding Chemistry, CNR Rao, Universities Press, Hyderabad, 1999.
5. A Biologist's Guide to principles and techniques of practical Biochemistry. K.Wilson and KH Goulding, ELBS Edition, 1986.
6. Principle of Biochemistry. Lehninger,A.L.,Nelson,D.L and Cox,M.M.2002.CBS Publishers
7. Biochemistry, Stryer, L., 2002, Fifth edition. W.H.Freeman and co
8. Biochemistry, U.Satyanarayana, (2005)
9. Fundamentals of Biochemistry, J.L.Jain (1999)

## **CORE-III**

### **MOLECULAR BIOLOGY**

#### **UNIT I**

Introduction of molecular biology, 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.

#### **UNIT II**

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 III**

Translation -Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms 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.

#### **UNIT IV**

Oncogenes and Tumor Suppressor Genes-Viral and cellular oncogenes, tumor suppressor genes from humans, Structure ,function and mechanisms of action of pRB and p53 tumor suppressor proteins.

#### **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.

**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(4<sup>th</sup> 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 (2<sup>nd</sup> Edition, J.Darnell, H.Lodish and D.Baltimore, Scientific American Book, USA, 1994.
6. Molecular Biology of the Cell (2<sup>nd</sup> 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 comprehnsive 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 Biotechnology, S.B.Primrose.2005.

**CORE- IV**  
**PRACTICAL – I**  
**LAB IN CELL BIOLOGY AND BIOLOGICAL CHEMISTRY**

**CELL BIOLOGY**

1. Principles of Microscopy and optics
2. Measurement of Cell size by Micrometry
3. Preparation of permanent slides – DPX mount
4. Mitosis and Meiosis
5. Giant Chromosomes (Polytene-Chironomous larvae)
6. Sex Chromatin (Barr Body)
7. Blood cells identification
8. Microtomy - Demo

**BIOMOLECULES**

1. Preparation of Buffers
2. Calibration of P<sup>H</sup> meter
3. Verification of Berr Lambert's Law
4. Estimation of glucose (DNS method)
5. Estimation of DNA (Diphenylamine)
6. Estimation of RNA (Orcinol)
7. Estimation of Protein ( Lowry's and Bradford Methods)
8. Extraction and Estimation of starch from potato/ tapioca
9. Separation of aminoacids by Paper and Thin layer chromatography
10. Qualitative analysis of carbohydrate
11. Qualitative analysis of aminoacids.
12. Native PAGE and SDS-PAGE

## **CORE – V**

### **PRACTICAL - II**

#### **LAB IN MICROBIOLOGY AND MOLECULAR BIOLOGY**

##### **MICROBIOLOGY**

1. Safety guidelines in laboratory practices.
2. Preparation of washing solution.
3. Handling of Microscopes
4. Sterilization Techniques – Physical and chemical methods.
5. Preparation of broth and agar media
6. Maintenance of Microorganisms
7. Staining methods – Simple staining, differential staining, special staining, and LCB mount.
8. Motility of bacteria by hanging drop method.
9. Biochemical characterization of Bacteria – Catalase test, oxidase test, Sugar fermentation, IMVIC, urease test, TSI test, Starch hydrolysis.
10. Cultural characteristics of microorganisms on Basal medium, Selective medium, Differential medium, Enriched medium, Enrichment medium.
11. Isolation and pure culture of microorganisms from soil and water - Serial dilution methods, Plating, Streaking.
12. Growth - Growth curve, Measurement of bacterial population by turbidometry, haemocytometry and serial dilution methods.
13. Antibiotic sensitivity test by Kirby- Bauer disc diffusion method.
14. Determination of potability of water by MPN method.

##### **MOLECULAR BIOLOGY**

1. Single Cell Colony isolation – Checking for antibiotic resistant Markers.
2. Induced Mutagenesis (UV, NTG & EMS).
3. Isolation of antibiotic resistant Bacteria by gradient plate technique.
4. Detection of mutants by replica plate technique.
5. Study of Mutation by Ames test.

**ELECTIVE – I**  
**MICROBIOLOGY**

**UNIT I**

History and development of microbiology. Microscopy- bright field, dark field, Electron. Sterilization, Control of microorganisms by physical and chemical methods. Bacterial taxonomy and classification according to Bergy's manual. Stains and staining methods-simple, differential and special staining.

**UNIT II**

Microbial Growth-mathematical expression of growth, growth curve, measurement of growth. Synchronous culture and Continuous culture. Factors affecting microbial growth. Culture media and their types. Pure Culture Techniques-Serial dilution methods - spread plate – pour plate – streak plate technique. Culture collection and preservation of microbial cultures.

**UNIT III**

Nutritional requirements and types of microorganisms, uptake of nutrients by microorganisms. Photosynthetic microorganisms. Nitrate and sulfur oxidizing bacteria, nitrate and sulfate reducing bacteria. Nitrogen fixation. Hydrocarbon transformation. Role of microorganism in agriculture, food and dairy industry.

**UNIT IV**

Host – parasite relationship, normal microflora. Causative agent, pathogenesis and control measures of typhoid, cholera, tuberculosis, AIDS, hepatitis, malaria and candidiasis. Antimicrobial agents and their mode of action – antibacterial, antiviral, antifungal, antiparasitic agents.

**UNIT V**

Mutation and Mutagenesis; UV and chemical mutagens; Types of mutation; Ames test for mutagenesis; Methods of genetic analysis – Transformation, Conjugation, Transduction, Recombination. Plasmids and Transposons. Bacterial genetic maps with reference to *E. coli* – Viruses and their genetic system – Phage life cycle, Genetic systems of yeast and Neurospora .

## References:

1. Pelczar MJ , Chan ECS, and Krieg NR, (2006) Microbiology,5<sup>th</sup> Edition Tata McGraw Hill Publishing Company.
2. Prescott LM, Harley JP and Klein DA (2005) Microbiology, 6<sup>th</sup> Edition. McGraw Hill.
3. Talero KP and Talero A (2002): Foundations in Microbiology. 4<sup>th</sup> Edition McGraw Hill.
4. Anantha Narayanan R and Panikar CKJ (2002). 6<sup>th</sup> Edition. Orient Longman Pvt.Ltd
5. Benson HJ (1999), Microbiological Applications: A Laboratory manual in General Microbiology.7<sup>th</sup> Edition. McGraw Hill.
6. Salle AJ, principles of bacteriology (1986).7<sup>th</sup> Edition. Tata McGraw-Hill Publishing Company Ltd. New Delhi.
7. Modi HA (1995), Elementary Microbiology (Volume- 1 Fundamentals of Microbiology).Akta Prakashan Nadiad Publication.
8. Freifelder D (1995), Microbial Genetics, Narosa Publishing House.
9. Maloy SR, Cronan JE and Freifelder D Microbial Genetics, Jones Barlett Publishers.
10. Cappuccino JG and Sherman N (1996). Microbiology - a laboratory Manual. 5<sup>th</sup> edition. Editors: Wirth AE and Olsen L.

## SEMESTER -II

Course	Subjects	Hours	Credit	Marks		
				CIA	EA	Total
Core VI	Immunology	5	5	25	75	100
Core VII	Genetic Engineering	5	5	25	75	100
Core VIII	Practical III	5	3	40	60	100
Core IX	Practical IV	5	3	40	60	100
Elective II	Biophysics & Bioinstrumentation	5	5	25	75	100
ED	Microbiology	5	5	25	75	100

## **CORE VI**

### **IMMUNOLOGY**

#### **UNIT I**

History and scope of immunology, Host - Parasite relationship, Infection – types – mode of transmission , Immunity – types- mechanisms, Haematopoiesis-lymphoid cells – myeloid cells and their maturation .Organs of the immune system- primary and secondary lymphoid organs – structure and functions.

#### **UNIT II**

Antigen – properties- classes, haptens, mitogens, adjuvants, epitopes. Immunoglobulin- basic structure, classes, function, molecular diversity of immunoglobulins. Immune responses- generation of immune response-humoral immune response - cell mediated immune response- recognition of antigen by humoral branch (B cells) and cell mediated branch (T cells).Generation of lymphocyte specificity and diversity, clonal selection of lymphocytes.

#### **UNIT III**

Antigen – Antibody reactions. Complements- components, properties, activation path ways-alternative, classical, lectin. Cytokines – properties structure and functions. Major histocompatibility complex –general organization and inheritance of MHC, structure – function- role in antigen processing and presentation. Immunological tolerance.

#### **UNIT IV**

Hypersensitivity – types, mechanisms, manifestations. Transplantation – classification, transplantation antigens, graft acceptance, rejection, process of graft rejection, immuno suppressive therapy, Molecular aspects of HLA typing. Autoimmunity- mechanism of auto immunization- types. Immunodeficiency diseases. Tumor immunology.

## UNIT V

Antigen-isolation and purification from pathogenic bacteria. Antibody production- Hybridoma technology and engineered monoclonal antibodies. Purification of antibodies. Isolation of macrophages. Macrophage culture. Immuno screening of recombinant library. Detection of immune complex in tissues. FACS. Delayed type hypersensitivity assessment – Mantoux test. Molecular aspects of HLA typing. Recent strategies of vaccines production and immunization schedule.

### References:

1. Rajasekara Pandian M and Senthilkumar B (2007) *Immunology and Immunotechnology*. Panima Publishing Corporation , New Delhi.
2. Goldsby RA, Kindt TJ, Osborne BA, Kuby J (2003) *Immunology* 6<sup>th</sup> Edn. WH Freeman & Co. New York.
3. Kuby J (1997) *Immunology* 3<sup>rd</sup> Edn .WH Freeman & Co. New York.
4. Benjamini E, Coico R and Sunshine G (2000). *Immunology* .4<sup>th</sup> Edn. A John Wiley & sons, Inc. Publication.
5. Roitt I, Brostoff J and Male D (1993). *Immunology* 3<sup>rd</sup> Edn. Mosby.
6. Weir DM (1979). *Handbook of Experimental Immunology*. Black Well Scientific Publications. Oxford.
7. Pelczar MJ, Chan ECS and Krieg NR. *Microbiology* (2006) 5<sup>th</sup> Edn. Tata McGraw-Hill Publishing Company Ltd. New Delhi.
8. Tizard IR (1995). *Immunology* 4<sup>th</sup> Edn. Saunders College Publishing Harcourt Brace College Publishers.
9. Talwar GP and Guptha (2004). *A hand book of practical immunology* .2<sup>nd</sup> Edn. Vol II .CBS Publications.



## **CORE-VII**

### **GENETIC ENGINEERING**

#### **UNIT I**

History and Scope of genetic engineering. Restriction enzymes, Ligases, Alkaline phosphatase, Polynucleotide kinase, Terminal nucleotidyl transferase, DNA Polymerases, Taq DNA polymerases, RNase, Reverse transcriptase. Linkers, Adaptors, Oligonucleotide primers & Homopolymer tailing.

#### **UNIT II**

Gene cloning vectors- Plasmids, Construction of pBR322, Bacteriophages vectors, phagemids, cosmids, Yeast vectors and Expression vectors in Prokaryotic and Eukaryotic. Cloning strategies- Gene Library construction, Screening of gene library.

#### **UNIT III**

Analyzing DNA and Protein Sequences, Polymerase chain reaction, inverse PCR, RT-PCR, Changing genes- Site-directed mutagenesis, Phage Display, Nucleic acid microarray arrays. Northern blot. Uses of online tools- Web cutters & Vector NTI, SAGE (Serial Analysis of Gene Expression).

#### **UNIT IV**

Expression strategies for heterologous genes- expression in bacteria, yeast, insects and insect cell lines, mammalian cell lines and in plants. Processing of recombinant proteins-Purification and refolding, characterization of recombinant proteins, stabilization of proteins.

#### **UNIT V**

Transposon tagging- Role of gene tagging in gene analysis. Transgenic animals(Mice, Cattle, Fish), Transgenic plants(Herbicide tolerance, Delayed ripening) Antisense RNA technology, Human GeneTherapy.

**References:**

1. Mickloss D.A and G.A.Greyer (1990) DNA Science - A First Course in Recombinant Technology, Cold Spring Harbor Laboratory Press, New York.
2. Primrose, S.B (1994) Molecular biotechnology (2<sup>nd</sup> Edi). Blackwell Scientific Publishers, Oxford.
3. Davis J.A. and W.S.Roznikolf (1992) Milestones in Biotechnology. Classic papers on genetic Engineering, Butterworth-Helnemann, Boston.
4. Walker M.R. and R.Repley (1997) Route Maps in Gene Technology Blackwell Science Ltd., Oxford.
5. Kingsman S.M. and A.J.Kingsman, (1998) Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes. Blackwell Scientific Publications, Oxford.
6. James D. Watson. Recombinant DNA (2001). Scientific American Books. USA
7. Glick, B Pasternak, J.J (2007) Molecular Biotechnology. ASM Press, Washington.
8. Benjamin Lewin. Genes-VIII. Oxford University Press.
9. Glover, D.M and B.D Hames. DNA cloning 1-4(2006) Oxford University Press.
10. Mark Schena (2002) Microarray Analysis. 1<sup>st</sup> Edition. John Wiley & Sons Ltd.

**CORE – VIII**  
**PRACTICAL – III**  
**LAB IN IMMUNOLOGY**

**1. Study On Blood Cells**

- a) Identification of blood cells
- b) Differential count of white blood cells
- c) Lymphocyte subset identification and enumeration

**2. Preparation of specimen for Immunology**

- a) Preparation of serum
- b) Preparation of plasma
- c) Preparation of blood antigens

**3. Agglutination test**

- a) ABO Blood grouping
- b) Widal test for typhoid fever (qualitative and quantitative test)
- c) Haemagglutination test

**4. Passive agglutination test**

- a) Anti - Streptolysin O (ASO) test
- b) C-reactive protein (CRP) test
- c) Rheumatoid arthritis (RA) test

**5. Agglutination inhibition test**

- a) Pregnancy test – Detection of HCG

**6. Flocculation test**

- a) Rapid Plasma Regain Test (RPR)

**7. Precipitation test**

- a) Ouchterlony's Double Immunodiffusion Technique (ODD)
- b) Counter Current Immunoelectrophoresis (CIE)
- c) Immuno Electrophoresis (IE)
- d) Radial Immuno Diffusion (RID)
- e) Rocket Immuno Electrophoresis (RIE)

**8. Laboratory Animals in Immunology**

- a) Inoculation routes in laboratory animals
- b) Raising of antiserum in laboratory animals

**9. Antibody purification by column chromatography**

**10. ELISA**

**11. Western blott -Demonstration**

**CORE – IX**  
**PRACTICAL IV**  
**LAB IN GENETIC ENGINEERING & BIOINSTRUMENTATION**

1. Selection of antibiotic marker.
2. Isolation of genomic DNA & Detection in AGE
3. Isolation of plasmid DNA & Detection in AGE
4. Screening of Bacteriophages.
5. Isolation of Lambda phage DNA
6. Quantification of DNA by UV spectrophotometer.
7. Bacterial Transformation.
8. Bacterial Conjugation – Uninterrupted & Interrupted
9. Restriction digestion
10. Ligation
11. Determination of molecular weight of Nucleic acids by Gel Doc.
12. Amplification of DNA - PCR.

## **ED I - APPLIED BIOTECHNOLOGY**

### **UNIT I: Plant Biotechnology**

Genetic Engineering of Plants: Insect resistance, Virus resistance, Stress tolerant Plants. Delayed fruit ripening, artificial seeds

### **UNIT II: Animal Biotechnology**

Transgenic cattle, Super ovulation, Embryo transfer. Gene knock out and mice model for human genetic disorder. Stem cell therapy.

### **UNIT III: Industrial Biotechnology**

Fermentor- Types. Production of enzymes-amylase, protease& lipase. Antibiotic- Penicillin. Amino acid- Glutamic acid. Production of Alcohol.

### **UNIT IV: Environmental Biotechnology**

Biosensors- Types, Xenobiotic degradation, Bioleaching, Sewage treatment. Bio gas production. Role of Super bug in biodegradation.

### **UNIT V: Bioethics & Biosafety**

Intellectual Property Rights. General ethics and ethical issues. Animal rights, Environmental safety of GMO's, Regulations of GMO's, Bioethics for the future.

### **Reference books:**

1. H.S.Chawla. 1998. Biotechnology in crop improvement. International Book Distributing Company.
2. U.Satyanarayana. 2005. Biotechnology. Books and Allied (p) Ltd.
3. Peter F. Stanbury. Principles of Fermentation Technology. Butterworth-Heinemann, Elsevier Science Ltd.
4. Introduction to Environmental Biotechnology, A.K. Chatterji(2002) Prentice- Hall of India.
5. Nigel Jenkins. Animal Cell Biotechnology: Methods and protocols. Humana Press.

## **ED II - CONCEPTS OF BIOTECHNOLOGY**

### **UNIT I: Biotechnological Perspectives**

Scope of Biotechnology, Conventional & Modern Biotechnology, Biotechnology Tree. Prospects of Biotechnology in India, Impact of Biotechnology, New Goals of Biotechnology.

### **UNIT II: Genetic Engineering**

Cloning strategies- Genome Organization. Physical and genetic mapping, gene tagging, gene silencing and DNA sequencing.

### **UNIT III: Tools of gene cloning**

Enzymes- Restriction endonucleases, Ligases; Vectors – Bacterial- P<sup>BR322</sup>, P<sup>UC</sup> vectors, Agro bacterium vectors, yeast vectors and phage vectors.

### **UNIT IV: Techniques of gene cloning and genome analysis**

Gene transfer methods – vector mediated and direct transfer methods, PCR techniques. RAPD, RFLP. Methods of screening of recombinants.

### **UNIT V: Modern concepts**

Principles of Bioinformatics- Protein engineering – Genome projects – HGP. Structural genomics, Nanobiotechnology – Bionano particles – Nano biosensors, IPR.

### **REFERENCE BOOKS:**

1. Primrose, S.B and R.M Twyman, (2006) Principles of Gene Manipulation. Seventh edn. Blackwell Scientific Publishers, Oxford.
2. James D. Watson. Recombinant DNA (2001). Scientific American Books. USA
3. Glick, B Pasternak, J.J.(2007) Molecular Biotechnology ASM Press, Washington
4. R.C. Dubay, (2008) A text book of Biotechnology. S.Chand & Company, New Delhi.
5. Sathyanarayana, U. (2005). Biotechnology. First edn. Books and allied (P) Ltd,Kolkata.

6. Christof M.Niemayer, Chad. A.Mirkin (2004) Nano biotechnology : concepts, applications and perspectives, Wiley VCH publishers.
7. Irfan Ali Khan (2004) Fundamentals of Biotechnology, Forensic Science and Genetic Engineering, Ukaaz Publications. Hyderabad.

### **ED-III MICROBIAL TECHNOLOGY**

#### **UNIT I**

Scope of Microbial technology, Production of Proteins : Bacteria- Chymosin, Yeast- Hepatitis B surface Ag, Production of Recombinant and synthetic Vaccines, Peptide Vaccines.

#### **UNIT II**

Biocontrol agents : *Trichoderma*, *Pseudomonas*, *Bacillus*. Microbial Insecticides- *B.thuringiensis*, *B.sphaericus*, *B.popillae* and Baculovirus. Microbial Biofertilizer- *Rhizobium sp.*, *Azospirillum*. Phosphobacteria, *Azolla*, BGA. Production of SCP.

#### **UNIT III**

Microbial Production of Polysaccharides- Xanthane Gum and Polyesters. Aminoacids- Histidine. Production of Microbial Enzymes- Amylase, Protease. Microbial degradation of Lignin, Cellulose.

#### **UNIT IV**

Microbial production of Vitamin B12. Production of Alcohol, Beer, Wine, Vinegar, Cheese. Mold modified Foods- Soy Sauce, Miso, Hamanatto, Sufu, Tempeh.

#### **UNIT V**

Microbial treatment of sewage- Primary & Secondary treatment. Degradation of Xenobiotics, Bioremediation. Genetic aspects of Biodegradation, Microorganisms in mineral recovery and removal of heavy metals.



**References:**

1. Alexander. N. Glazer & Hiroshi Nikaido.W.H. (1995) Microbial Biotechnology. Freeman and Company.
2. H.J. Peppler & D. Perlman. (2004) Microbial Technology. Volume I & II. Second edn. Academic press.
3. Wulf Crueger & Anneliese Crueger. (2000) Biotechnology. 2nd Edition, Panima Publications.
4. A text book of Biotechnology. R.C. Dubay, (2008) A text book of Biotechnology. S.Chand & Company, New Delhi.
5. Ronald M. Atlas & Richard Bartha. (2005) Microbial Ecology. 4th edition. Benjamin/Cummings Science Publishing.
6. Subbarao, N.S. (1995). Biofertilizers in Agriculture and forestry. Third edn. Oxford and IBH Pub.Co.Pvt.Ltd, New Delhi.
7. Sathyanarayana, U. (2005). Biotechnology. First edn. Books and allied (P) Ltd,Kolkata.
8. Patel, A.H. (2005). Industrial Microbiology. Mac Millan India Ltd, New Delhi.

**ELECTIVE-II**  
**BIOPHYSICS AND BIOINSTRUMENTATION**

**UNIT I**

Scope and methods of Biophysics. Various bonding: structure and properties of water. Understanding various structure of proteins, globular and fibrous protein; protein stability; protein folding. The physics of nucleic acids: Forces stabilizing structures; Double helical structures; properties; helix – coil; transitions.

**UNIT II**

Colorimeter-Beer Lambert's law, UV-Visible spectroscopy, Atomic absorption spectroscopy, Flame photometer, IR and Raman Spectroscopy, Spectrofluometry, Mass Spectrophotometry- Matrix assisted layer desorption ionization and surface enhanced laser desorption ionization.

**UNIT III**

Centrifuge, Chromatography- Paper chromatography- Thin layer chromatography-Column chromatography- LPCC and HPLC, Affinity chromatography, Partition chromatography, Ion exchange chromatography, Permeation chromatography.

**UNIT IV**

Radiation Biophysics: basic concept of radioactivity and measurement radioactivity. Radioisotope techniques – GM Counter, Liquid scintillation and Solid scintillation counter, fluorimetry and its types.

**UNIT V**

Physical Biomedical method of Imaging techniques, Intact biological structures (X-ray, CAT-SCAN, ECG, EEG, NMR) Autoradiography, X ray crystallography, Photography, ultrasound, MRI, Angiography.

**References:**

1. Biochemistry (1995) Voet, D. & Voet, J.G. 2<sup>nd</sup> Edi. John Wiley & Sons.
2. Bioinstrumentation (2004) John Webster. John Wiley & Sons.
3. Bioinstrumentation (2006) Veerakumari, 1<sup>st</sup> Edi. MJP Publishers.
4. Molecular Biology of the Gene. (1987). James, D. Watson. Hopkins, N.H, Roberts. The Benjamin/Cumminngs Publishing Company, New York.
5. Biochemistry. (1993). Zubay.G.L, 4<sup>th</sup> Edi. WmC.Brown Publishers.
6. A Biologist guide to principles and techniques of practical biochemistry.(1975). Bryan,W. & Keith,W.
7. Practical Biochemistry (1995) Wilson,K. & Walker,J. 5<sup>th</sup> Edi. Cambridge University Press.

### SEMESTER -III

Course	Subjects	Hours	Credit	Marks		
				CIA	EA	Total
Core X	Plant Biotechnology	5	5	25	75	100
Core XI	Animal Cell Science & Technolgy	5	5	25	75	100
Core XII	Bioprocess Technology	5	3	25	75	100
Core XIII	Practical V	5	3	40	60	100
Core XIV	Practical VI	5	5	40	60	100
Elective III	Bioinformatics, IPR and Bioethics	5	5	25	75	100

**CORE-X**  
**PLANT BIOTECHNOLOGY**

**UNIT I**

Plant tissue culture: a historic perspective. Organizing plant tissue culture laboratory. Nutritional requirements of plant tissue culture. The concept of totipotency of cells. Plant tissue culture-principles, callus culture, organogenesis sterilization of plant tissues, cryopreservation.

**UNIT II**

Production of haploid plant, virus – free plants. Embryo culture. Isolation, culture and fusion of plant protoplasts. Clonal propagation, somaclonal variation. Valuable chemicals from plant tissue culture. Somatic embryogenesis, *In vitro* pollination and fertilization.

**UNIT III**

Plant genome organization, gene silencing in crop plants, gene transfer methods. Role of RFLP in Plant breeding, current status of plant transformation technologies. Production of therapeutic antibodies in plants.

**UNIT IV**

Genetic engineering of crop plant for insect resistance, fungus resistance, virus resistance, drought, cold and saline resistance. Molecular biology of plant pathogen interactions. Transposable elements.

**UNIT V**

Procedures involved in commercialization of transgenic crops. Plant tissue culture in agriculture, horticulture and silviculture. Policy and technological options to deal with India's food surpluses and shortages.

**References:**

1. J.Hammond, P.McGarvey and V.Yusibov(Eds.): Plant Biotechnology. Springer verlag, 2000.
2. T-J.Fu, G.Singh and W.R.Curtis(Eds): Plant Cell and Tissue Cuktare for the Production of Food ingredients. Kluwer Academic/Plenum Press.1999.
3. H.S.Chawla: Biotechnology in crop improvement. International Book distributing Company,1998.
4. R.J.Henry: Practical Application of plant Molecular biology. Chapman and hall.1997.
5. P.K. Guptha: Elements of Biotechnology. Rastogi and Co. Meerut,1996.
6. U.Satyanarayanan. Biotechnology, Books and allied (p) Ltd., 2005.
7. S.S. Bhojwani and M.K.razdan, Tissue Culture Theory and Practice, 2004.
8. Paul Christou and Harry Klee (2004) Hand Book of Plant Biotechnology. Vol.I & II. John Wiley & Sons.

**CORE-XI**  
**ANIMAL CELL SCIENCE AND TECHNOLOGY**

**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. Chemical, physical and metabolic functions of different constituents of culture media. Role of carbon dioxide in animal cell culture.

**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.

**References:**

1. Culture of Animal cells, 3<sup>rd</sup> Edition, R. Ian Freshney. A John Wiley & Sons, Inc., publications.
2. Animal Cell Culture- Practical Approach, R.W. Masters, Oxford.
3. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
4. Animal Cell Biotechnology, Methods and protocols, Nigel Jenkins, Humana Press.
5. Biotechnology of Animal Tissue. P.R.Yadav & Rajiv Tyagi. 2006. Discovery Publishing House. New Delhi.
6. Animal Cell Culture- Practical Approach. John, R.W.Masters. 2000. 3<sup>rd</sup> Edi. Oxford University Press.



## **CORE-XII**

### **ENZYMOLGY AND BIOPROCESS TECHNOLOGY**

#### **UNIT I**

Enzyme classification and nomenclature according to IUB. Order of reaction, activation energy. Kinetics of enzyme catalyzed reaction-steady state kinetics, Michaeli's menten equation and its transformation. Bi substrate reaction – mechanism-random-ordered and Ping pong mechanism- radio isotopic studies.

#### **UNIT II**

Enzyme inhibitors- kinetics of competitive, non competitive and uncompetitive inhibitors. Allosteric interaction mechanism of enzyme catalysis includes acid base catalysis, co-valent, metal ion, electrostatic proximity and orientation effect.

#### **UNIT III**

Isolation, Screening of industrial important microorganisms, Strain improvement, Culture preservation and stability, Preparation and Sterilization of fermentation media. Types of fermentation – Batch, Fed batch and Continuous. Immobilization techniques

#### **UNIT IV**

Transport phenomena in bioprocess. Fermentor Design and Scale-up, Imperfectly Mixed Bioreactor Systems, Dynamic Modeling of fermentation systems, Instrumentation for Monitoring and Controlling Bioreactors, Instrumentation for Process Control, Systems for Fermentation process control, Data analysis.

#### **UNIT V**

Downstream Processing – Disruption of Microbial Cells, Centrifugation, Filtration of Fermentation Broths, Cell Processing & Cell separations, Ultrafiltration, Liquid-Liquid Extraction, Chromatography - Ion Exchange, Molecular Sieve, Affinity, HPLC. Distillation, Fluid Extraction & Electrodialysis.

## References:

- a. Biochemistry. (1993). Zubay.G.L, 4<sup>th</sup> Edi. WmC.Brown Publishers.
- b. A Biologist guide to principles and techniques of practical biochemistry.(1975). Bryan,W. & Keith,W.
- c. Comprehensive Biotechnology. 1-4 Volumes. Murry Moo-Young. Pergamon Press Ltd.
- d. Principles of Fermentation Technology. Peter F. Stanbury. Butterworth-Heinemann, Elsevier Science Ltd.
- e. Biotechnology: A Text Book of Industrial Microbiology, Wulf Crueger and Anneliese Crueger. Science Tech Publishers.USA.
- f. Fermentation Biotechnology. Jayanto Achrekar. 2006. Dominant Publishers and Distributors. New Delhi.
- g. Separation Process in Biotechnology. Juan.A.Asenjo. 2007. Taylor & Francis group.
- h. Fermentation and Biochemical Engineering Handbook. Henry C.Vogel & Celeste L. Torado. 2005. Standard Publishers Distributors. New Delhi.

**CORE-XIII**  
**LAB IN PLANT& ANIMAL BIOTECHNOLOGY**

**Plant Biotechnology**

1. Preparation of media.
2. Sterilization Techniques.
3. Organ cultures.
4. Callus propagation, organogenesis, transfer of plants, hardening process.
5. Protoplast isolation and culture.
6. Anther and pollen cultures - production of haploids.
7. *Agrobacterium* induction reporter gene (GUS) assay - Demo
8. Isolation of plant DNA

**Animal Biotechnology**

1. Preparation of tissue culture media and membrane filtration.
2. Preparation of single cell suspension from spleen and thymus.
3. Cell counting and cell viability.
4. Trypsinization of monolayer and sub-culturing.
5. Embronated Egg inoculation.
6. Preparation chicken embryo fibroblast culture(monolayer).

## **CORE-XIV**

### **LAB IN ENZYMOLOGY, BIOPROCESS TECHNOLOGY AND BIOINFORMATICS**

#### **ENZYMOLOGY AND BIOPROCESS TECHNOLOGY**

1. Isolation of Amylase and protease producing organisms from soil.
2. Isolation of antibiotic producing microbes from soil.
3. Culture optimization (pH, Temperature, Carbon & Nitrogen sources).
4. Production and assay of amylase and protease by submerged fermentation .
5. Production and assay of amylase and protease by solid-state fermentation.
6. Bioassay of Antibiotics.
7. Microbial production of citric acid using *Aspergillus niger*.
8. Immobilization of cells for enzyme production.
9. Alcohol production by yeast fermentation and its estimation.
10. Purification of enzymes by salting and dialysis and column chromatography techniques.

#### **BIOINFORMATICS**

1. Sequence retrieval for NCBI
2. Local alignment – BLAST
3. Phylogenic analysis.

**ELECTIVE-III**  
**BIOINFORMATICS, IPR AND BIOETHICS**

**UNIT I**

Bioinformatics: Biological Databases- uses –Sequence databases-Nucleic acid (NCBI, EMBL, DDBJ),Proteins-(SWISSPROT, PIR),Structural databases- PDB, CATH, SCOP, Specialised databases – KEGG, OMIM, PubMed – Human Genome Project.

**UNIT II**

Sequence analysis – Local Alignment, Global alignment- BLAST, Multiple sequence alignment-ClustalW, Phylogenetic analysis- WPGMA,UPGMA methods, Secondary structure prediction – GOR, Chau-Fasman method, ORF finder restriction site analysis,molecular visuvalization tool-Rasmol

**UNIT III**

Microarray data analysis : Microarray data analysis methods,tools and resources and sequences and sequence sampling and SAGE (Serial analysis of gene expression). Proteomic data analysis –Analyzing data from 2D-PAGE gels and analyzing protein mass spectrometry data(Bioinformatics in pharmaceutical industry :Drug discovery and pharmacogenomics)

**UNIT IV**

Intellectual property Right: WTO-GATT and TRIPS. Different types of Intellectual property Rights –Patents-Plant breeder's rights. Patent application - Rules governing patents. Examples of patents in biotechnology. Special application of patent laws in Biotechnology. Licensing and cross licensing. Flavr savr<sup>tm</sup> tomato as a model case.

**UNIT V**

Biosafety : Definition – requirement-Biosaftey for human and environment-General guidelines for rDNA research activity-Containment facilites and Biosafety practices-Guidelines for research in transgenic plants and applications.Social and ethical issue.

**References:**

1. Instant Notes- Bioinformatics David R.Westhead,J.Howard parish and Richard M.Twyman.Viva Books Private Limited,Chennai
2. Molecular databases for protein sequence and structure studies by Sillince,JA and Sillince M(1991) Springer Verlag.
3. Sequence analysis primer by M.Gribskov, J.Devereux (1989) Stockton Press.
4. Computational methods in Molecular biology now comprehensive Biochemistry Vol 32.S.L Seizberg,DB searls,S.Kasif Elsevier 1998.
5. Information theory and living systems by L.I Garfield,(1992) Columbia University Press.
6. Recombinant DNA safety guidelines, Department of Biotechnology, Ministry of Sciences & Technology, Government of India.
7. Recombinant DNA safety guidelines & regulation, Department of Biotechnology, Ministry of Sciences & Technology, Government of India.
8. Revised guidelines for research in transgenic plants Department of Biotechnology, Ministry of Sciences & Technology, Government of India.

### SEMESTER-IV

Course	Subjects	Hours	Credit	Marks		
				CIA	EA	Total
Core XV	Environmental Biotechnology	5	5	25	75	100
Elective IV	Nanobiotechnology	5	5	25	75	100
Project		-	3	40	60	100

**CORE –XV**  
**ENVIRONMENTAL BIOTECHNOLOGY**

**UNIT I**

Basic concepts and Issues. Environmental pollution. Types of pollution methods for measurement of pollution, methodology of environmental management- the problem solving approach and its limitations. Global environmental problems- Ozone depletion, Green house effect and Acid rain. Microbial association in environment.

**UNIT II**

Air pollution and its control through biotechnology, bioremediation of soil and water contaminated with oil spills, heavy metals and detergents, Microbiological and biochemical aspects of waste water treatment process. Various industrial effluent treatment methods- dairy, dye and other industries. Pollution abatement using microbes.

**UNIT III**

Microbiology of degradation of xenobiotics in environment: Ecological considerations, decay behaviour and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants.

**UNIT IV**

Phytoremediation: Degradation of Xenobiotics by plants. Bioleaching: Leaching of ores by microorganisms (gold, copper and uranium). Environmental significance of genetically modified microbes, plants and animals.

**UNIT V**

Waste disposal and management, legislation of environmental problems, composting and vermicomposting- method of composting types, microbial consortia used in composting, monitoring and influence of physico-chemical and microbiological parameters-benefits and applications.



## References:

1. Environmental Science and Biotechnology: theory and Techniques, A.G.Murugesan and C.Rajakumari,(2005).
2. Environmental microbiology, K.Vijaya Ramesh(2004).
3. Industrial and Environmental Biotechnology,Wise(2005)
4. Encyclopaedia of Environmental Biology, Chhatwal(2005).
5. Environmental Biology, P.D.Sharma(1994) Rastogi Publications.
6. Environmental Biotechnology and cleaner Bioprocesses, Eugenia J.Olguin(2000) Tayloir and Francis.
7. Principle Environmental Science , William P. Conningham and Mary Ann Conningham(2003) Tata McGraw-Hill publishing Company.
8. Environmental Biotechnology, K.V. Agarwall(2005) Nidhi Publishers.
9. Introduction to Environmental Biotechnology, A.K. Chatterji(2002) Prentice-Hall of India.
10. Environmental Biotechnology, Hans-Joachim Jordening, josefwinter(2005).
11. Environmental Biotechnology by Jogdan.
12. Microbial Ecology, Atlas and Bhartha.2005. Pearson Education.

**ELECTIVE-IV**  
**NANOBIOTECHNOLOGY**

**UNIT I**

**BASIC CONCEPTS OF NANO-BIOLOGY**

Nano-definitions, biosystems, biological networks, biological neurons, neurotransmitters. Protein interactions modulated by chemical energy:- actin, myosin and molecular motors. Bionanoparticles – nanocomposites, nanoparticles.

**UNIT II**

**BIOMATERIALS SCIENCE**

Introduction - Types of biomaterials. Biodegradable polymers. Biodegradation of solid polymers. Modes of erosion (surface & bulk). Molecular effects on hydrolytic breakdown.

**UNIT III**

**FABRICATION AND CHARACTERIZATION OF NANOSTRUCTURES**

Techniques to construct nanostructures – scanning probe instruments, nanoscale lithography. Techniques to predict nanostructures – TEM, SEM, AFM. Characterization techniques – NMR, Mass (MALDI-TOF) spectroscopy, x-ray diffraction.

**UNIT IV**

**NANO-BIOSENSORS**

Biomedical sensors and biosensors-. Biosensors – definition and classification – potential based sensors; electrochemical sensors; acoustic/mechanical sensors; thermal and phase transition sensors; sensors in modern medicine- Biomembrane based sensors. Diagnostic imaging techniques (digital imaging; molecular imaging).

**UNIT V**

**PROSPECTS OF NANOMEDICINE AND NOVEL DRUG DELIVERY SYSTEMS**

Drug delivery systems – polymer therapeutics:- polymer drug conjugates; polymeric micelles; liposomes. Mechanical testing; elasticity; toughness; effect of fabrication on strength. Application of nano materials in medicine:-

cardiovascular medical devices; tissue regeneration (tissue engineering).  
Dendrimers as nanoparticulate drug carriers.

### References:

1. Molecular Design and Synthesis of Biomaterials Biological Engineering Division, MIT Open Course Ware, 27<sup>th</sup> May 2005.
2. Biomaterials Sciences: An Introduction to Materials in Medicine 2<sup>nd</sup> Edition, Buddy D.Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons
3. Nanotechnology: A Gentle Introduction to the Next Big Idea Mark Ratner and Daniel Ratner. Pearson Education Publishers, 2002.
4. Encyclopedia of Nanoscience & Nanotechnology, H.S. Nalwa (Ed.), American Scientific Publishers, California, 2004.
5. Lehninger's Principles of Biochemistry, 4<sup>th</sup> Edition, David L. Nelson and Michael M. Cox, 2006.
6. Nano biotechnology : concepts, applications and perspectives. Christof M.Niemayer, Chad A.Mirkin ,Wiley VCH publishers 2004.
7. Bionanotechnology: Lessons from Nature, David .S.Goodsell, Jhonwiley 2006.