

**BHARATHIAR UNIVERSITY: COIMBATORE – 641 046**

**M. Sc. ANIMAL BIOTECHNOLOGY (CBCS PATTERN)**

**(For the students admitted during the academic year 2011-2012 batch and onwards)**

**Duration of the course: 2 years**

**Eligibility Condition:**

B.Sc. Zoology	B.Sc. Biochemistry
B.Sc. Advanced Zoology	B.Sc. Microbiology
B.Sc. Applied Zoology	B.Sc. Genetics
B.Sc. Life Sciences	B.Sc. Bioinformatics
B.Sc. Animal Science and Biotechnology	B.Sc. Environmental Sciences
B.Sc. Advanced Zoology and Biotechnology	B.Sc. Environmental Zoology
B.Sc. Biotechnology	B.V.Sc.

**Scheme of Examination**

Semeste	Core/Elective /Supportive Paper	Subject Code 10ZO0B	Title of the Paper	Instructional Hours/week	Internal	External	Total Mark	Total Credits
<b>I</b>	Core-I	13A	Biochemistry and Biophysics	4	25	75	100	4
	Core-II	13B	Molecular Cell Biology	4	25	75	100	4
	Core-III	13C	Microbiology	4	25	75	100	4
	Core-IV	13D	Human Cytogenetics	4	25	75	100	4
	Core Practical- I	13P	Practical (Biochemistry and Biophysics, Molecular Cell Biology, Microbiology and Human Cytogenetics)	6	25	75	100	4
	Elective-I	1EA	Protein Chemistry	4	25	75	100	4
	Supportive-I	----	Offered to other Department	4	12	38	50	2

<b>II</b>	Core-V	23A	Proteomics	4	25	75	100	4
	Core-VI	23B	Cell Signalling and Receptor Biology	4	25	75	100	4
	Core-VII	23C	Stem Cell Technology	4	25	75	100	4
	Core-VIII	23D	Molecular Toxicology	4	25	75	100	4
	Core Practical-II	23P	Practical (Proteomics, Cell Signalling and Receptor Biology and Stem Cell Technology and Molecular Toxicology)	6	25	75	100	4
	Elective-II	2EA	Advances in Nematology	4	25	75	100	4
	Supportive-II	----	Offered to other Department	4	12	38	50	2
<b>III</b>	Core-IX	33A	Nanobiotechnology	4	25	75	100	4
	Core-X	33B	Immunotechnology	4	25	75	100	4
	Core-XI	33C	Genetic Engineering	4	25	75	100	4
	Core-XII	33D	Conservation Biology	4	25	75	100	4
	Core-XIII	33E	Bioethics and Biosafety	4	25	75	100	4
	Core Practical-III	33P	Practical (Nanobiotechnology, Immunotechnology, Genetic Engineering, Conservation Biology and Bioethics and Biosafety)	6	25	75	100	4
	Elective-III	3EA	Ecobiotechnology	4	25	75	100	4
	Supportive-III	----	Offered to other Department	4	12	38	50	2
<b>IV</b>	Project and Viva	47V	Project Work				100	4
			Viva-voce Examination				50	2
			Field Trip* (Visiting Educational Institution, Research Labs. and industries etc.)				25	1
			Skill Development* (Communication skills, Personality development, Summer training programme, Hands on training, On the job training programme etc.,)				25	1
<b>Total</b>							<b>2250</b>	<b>90</b>

\* To be submitted along with Project Work.

**Practical Components:**

The M.Sc. Animal Biotechnology Core Practical Examination having the following Marks:

**Internal Marks: 25**

**Time: 1.30 minutes**

Major Practical	10 Marks
Minor Practical	5 Marks
Spotters (A, B, C & D)	4x21/2 = 10 Marks
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Total	= 25 Marks
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**External Marks: 75**

Major Practical	20 Marks
Minor Practical	15
Marks	
Minor Practical	10
Marks	
Spotters (A, B, C & D)	4x5 = 20
Marks	
Record	10 Marks
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Total	= 75 Marks
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**Theory Components:**

The M.Sc. Animal Biotechnology Core and Elective theory Examination having the following Marks:

**Core and Elective Papers: Maximum Marks – 100**

**Internal Marks: 25**

Test	- 15 Marks
Assignment	- 5 Marks
Seminar	- 5 Marks

**External Marks: 75**

**Section A - 10x1=10 Marks (Question No. 1 to 10)**

Choose the best Answer type. Answer all questions. All questions carry equal marks.

**Section B – 5x5 = 25 Marks (Either or type – Question No. 11 to 15)**

Answer all questions. All question carry equal marks. Each answer should not exceed 2 pages.

**Section C – 5x8 = 40 Marks (Either or type – Question No. 16 to 20)**

Answer all questions. All Question carry equal marks. Each answer should not exceed 4 pages.

**Supportive Papers: Maximum Marks - 50**

**Internal Marks: 12**

Test - 6 Marks  
Assignment - 3 Marks  
Seminar - 3 Marks

**External Marks: 38**

**Section A – 5x1=5 Marks (Question No. 1 to 5)**

Choose the best Answer type. Answer all questions. All questions carry equal marks.

**Section B – 3x3 = 9 Marks (Either or type – Question No. 6 to 8)**

Answer all questions. All Question carry equal marks. Each answer should not exceed 1 page.

**Section C – 4x6 = 24 Marks (Either or type – Question No. 9 to 12)**

Answer all questions. All Question carry equal marks. Each answer should not exceed 2 pages.

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## Core - I - 13A

## BIOCHEMISTRY AND BIOPHYSICS

The objective of the course is to provide a concise and unifying approach to physical chemistry, biochemistry and biophysics. It also provides the structure, function and interactions of bio molecules, how biological processes occur at the molecular level and to understand these processes with strong backgrounds in chemistry, biology, and physics.

### Unit – I

Structure of atom, molecules, ionic bonds, covalent bonds, hydrogen bond, Vander Vaal's forces, Intermolecular forces, electrolytes, pH and buffer capacity in the cell environment.

### Unit – II

**Amino acids:** Structure, classification, properties, isoelectric point and zwitter ions. **Proteins:** Classification based on chemical structure, function and solubility; properties, primary, secondary and tertiary, Helix, principles of isolation and purification, Synthesis of polypeptides.

**Enzymes:** Classification, Kinetics, Co-factors, Enzyme inhibition, Enzyme substrate compounds.

### Unit – III

**Nucleic acids:** DNA structure and properties, DNA as a genetic material, DNA synthesis – mechanism of replication (semi conservative and reverse transcription), nucleotides. **Different types of RNA:** mRNA and rRNA.

**Lipids:** Classification, properties – saturated and unsaturated fatty acids – plant waxes, steroids, cholesterol and lecithin.

**Carbohydrates:** Classification, structure and properties of functional groups.

### Unit – IV

**Bioenergetics:** Laws of thermodynamics, concept of free energy, oxidation reduction (redox) reactions. Energy coupling reactions, energy rich compounds, ATP cycle, standard free energy, membrane potentials, and negative entropy changes in living systems, enzyme catalysis.

### Unit – V

**Analytical techniques:** Principle and application of Chromatography (Paper, thin-layer, column and GLC), Centrifugation (RPM and G, Ultra centrifugation), Spectroscopic techniques (UV, visible spectroscopy, X-ray crystallography, NMR, IR, fluorescence & atomic absorption), Isotopes and their importance (GM counters & Scintillation counting).

### Reference Books:

1. Biochemistry, by D.Voet and J.G. Voet, 2004. John Wiley & Sons, USA
2. Biochemistry, by R.H. Garrett and C.M. Grisham, (3<sup>rd</sup> Edition) 2007. Saunders College Publishers.

3. Principles of Biochemistry by A.L. Lehninger. 1984. CBS Publishers and Distributors, New Delhi.
4. Physical Biochemistry by D. Friefelder, (2<sup>nd</sup> edition) 1982. W.H. Freeman & Company.
5. The Physical Basis of Biochemistry, by Peter R. Bergethon, Springer-Verlag, 1998.
6. Biophysics-An Introduction, by C. Sybesma, 1989, Kluwer Academic Publisher.
7. Cellular Biophysics I and II, by Thomas F. Weiss, 1995, MIT Press.
8. Basic Biophysics for Biology, by E. K. Yeagers, 1992, CRC press.
9. Principles of Biochemistry by Albert L. Lehninger (4<sup>th</sup> edition) 2004. CBS Publishers & Distributors, New Delhi.
10. Biochemistry by Lubert stryer (4<sup>th</sup> edition) 2000. Freeman International Edition.
11. Biochemistry by Keshav Trehan, 1990. Wiley Eastern Publications.
12. Fundamentals of Biochemistry by J.L.Jain et. al. (4<sup>th</sup> edition) 1994. S.Chand and Company.
13. Textbook of Organic Chemistry (A Modern Approach) I<sup>st</sup> edition) 2002. McGraw Hill.
14. The Biochemistry of Nucleic acid – Tenth Edition-Roger L.P.Adams, John T. Knowler and David P.Leader, 1992. Chapman and Hall Publications.
15. Essentials of Biophysics by Narayanan, P (2000), New Age Int. Pub. New Delhi.
16. A Text Book of Biophysics by Roy R.N. (1999), New Central Book Agency.
17. Biochemistry. S. C. Rastogi, 2<sup>nd</sup> edition. 2003. Tata McGraw Hill Publishing Company Ltd., N. Delhi.

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## Core - II – 13B

## MOLECULAR CELL BIOLOGY

### Unit – I

Cell organization, Sub-cellular structures of prokaryotic and eukaryotic cells. Synthesis and sorting of plasma membrane. Chromatin structure and nucleosome concept, Organization and function of genetic material, Gene paradox, Repetitive DNA, Satellite DNA, Overlapping genes, Split genes, Pseudogenes. Chromatin, nuclear and mitochondrial genome organization, Structures of DNA and RNA, Stereochemistry of bases and secondary structures. Genetic structure analyses of eukaryotic genomes.

### Unit-II

Evidence of basic targets, Enzymes, Mechanisms of DNA replication in eukaryotes. t-RNA, m-RNA, r-RNA and hn-RNA structures and folding, Mechanisms in eukaryotes RNA splicing. Ribosomes, Genetic code, General control of DNA, RNA and protein synthesis, Post-translational modifications, Protein targeting.

### Unit-III

Gene regulation in eukaryotes, Gene clustering, Mechanism of positive and negative control of gene expression. Translational and transcriptional control of regulatory mechanism of gene expression, Environmental effects on gene regulation.

### Unit-IV

Signaling at the cell surface, Types of signaling pathways that control gene activity, Integration of signals and gene controls. Moving proteins into membranes and organelles, Vascular traffic, secretion and endocytosis, Metabolism and movement of lipids.

### Unit-V

Regulation of the Eukaryotic cell cycle, Cell birth, Lineage and cell death. Cancer/ oncogenes, Cell markers, Cellular morphology, Primary and established cell lines, Kinetics of cell growth, Genetics of cultured cells. Stem cell culture, embryonic stem cells and their applications. Cell culture based vaccines. Somatic cell genetics.

### List of Suggested Reference Books:

1. Cell and Molecular Biology, (8th edn)., De Robertis, E.D.P. and De Robertis, E. M.F. 1995, B.I.Waverly Pvt. Ltd., New Delhi.
2. Essential Cell Biology, B. Albert et al., 1998. Garland Publishing, Inc. New York.
3. Principles of Cell and Molecular Biology. (2nd edn)., Kleinsmith, L. J. & Kish, V.M. 1995.
4. Molecular Biology of the Cell. (3rd edn)., Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D. (eds.) 1994. Garland Publishing, Inc., New York.

## Core - III - 13C

## MICROBIOLOGY

### Unit – I

**Introduction– Scope and History of microbiology** –Classification of bacteria, fungi, yeast and virus. Structure and functions of bacteria and virus. Reproduction in bacteria – Transformation, conjugation, transduction. Mapping in bacterial genomes.

### Unit – II

**Cultivation and control of microorganism** – Methods of collection of sample – methods of estimation of microorganism in soil, water and air – Isolation and identification of bacteria. Methods of sterilization and disinfection – Microbial control – Physical and chemical – techniques of pure culture – Method of cultivation of bacteria – Phases of growth .

### Unit – III

**Microbial Ecology:** Distribution of microorganism in soil, water and air – Environmental factors influencing the distribution of microorganism – Role of microorganisms in the cycling of nutrients – Carbon, nitrogen, phosphorous and sulphur cycle.

### Unit – IV

**Food Microbiology:** Sources, types incidence of microorganism in vegetables, meats, poultry, seafood, milk and diary products – spoilage of food, fruits, vegetables, cereals, meat, poultry egg, seafood, caned products – Factors influencing spoilage – Methods of detection of spoilage, principles of food preservation and prevention of food spoilage.

### Unit – V

**Microbial Technology:** Genetic engineering of food and additives – Single Cell Protein (SCP) production – Production of organic acids (acetic acid), ethanol – Antibiotics – Microbial toxins – methanogenesis — Fermentation products.

### References:

1. Burden, K.L. and R.P. Williams (6<sup>th</sup> Ed.) 1968. Microbiology. The Macmillan Co., London P. 818.
2. Dawes, E.A. (Ed.) 1986. Energy conservation in bacterial photosynthesis. In: Microbial energetics. Blackie & Son Ltd., Glasgon, 133-144pp.
3. Doelle, H.W. (Ed.) 1969. Fermentation acetic acid bacteria and lactic acid bacteria. In: Bacterial metabolism. Academic Press. New York, London. 256 – 351 pp.
4. Hay, J.M. (Ed.) 1986. Modern Food Microbiology. CBS publishers, Delhi. 622 pp.
5. Reed, G. (4<sup>th</sup> Ed.) 1983. Prescott & Dunn's Industrial Microbiology. AVI Publishing Co., Inc. Connecticut, 883. pp.
6. Roberts, T.A. and F.A. Skinner (Eds.) 1983. Food Microbiology: Advances and Prospects, Academic Press, Inc. London, 393 pp.
7. Selle, A.J. (Ed.) 1967. Fundamental Principles of Bacteriology. Tata McGra – Hill Publishing Company Ltd., New Delhi, 822 pp.



## Core – IV - 13D

## HUMAN CYTOGENETICS

### Unit - I

History of Human Chromosome Research - Denver Conference (1940) - Chicago Conference (1966) - Paris Conference (1971) - Nomenclature of Human Chromosome.

### Unit - II

Identification of Human diploid chromosome - peripheral blood cultures - banding techniques - G-band; Q-band; C-band; R-band - Identification of 23 pairs of Human chromosomes by band position.

### Unit - III

Chromosomal syndromes: Autosomal syndromes - Sex chromosomal syndromes - Structural chromosomal syndromes.

### Unit - IV

Prenatal diagnosis: Chorionic villi sampling - Foetoscopy, Ultrascopy - Amniocentesis. b) Postnatal diagnosis: Peripheral blood leucocyte culture - Sister Chromatid Exchange - Fragile site - Mitotic index. c) Genetic Counseling.

### Unit - V

Hereditary forms of Cancer - Oncogenes and Cancer - Chromosomes and Cancer - Cancer and the environment.

### Reference books

1. Human Heredity Principles and issues -- by Michael R. Cumming's. 3<sup>rd</sup> Edition.
2. Genetics Medicine - by Karl. H. Muench Elsevier Pb. London
3. Human Genetics by Elof Axel Carlson, TATA Mc Graw-Hill Pb. New Delhi.
4. Attwood, T.K. and Parry Smith, D.J. 1999, Introduction to Bioinformatics, Longman Publications, Pearson Education Ltd., New Delhi.
5. Baxevanis, A.D. and Francis Ouellette, B.P., 1998, Bioinformatics, A Practical Guide to the Analysis of Genes and Proteins, Wiley – Interscience Publication, New York.
6. Bishop, M.J. and Ramlings, C.J., 1987, Nucleic Acid and Protein Sequence Analysis, A Practical Approach, IRL Press, Oxford.
7. Brown, T.A., Genomes, 1999, John Wiley and Sons Inc., New York.
8. Zhang, W.E.I. and Shmulevich, I.Y.A. 2002, Computational and Statistical Approaches to Genomics, Kluwer Academic Publishers, London.

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**Core Practical – I - 13P      BIOCHEMISTRY AND BIOPHYSICS, MOLECULAR CELL  
BIOLOGY, MICROBIOLOGY AND HUMAN  
CYTOGENETICS**

**Biochemistry and Biophysics**

1. pH: Structure and operation of pH meter
2. Preparation of buffers: Phosphate buffer and citrate buffer.
3. Colorimetric/Spectrophotometric estimation of the following biomolecules.
  - a. Total free amino acids (Ninhydrin reagent method)
  - b. Protein (Lowry et al., 1951 method)
  - c. Total soluble carbohydrates (Anthrone reagent method)
  - d. Total cholesterol (Zlatkis et. al. method)

**Molecular Cell Biology**

1. Principles of microscopy and optics.
2. Cell size determination
3. Microtomy and photography.
4. Mounting of polytene chromosomes.
5. Preparation of mitosis in Onion root tip.
6. SDS - PAGE of protein from animals.

**Microbiology**

1. General rules of microbiology laboratory.
2. Preparation of Non-selective and selective culture media.
3. Estimation of bacteria from soil and water using plate count method.
4. Observation of morphological characters of bacteria (temporary wet mount technique).
5. Staining methods: Preparation of smears for staining - simple staining, negative staining, gram staining.

**Human Cytogenetics**

1. Problems related to Mendelian laws.
2. Pedigree analysis
3. Peripheral blood leukocyte culture for chromosomal studies
4. Mitotic indices
5. Sister chromatid exchange -determination
6. Micronucleus test
7. Chromosomal disorders-Numerical, Structural

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## **Elective - I - 1EA**

## **PROTEIN CHEMISTRY**

### **Unit- I**

Building blocks of protein: amino acids- essential, non essential amino acids; Aliphatic and aromatic amino acids. Protein synthesis in prokaryotes, eukaryotes and cell organelles like mitochondria. Post- translational modifications.

### **Unit- II**

Structure of amino acids: basic carbon skeleton of amino acid, chemical bonds- hydrogen bond, covalent bond,  $\pi$ - bond, disulfide bond, peptide bond ; intrinsic and extrinsic forces maintaining protein structure – Vander Waall's force, electrostatic force. Molecular mechanism of protein folding and zymogen activation.

### **Unit- III**

Proteins – Simple, Complex, Metallo, lipo and glycoprotein ; Structural classification of protein – Primary, Secondary, Tertiary and quaternary structure ; Functional classification of protein- Structural component of plasma membrane, receptors, enzymes, carriers, hormones and pheromones.

### **Unit- IV**

Principle, of quantitative estimation methods of – Lowry's method, BCA method, Bradford method. Protein purification methods- Solvent extraction, HPLC. Visualization of expressed proteins: PAGE, Western blot, hybridization technique. Chemiluminescent, Immunohistochemical and confocal microscopic methods.

### **Unit-V**

Protein structure prediction – primary (Edman's method), secondary (Ramachandran plot), tertiary and quaternary (X-Ray diffraction and NMR study), Proteomic tools – Rasmol, SWISS-port, SCOP and composite databases. Current status and applications of proteomic research and databases.

## **References**

1. K.H.Nierhaus, D.N Wilson 2004. Protein Synthesis and Ribosome Structure, Wiley-VCH Verlag Gmbh & Co. KGaA; Germany
2. Albert Lehninger, David L Nelson, Michel M. Cox. 2008. Principles of Biochemistry, Fifth Edition, W.H. Freeman & Company's.
3. Carl Branden; 1999. Introduction To protein Structure;; Garland Science, Sweden.
4. Anna Tramontano, 2006. Protein Structure Prediction, Wiley-VCH; USA.
5. Simon Roe 2001. Protein Purification Techniques, Fourth edition, Oxford; New York.

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## **Core - V – 23A**

## **PROTEOMICS**

### **Unit –I**

Introduction to proteomics: Proteome at a glance. Life and death of a protein. Functional protein families. Deducing proteome from the genome. Analytical proteomics. Significance for analytical proteomics. Peptide separations. Protein extraction from biological samples. Protein digestion techniques. Proteases, Cyanogen bromide and In-gel digestion.

### **Unit –II**

One dimensional SDS-PAGE. Two dimensional SDS-PAGE. Problems with 2D- SDS-PAGE. Ionization techniques for macromolecules. Preparative IEF. High-performance liquid chromatography. Capillary electrophoresis.

### **Unit –III**

Mass spectrometer analysis of proteins and peptides. MALDI-TOF MS instrument. MALDI. TOF Mass analyzer. ESI Tandem MS instruments. Tandem Mass analyzers. Triple Quadrupole Mass Analyzer. Ion-Trap Mass Analyzer. Q-TOF and Fourier Transform-Ion Cyclotron Resonance MS instruments.

### **Unit –IV**

Protein identification by peptide Mass fingerprinting. Peptide sequence analysis and identification by Tandem Mass spectrometry. Data Mining in proteomics. Protein expression profiling. Identification of protein-protein interactions and protein complexes. Mapping protein modifications.

### **Unit –V**

Protein chips. SELDI. Microsequencing. Proteomics in cancer research. Proteomic analysis in pancreatic ductal adenocarcinoma and human breast carcinoma. Profiling of chemoresistant cancer cells. Proteomics in disease understanding.

### **References:**

Hubert Rehm. 2006, Protein biochemistry and proteomics, Academic Press, Elsevier. USA.  
Mahmoud Hamdan and Pier Giorgio Righetti. 2005, Proteomics today, John Wiley & Sons, New Jersey, USA,  
Daniel C. Liebler. 2002 Introduction to proteomics Humana Press, Totowas, NJ, USA,

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**Core - VI – 23B**

**CELL SIGNALLING AND RECEPTOR BIOLOGY**

**Unit –I**

Cell signaling Mechanisms - Types of signaling pathways that control gene activity, Integration of signals and gene controls. Cell Communication: General principles of Cell signalling – types and Mechanisms- Cell surface receptors – GPCR

**Unit –II**

Signal transduction mechanisms for plasma – membrane receptors- Introduction – classification – Adenylyl cyclase and cyclic AMP- Guanylyl cyclase and cyclic GMP- Ion channels controlled by G proteins - Calcium as a second messenger.

**Unit –III**

Introduction to receptor – Regulation of receptors - application of receptors in biology- Examples of receptors, Autocrine, Paracrine and Endocrine models. Vertebrate visual photoreceptors - Rhodopsin – Photo transduction - Nicotinic acetylcholine receptor - Structure and function - Receptor phosphorylation - Steroid receptors and membrane receptors.

**Unit – IV**

Functions of : Cell Surface receptor, Enzyme linked Receptor – Activated Tyrosine kinase and MAP kinase path-ways. Cell Division: Overview of cell cycle- Mitosis and Meiosis. Cell Cycle control in mammalian cells – Checkpoint in cell cycle regulation

**Unit –V**

Characterization of receptors - Receptors for Immunoglobulin G (IgE) and its function. Hormone receptors – Introduction – Mechanism of hormone action -Thyroid hormone receptors- Events elicited by hormone – receptor binding

**Books Recommended**

1. Fundamentals of Receptor Molecular Biology By Donald Francis Hoelzl Wallach.
2. Molecular Biology of the Cell (4th Ed.), Albert *et al.*: Garland Publishing Inc., 2002
3. Molecular Cell Biology (5th Ed.), Lodish *et al.*: Freeman and Company, 2004
4. Biochemistry (5th Ed.), Berg *et al.*: Freeman and Company, 2002
5. Harper's Biochemistry (26th Ed.), Murray *et al.* Appleton & Lange, 2003.
6. The Receptors by P. Michael Conn, Volume 1 Academic press, Inc.,
7. Molecular Cell Biology by Darnell J., Lodish H., Baltimore D., Freeman W.H., 1990.
8. Cell Biology by Kimball T.W., Wesley Publishers, 1989.

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## Core - VII – 23C

## STEM CELL TECHNOLOGY

### Unit-I

Stem cell concept – Properties of stem cell – Types of stem cell embryonic stem cell – Adult stem cells – Problem of differentiation.

### Unit-II

Differentiation status of cells – Primordial germ cell -Skin cell - Gastrointestinal cells – Embryonic stem cell differentiation as a model to study haematopoetic and endothelial cell development.

### Unit-III

Stem cell location and Classification – Neural stem cells – Stem cell niches – Germ line Epithelial and Epidermal and neural niches.

### Unit-IV

Uses of Stem cells - Human stem cells – Renewal of stem cells- Stem cells and Tissue engineering –Embryonic stem cells and Gene therapy - Therapeutic cloning.

### Unit-V

Single-Cell PCR methods for studying stem cells – Ethical and Social consideration of Stem cell research

### References:

1. **Embryonic Stem Cells Method and Protocols** Edited by **Kursad Turksen**, Humana press, 2002.
2. **Stem Cell Century**, Law and Policy for a Breakthrough Technology **Russell Korobkin** and **Stephen R. Munzer**, Yale University Press (2007).
3. **Essential of Stem cell Biology**, **Robert Lanza** (Eds.) **Elsevier press**, (2005).
4. **Hand Book of Stem Cells** Volume 1&2, **Robert Lanza** (Eds.), **Elsevier press**,(2004).
5. **Stem Cells and the Future of Regenerative Medicine** by Committee on the Biological and Biomedical Application of Stem Cell Research, (2004).
6. **Stem cells**, scientific progress and Future Research Direction by National Institutes of Health, (2000).

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## **Core-VIII-23D**

## **MOLECULAR TOXICOLOGY**

The objective of the course is to provide opportunities for the students to increase their knowledge on basic principles of toxicology including the history and scope of the field, to understand toxic effects of compounds at the molecular and biochemical level and to examine recent toxicological research involving molecular and biochemical mechanisms of chemicals and other toxicants with cell systems.

### **Unit-I**

Definition and basic principles of toxicology – Passage of a chemical through the body – Absorption - Distribution –Metabolism – Excretion – ADME.

### **Unit-II**

Biotransformation of toxicants – Phase I reactions- Cytochrome P450 –Flavin mono-oxygenase – P450 reductase – Cytochrome b5 –Prostaglandin synthetase mediated toxicity.

### **Unit-III**

Phase II reactions – Glucuronide conjugation –Sulphate conjugation – Glutathione conjugation – Epoxide hydrolase mediated toxicity.

### **Unit-IV**

Toxic effects – Acute toxicity – Short term and long term toxicity - Target organs – Neurotoxicity – Immunotoxicity – Hepatotoxicity – Nephrotoxicity- Teratogenesis

### **Unit-V**

Technologies for toxicity assessment – Genomics – transgenics – Transcriptomics –Micro array analysis – RT-PCR - Proteomics – protein chip analysis – Metabonomics

### **Reference Books**

1. Molecular Toxicology by N.Pant –First edition, BIOS Scientific Publishers, New York
2. Basic Toxicology by Frank C. Lu –Fourth edition, Taylor and Francic, New York
3. Molecular and Biochemical Toxicology: Definition and Scope by Ernest Hodgson and Robert C. Smart, 4th edition, John Wiley & Sons, Germany.
4. Casarett & Doull's Toxicology: The Basic Science of Poisons by Doull, J. Klaassen, C.D and Amdur, M.O., Second edition, Macmillan Publishing Co., Inc, New York.
5. Molecular, Clinical and Environmental Toxicology – Luch Anderson – Springer
6. Advances in Molecular Toxicology - James C Fishbein –Elsevier Science.
7. Advances in Molecular Toxicology - C Reiss, S Parvez, G Labbe-VSP Books-India
8. Molecular Toxicology – P. David Josephy – Oxford University press.

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**Core Practical – II - 23P    PROTEOMICS, CELL SIGNALLING AND RECEPTOR BIOLOGY,  
STEM CELL TECHNOLOGY AND MOLECULAR TOXICOLOGY**

**Proteomics**

1. Protein extraction and digestion from biological samples.
2. Liquid chromatography.
3. SDS-PAGE and silver staining of gels.
4. Blotting procedures.
5. 2D SDS-PAGE
6. Spot matching in 2D gels using software.
7. Protein analysis by HPLC.
8. Protein modification and analysis.

**Cell Signalling and Receptor Biology**

1. Mouse Leptin Receptor assay by ELISA
2. Progesterone receptor assay
3. Estrogen receptor assay

**Stem Cell Technology**

1. Preparation and requirements of Stem cell Technology laboratory.
2. Culture of stem cell – Differentiation experiments.
3. Techniques on protein – Nucleic acid interaction : Gel retardation assay, DNAase footprinting modification production ,Modification interference – Demonstration
4. Single cell PCR methods for studying Stem cells –Demonstration

**Molecular Toxicology**

1. Determination of GOT, GPT and LDH activity in treated and untreated groups
2. Histopathology of liver and kidney
3. Quantification of DNA in necrotic cells
4. MTT assay for cytotoxic effect
5. Electrophoresis of RNA

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**Elective - II – 2EA                      ADVANCES IN NEMATODOLOGY**

**Unit-I**

History and Development of Nematology in India and Abroad – Position of nematode in animal kingdom – Importance of nematodes to plants – Economic loss in crop plants.

**Unit-II**

Morphology and anatomy of nematodes (cuticle, digestive, reproductive and nervous system, sense organs) – Taxonomy of plant parasitic nematodes – Classification of plant parasitic nematodes based on feeding habits.

**Unit-III**

Symptoms and biology of important plant parasitic nematodes (Meloidogyne, Heterodera, Pratylenchus, Tylenchulus and Rotylenchulus).

**Unit-IV**

Principles of nematode management – Physical methods (soil solarisation, hot water treatment, seed cleaning), cultural methods (deep ploughing, fallowing, crop rotation), biological control (antagonistic crops), chemical control – soil fumigants and nematode management.

**Unit-V**

Major nematode parasites and their management in rice, wheat, cotton, tomato, potato, banana, corn. Nematode sample collection - Nematode extraction (Cobb's technique, Centrifugal floatation, Cyst extraction) - Biology of entomopathogenic nematodes.

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## Core - XI- 33A

## NANOBIOTECHNOLOGY

### Unit- I

Introduction to Nanobiotechnology - Biomimetic inorganic Nanomaterial- Biocompatible devices - Implant coating – stents and seeds –Structure and process of biomolecules for functional materials- Bioelectronics in Medical applications.

### Unit- II

Introduction to protein based Nano structure- Protein patterning and application in bio materials and Bio devices DNA based Nano structures - fabrication properties and application.

### Unit- III

Nanoanalysis - Nano particle molecular labels - Polymers nanofibres and their applications in bioengineering – Functional polymers for bone tissue engineering applications-Applications of nanotechnology in tissue engineering

### Unit- IV

Microfluidics - Devices and their importance for Nanobiotechnology- Advantages of Microfluidics Devices – Concepts for Microfluidics Devices - Materials for Microfluidics components – Fluidic Structures.

### Unit- V

Bio medical applications - Bio active Nano material in bone crafting and tissue engineering – Inorganic / polymers Nanocomposites for dental restoration and bone replacement application- Biosensors – Drug delivery –Neuro electronic interfaces – Protein engineering – Nanoluminescent tags.

### References:

1. **K.K.JAIN 2006, Nanobiotechnology in Molecular Diagnostics:** Current Techniques and Applications Horizon Biosciences.
2. **MARK RATNER and DANIEL RATNER 2005, Nanobiotechnology a Gentle Introduction** to the Next Big Idea, Pearson Education.
3. **CHALLA S.S.R. KUMAR (Ed). 2006.** Biological pharmaceutical Nanomaterial. Wiley-VCH Verlag GmbH & Co, KGaA.
4. **NIEMEYER, C.M., MIRKIN, C.A. (Eds.).2004.** Nanobiotechnology Concepts, Applications and Perspectives, Wiley-VCH, Weinheim.

## Core - X- 33B

## IMMUNOTECHNOLOGY

### Unit - I

Introduction to Immune system; cellular and humoral immunity; complement; molecular basis of immune diversity. Host –parasite interaction; Immunity and infection: Immunity to bacteria, virus, protozoa, fungi and tumor.

### Unit - II

Antigens and antigenicity. Polyclonal and monoclonal antibody production and purification. Conjugation of antibody with enzymes, fluorochrome and toxin. Humoral immune response and cell mediated immune response.

### Unit - III

Immunity to infections. Immunological techniques: RIA, ELISA, immunocytochemistry, Immunofluorescence and Immunoblotting.

### Unit - IV

Fluorescence antibody techniques, flow cytometry, fluorescence in situ hybridization. Immunopathology and immunological disorders.

### Unit - V:

Principles and methods of vaccine preparation – Edible vaccines. Antibody engineering and structure. Cytokines and immunotherapy.

### References:

1. Immunology, S.K. Gupta (1999). *Narosa Publishing House*, New Delhi.
2. Essential Immunology (8<sup>th</sup> Edition), Ivan Roitt, 1994. *Blackwell Scientific Publication*. Immunology W.H. Freeman and Company.
3. Abdul .K. Abbas. Andrew .K. Litchmen and Jordan, 1997, Cellular and Molecular Immunology, 3<sup>rd</sup> Edn. *W.B. Saunder Company*.
4. Weir, D.M. and Stewart, J., 1997, Immunology, 8<sup>th</sup> Edn., *Churchill Livingston*, New York.
5. Eryl Liddell and Ian Weeks., 1995, Antibody Technology, *BIOS Scientific Publishers*.
6. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts and James D. Watson.(Eds.), 1994, Molecular Biology of the cell, 3<sup>rd</sup> Edn., *Garland Publishing Inc.*, New York.
7. Immunology, George Pinchuk (2004). *Tata McGraw-Hill Publishing Company Limited*, New Delhi.

## Core - XI- 33C

## GENETIC ENGINEERING

### Unit-I

Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, Concept of restriction and modification - Restriction endonucleases, DNA modifying enzymes, Ligases. Host-vector system - Cloning vectors for *E. coli.*, Cloning vectors for Eukaryotes. Different Kinds of Vectors - Plasmids, Phage vectors, Cosmids, Phagemids, Virus vectors, Shuttle vectors and expression vectors.

### Unit-II

Isolation and purification of DNA from animal cells, DNA sequencing and sequence analysis, Synthesis of gene, DNA finger printing, Different strategies of cloning, Direct and vector mediated gene transfer, Ligation strategies, Genomic libraries, cDNA libraries, Gene tagging, Expression of cloned genes, Isolation and purification of the expressed product. Site-directed mutagenesis. PCR technology, its principles and application. Molecular marker technology, Promoters and Operon systems. DNA forensics, DNA finger printing and paternity decisions.

### Unit-III

Micro manipulation and cloning, Somatic cell cloning, Identification and isolation of genes of economic importance, Gene mapping, Transgenesis for animal improvement and production of animals as bioreactors for proteins of pharmaceuticals value, Gene transfer in fish, Expression of animal genes in bacteria, Biohazards and safeguards of genetic engineering.

### Unit-IV

Conventional methods of animal improvement, predominantly selective breeding and cross-breeding. Embryo biotechniques for augmentation of reproductive efficiency and faster multiplication of superior germ plasm. Super ovulation. Oestrus synchronization. Embryo collection, evaluation and transfer. *In vitro* maturation of oocytes. *In vitro* fertilization and embryo culture. Embryo preservation, Embryo sexing.

### Unit-V

Genetic diversity, Molecular taxonomy, Species and population biodiversity, Biodiversity and centers of origins of animals, Conservation of animal genetic resources, Morphological and molecular characterization of biodiversity. Bio-safety in relation to transgenic research and applications.

### **List of Suggested Reference Books:**

1. Genetics (3<sup>rd</sup> Edition), Strickberger, M.W. 1996, *Printice Hall*, India Ltd., New Delhi.
2. Molecular Biology of the Cell (3<sup>rd</sup> Edition), Alberts, B. et. al., 1994, *Garland Publishing Inc.*, New York.
3. Genes VIII. Levine, B., 2004, *Oxford University Press*.
4. Genetics: Analysis of Genes and Genomes (5<sup>th</sup> Edn.), Hartl, D.L. & Jones, E.W., 2001, *Jones and Bartlett Publishers*, Sadbury, Massachusetts.

5. Gene Cloning and DNA Analysis, (5<sup>th</sup> Edn.), T.A. Brown, 2001, *Blackwell Science Ltd.*,
6. Genetics. The Continuity of Life, D.J. Fairbanks & W.R. Andersen, 1999. *Books/ Cole Pub. Company.*
7. An Introduction to Genetic Analysis (7<sup>th</sup> Edn.), A.J.F. Griffiths et al., 2000. *W.H. Freeman & Co.*
8. Principles of Genetics (6<sup>th</sup> Edn.), R.H. Tamarin, 1996. *WCB/McGraw-Hill*, New Delhi.
9. Genetic Engineering, Boyer.H.W and Nicosia. S. 1978. *Elsevier/North Holl and Biomedical Press*, Amsterdam
10. Genetics of Industrial Microorganism, Seberk, O.K and Laskin, A.I., 1979. *American Society of Microbiology*, Washington.
11. Principles of gene manipulation, 3rd Edn., Old & Primrose, 1989, *Publishers Business Service.*
12. Recombinant DNA Technology, (2<sup>nd</sup> Edn.), J.D. Watson, M. Gilman, J. Witkowski & M. Zoller, 1992. *Scientific Americans Books*, New York.
13. Molecular Biotechnology, S. Maulik and S.D. Patel, 1997, *Wiley. Liss*
14. r - DNA technology and Biotechnology, K. Kreuzer & A. Massey, 1996, *ASM Press*, Washington. D.C
15. Dealing with genes, D. Berg & M. Singer, 1992, *Blackwell Scientific Publication.*
16. Molecular Biotechnology, B.R. Glick & J.J.Pasternak, 1994, *ASM Press*, Washington
17. Techniques for Engineering Genes, Butterworth. Heinemann, 1993, Open Universities Nederland.
18. Methods in Gene Biotechnology, W. Wu, M.J. Welsh, P.B. Kaufman & H.H. Zhang, 1997, *CRC Press*, New York.

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**Core – XII – 33D**

**CONSERVATION BIOLOGY**

### **Unit I - BIODIVERSITY; SPECIES CONCEPTS; ANIMAL DIVERSITY**

**What is Biodiversity?** - Components of Biodiversity (Ecosystem, Genetic and Species diversity)  
- Assigning values to biodiversity - Species concepts - **Animal diversity:** (Distribution, inventory, species richness) - Biodiversity Hotspots (Western Ghats, Indo-Burma region).

### **Unit II - LOSS OF ANIMAL DIVERSITY, STATUS OF SPECIES**

**Extinctions:** Past rates of Extinctions - Concepts of Island biogeography and extinction rates on Islands - Human induced, Modern and local extinctions - Population reduction-threats to wildlife (examples)- Habitat loss, degradation and fragmentation. Threats to animal diversity in India - **Status of species:** Rare, endemic and threatened species - Measuring status of species in the wild - IUCN Red list (Assessments and methodologies) - Status of Indian animals.

### **Unit III - CONSERVATION: TOOLS IN ANIMAL CONSERVATION**

**What is conservation biology?** - *In situ* and *Ex situ* conservation of Indian animals (Case studies) - Population management -Project Tiger and Elephant - Captive breeding programme - peoples participation in conservation - Successes and failures of conservation actions in India (Case study) -**Tools in Conservation:** Interpretation of various data on wildlife - GIS - remote sensing - Landscape model – PVA and CAMP processes.

### **Unit IV - ANIMAL LAWS AND POLICIES IN INDIA; ECONOMICS OF BIODIVERSITY CONSERVATION**

Wildlife (Protection) Act of India (1972) - Protected Area network - forest policy - Prevention of cruelty to Animal Act - Convention on Biological diversity, International Trade in endangered species - Zoo policy- Laws and their applications in Zoological parks, wildlife sanctuaries and biosphere reserves - Economics of biodiversity conservation.

### **Unit V - CONSERVATION EDUCATION AND AWARENESS**

Wildlife / Animal magazines, Journals- How to write popular and Scientific articles - Magazine and Journal information - Wildlife, nature, environment games (examples) – Role of NGO's and Government organizations in wildlife conservation - Wildlife celebration days in India - Biotechnology in conservation.

#### **Selected References:**

1. R. B. Primack 1993. Essentials of Conservation Biology, Sinauer Associates, USA
2. G. K. Meffe and C. R. Carroll 1994. Principles of Conservation Biology, Sinauer Associates, USA
3. B. Groom bridge 1992. Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.
4. R. A. Mittermeier, N. Meyers, P.R. Gil and C. G. Mittermeier 2000. Hotspots: Earth's Biologically richest and most endangered Terrestrial Ecoregions. Cemex/Conservation International, USA
5. M.E. Soule 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA.
6. M. L. Reaka - Kudla, D. E. Wilson and E. O. Wilson 1997. Biodiversity II: Understanding and Protecting our Biological Resources. Joseph Henry Press, Washington, DC.
7. T. W. Clark, R. P. Reading and A.L. Clarke 1994. Endangered Species Recovery: Finding the Lessons, Improving the process. Island Press, Washington, DC.
8. <http://www.redlist.org>
9. W. V. Reid and K.R. Miller 1989. Keeping options Alive. World Resources Institute.
10. Anon. 1997. Wildlife (Protection) Act of India, Nataraj Publishers, Dehradun
11. K. J. Gaston 1996. Biodiversity: Biology of numbers and Difference. Blackwell Science, Oxford.

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## Core – XIII – 33E

## BIOETHICS AND BIOSAFETY

### Unit – I

Introduction to Bioethics in Biotechnology- Ethics – Bioethics - Biotechnology – Positive effects – Negative effects - Ethics in biotechnology- Biotechnology examples – Rice with Vitamin A - Slow Ripening Fruits- Saving the Banana- Virus Resistant Crops - Building with Silk- Educated Need for Fertilizers- More from the Sun- Toxic Soils- Biological Pest Controls – Fast Growing Trees- Fast Growing fish- The Monarch Butterfly Story- Consumer traits – food safety- Environmental concerns- Economic and Social Concerns.

### Unit – II

#### **Biosafety Regulations- National and International Guidelines.**

Introduction – Regulation framework in various countries – USA- European Union-Canada- Australia- South Africa- Asian Region- International Guidelines.

### Unit –III

#### **CPCSEA Guidelines for Laboratory Animal Facility**

Goal- Veterinary care- Animal procurement- Quarantine, Sterilization and separation – Surveillance, diagnosis, treatment and control of disease- Animal care and technical personnel- Personal hygiene- Animal experimentation involving hazardous agent- Multiple surgical procedures on single animal- Duration of experiments- Physical restraint- Physical plant- Physical relationships of animal facilities to laboratories – Functional areas- Physical relationship of animal facilities to laboratories- Functional area- Physical facilities- Environment- Animal husbandry- Activity – Food- Bedding- Water- Sanitation and cleanliness- Assessing the effectiveness of sanitation – Waste disposal- Pest control- Emergency , weekend and holiday care.

### Unit – IV

GLP and Bioethics- Introduction – National Good Laboratory Practice (GLP) Programme- The GLP authority functions- Why follow Good Laboratory Practices?- The Aspiration – Who is responsible? – The IT Way- Role of a Sponsor- What are the quality standards for Clinical Trials?- Why is India a favorite destination for Clinical Trials worldwide?

### Unit – V

Intellectual Property Rights - An introduction- Origin of the Patent Regime- Early patterns Act & Indian Pharmaceutical Industry – History of Indian Patent System- The Present Scenario – Basis of Patentability –Patent Application Procedure in India- Patent Granted Under Convention Agreement- Who can apply for a patent?- Patent Procedure – Opposition to Grant of Patent- Grant and Sealing- Exclusive Rights – Grant of Exclusive Rights- Special Provision for selling or distribution – Suits relating to infringements – Compulsory License- Termination of Compulsory License – Case study- Compulsory Licenses- Relief under TRIPS agreement.

### Reference Books:

1. Bioethics, by Shaleesha A. Stanley (2008). Published by Wisdom Educational Service, Chennai.

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**Core Practical – III – 33P NANOBIO TECHNOLOGY, IMMUNOTECHNOLOGY,  
GENETIC ENGINEERING, CONSERVATION BIOLOGY  
AND BIOETHICS AND BIOSAFETY**

**Nanobiotechnology**

1. Protein Micro array –Demonstration
2. Quantum dots-Demonstration
3. DNA micro array- Demonstration.
4. Materials for the manufacture of Micro fluidics components-silicon-glass- polymers-Fluidic structure and fabrication methods –Demonstration.

**Immunotechnology**

1. Media preparation and animal cell culture.
2. Primary cell culture establishment from tissue.
3. Antibody development and purification.
4. ELISA
5. Western Blot.
6. Immunofluoresence.
7. RIA
8. Mounting of Spleen and Bone Marrow Cells
9. Lymphoid organs in Rat.
10. Differential counting of human WBC
11. Demonstration of Antigen – Antibody by interfacial ring test / blood grouping culture.

**Genetic Engineering**

1. Preparation of plasmid DNA and genomic DNA from *E.coli*.
2. Preparation of genomic DNA from animals/ human.
3. Agarose gel electrophoresis of plasmid and genomic DNA.
4. Restriction mapping of plasmid DNA.
5. PCR amplification, RFLP\*.
6. Vector preparations\*.
7. Insert preparations\*.
8. Ligation\*.
9. Transformation of *E. coli* with plasmid DNA using  $\text{CaCl}_2$  \*.
10. Isolation of the recombinant plasmid\*.
11. Preparation of cDNA using RT-PCR\*.

\* Practical by demonstration only.

**Conservation Biology**

1. Inventories/Surveys.
2. Field Techniques.
3. Identification and use of keys – Reference specimen.



4. Collection and preservation.
5. Introduction to computerized techniques – Remote sensing CAMP and GIS and their modules for conservation.
6. IUCN Red List Exercise and PVA modeling.
7. Statistical analysis/interpretation.
8. Technical writing and reporting of field studies.
9. Public presentation.
10. Field Project/ Report – Visit to Zoological parks, wildlife sanctuaries and biosphere reserves.

**Bioethics and Biosafety**

1. Visit to Research institutes holding animal house facility.
2. Visit to pharmaceutical industry and report submission.
3. CPCSEA, GLP, IPR- Group discussion - report submission.

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### **Elective - III – 3EA**

### **ECOBIO TECHNOLOGY**

This course provides the application of biotechnology to solve environmental problems like pesticides, metals, industrial effluents, solid waste, acid rain, global warming, ground water contamination etc., by environmental quality evaluation, monitoring, and remediation of contaminated environments. This course also provides detailed knowledge of environmental biology and pollution.

#### **Unit – I**

**Introduction:** Ecology and Ecosystem, Environmental biotechnology, Scope and importance, Current status, Future. **Environmental pollution:** Origin, Types, Air, Water, Soil, Noise and Thermal, their sources and effects.

#### **Unit – II**

**Sewage and waste water treatment:** Introduction, Aerobic and anaerobic treatment, Conventional and advanced treatment technology, Use of microorganisms, Bioreactors, Use of immobilized enzymes.

#### **Unit – III**

**Solid waste management:** Introduction, Impact on global climate change, E-waste, Landfills, Composting, Earthworm treatment.

#### **Unit – IV**

**Hazardous waste management:** Introduction, Xenobiotics compounds, Hazardous waste, Biodegradation of xenobiotics compounds, Organisms involved in degradation of xenobiotics.

#### **Unit – V**

**Novel methods for pollution control:** Introduction, Vermitechnology, Application of environmental genetics and Aiming for biodegradable and eco-friendly products.

#### **Text Books:**

1. Fundamentals of Ecology by Eugene P. Odum, 1972, *W.B. Saunders Company*, London
2. Environmental Pollution by Hodges, L., 1977. *Holt, Reinhart Publishers*, USA.  
Environmental Pollution and Control by Jeffrey Peirce, J., Arne Vesilind, P. and Ruth Weiner, 1997, *Elsevier*, The Netherlands.
3. APHA Standard Methods for the Examination of Water and Waste Water, 14<sup>th</sup> Edition, 1985. American Public Health Association., Washington, USA.
4. Environmental Biotechnology by C. F. Forster and D. A. J. Wase, 1987. *Ellis Horwood Limited*, England
5. Environmental Microbiology by W.D. Grant and P.E. Long, 1985. *Blakie Glasgow*, London.
6. Industrial Microbiology by Casida, 1994, *Wiley Eastern Publishers*.
7. Microbial Gene Technology by H. Polasa, 1991. *South Asian Publishers*, New Delhi.

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