BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI – 620 024.

B.Sc. Biotechnology – Course Structure under CBCS

(For the candidates admitted from the academic year 2010-2011 onwards)

Semester	Part	Course	Title	Instr Hours/ Week	Credit	ExamHours	Marks		Total
							Int.	Extn	
	I	Language Course – I (LC) – Tamil*/Other Languages ** #		6	3	3	25	75	100
	II	English Language Course - I (ELC)		6	3	3	25	75	100
	III	Core Course – I (CC)	General Microbiology	5	5	3	25	75	100
		Core Course – II (CC)	General Microbiology Lab.	5	3	3	40	60	100
		First Allied Course –I (AC)	Biological Chemistry	5	3	3	25	75	100
		First Allied Course – II (AC)	Immunology	3	-	***	-	-	-
				30	17				500
II	I	Language Course – II (LC) - – Tamil*/Other Languages ** #		6	3	3	25	75	100
	II	English Language Course – II (ELC)		6	3	3	25	75	100
	III	Core Course – III (CC)	Cell and Molecular Biology	5	5	3	25	75	100
		Core Course – IV (CC)	Cell Biology Lab.	3	2	3	40	60	100
		First Allied Course – II (AC)	Immunology	2	3	3	25	75	100
		First Allied Course – III (AC)	Biophysics and Instrumentation	4	4	3	25	75	100
	IV	Environmental Studies		2	2	3	25	75	100
	IV	Value Education		2	2	3	25	75	100
				30	24				800
III	I	Language Course – III (LC) – Tamil*/Other Languages ** #		6	3	3	25	75	100
	II	English Language Course - III (ELC)		6	3	3	25	75	100
	III	Core Course – V (CC)	Molecular Genetics	**5**	4	3	25	75	100
		Core Course – VI (CC)	Molecular Genetics–lab.	**4**	2	3	40	60	100
		Second Allied Course – I	Bioinformatics	4	4	3	25	75	100
		Second Allied Course – II	Bioinformatics Lab.	3	-	***	-	-	-
		Non Major Elective I - for those who studied Tamil under Part I a) Basic Tamil for other language students b) Special Tamil for those who studied Tamil upto +2 but opt for other languages in degree programme	Biotechnology and Health	2	2	3	25	75	100
				30	18				600

IV	I	Language Course –IV (LC) - Tamil*/Other Languages ** #		6	3	3	25	75	100
	II	English Language Course – IV (ELC)		6	3	3	25	75	100
	III	Core Course – VII (CC)	rDNA Technology	4	4	3	25	75	100
		Core Course – VIII (CC)	rDNA Technology – Lab.	3	2	3	40	60	100
		Second Allied Course - II	Bioinformatics Lab.	2	2	3	40	60	100
		Second Allied Course - III	Biostatistics	5	4	3	25	75	100
	IV	Non Major Elective II - for those who studied Tamil under Part I a) Basic Tamil for other language students b) Special Tamil for those who studied Tamil upto +2 but opt for other languages in degree programme	Biotechnology in Agriculture	2	2	3	25	75	100
	IV	Skill Based Elective I		2	**4**	3	25	75	100
				30	**24**				800
V	III	Core Course – IX (CC)	Animal Biotechnology	5	5	3	25	75	100
		Core Course – X (CC)	Plant Biotechnology	5	5	3	25	75	100
		Core Course – XI (CC)	Microbial Biotechnology	5	5	3	25	75	100
		Core Course – XII (CC)	Practical covering the core courses IX ,X & XI	6	4	3	40	60	100
		Major based Elective – I	Plant Tissue Culture	5	5	3	25	75	100
	IV	Skill based Elective –II		2	**4**	3	25	75	100
		Skill based Elective – III		2	**4**	3	25	75	100
				30	**32**				700
VI	III	Core Course – XIII (CC)	Bioprocess Technology	**6**	5	3	25	75	100
		Core Course – XIV (CC)	Environmental Biotechnology	**6**	5	3	25	75	100
		Core Course – XV (CC)	Practical covering the core courses XIII &XIV	6	4	3	40	60	100
		Major based Elective II	IPR, Biosafety & Bioethics	**6**	5	3	25	75	100
		Major based Elective III	Biodiversity	**5**	4	3	25	75	100
	V	Extension activities		-	1	-	-	-	-
				1	1	3	25	75	100
				30	25				600
			Total	180	140				4000

Note:

	Internal Marks	**External Marks**
1. Theory	25	75
2. Practical	40	60

3. Separate passing minimum is prescribed for Internal and External marks

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10 marks]

The passing minimum for University Examinations shall be 40% out of 75 marks [i.e. 30 marks]

* for those who studied Tamil upto +2 (Regular Stream)

** Syllabus for other Languages should be on par with Tamil at Degree level

\# those who studied Tamil upto 10th or +2, but opt for other languages in degree level under Part I should study special Tamil in Part IV

*** Examination at the end of the next semester.

Extension activities shall be out side the instruction hours.

கற்பிக்கும் கால அளவு

மோழிப் பாடங்கள் - 1 மதிப்பீடு = 2 மணிநேரம் கற்பித்தல் வகுப்பு

கலை மற்றும் அறிவியல் பாடங்கள் :1 மதிப்பீடு = 1 மணிநேரம் கற்பித்தல் வகுப்பு [Lecture]

= 2 மணிநேரம் பயிற்சி வகுப்பு [Tutorial]

= 2-3 மணிநேரம் செய்முறை வகுப்பு [Practical]

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CORE COURSE I – GENERAL MICROBIOLOGY

UNIT 1:

History of Microbiology, Methods of sterilization, Microscopic Principles and applications – Electron microscopy (TEM and SEM) Prokaryotic and Eukaryotic microorganisms. Classification of microorganisms.

UNIT II:

Ultra structure of algae, bacteria, fungi, viruses and protozoan, sub cellular structures and cell envelope-slime, capsule, cell wall, cell inclusion, biosynthesis of bacterial cell wall – Nutrition – commercial product, reproduction and life cycle pattern.

UNIT III:

Aerobic and anaerobic nutritional requirements – macro nutrients – growth factors – selective / differential media – enrichment media – microbial assay media. A general account of algal photosynthesis – chemo synthesis.

UNIT IV:

Factors influencing and affecting microbial growth – growth determination Growth and death kinetics – pH, temperature and light, Bacteriostatic, disinfections, control of microorganisms – physical and chemical agents, antimicrobial chemo therapy.

UNIT V:

Gene transfer in microbes, conjugation, Transformation, Transduction, Transfection sex factor.

REFERENCES:

1. Microbiology- M.J. Pelczar, Jr., E.C.S. Chang and N.R. Krieg, McGraw Hill Company, Newyork (1986).
2. Microbiology-concepts and applications, M.J. Pelczar, Jr., E.C.S. Chang and N.R. Krieg, McGraw Hill Company (1993).
3. Microbiology – L.M. Prescott, J.P. Hareley D.A. Klein – Wm.c. Brown publishers. Dutique, Jawa, Melbourne. 1993.
4. Modern Microbiology – wayne w. Umbreit – W.H, Freeman and company, son franscislcod London (1962).
5. Basic and Practical Microbiology – Ronald M. Atlas, Mac.Milleen Company, Newyork (1986).

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CORE COURSE II – PRACTICAL - LAB IN GENERAL MICROBIOLOGY

UNIT I:

Maintenance of hygenic conditions in the laboratory and legal disposal of laboratory wastes.

UNIT II:

Microscope and its functions, preparation of culture media and sterilization methods.

UNIT III:

Staining techniques, simple, grams, spore and capsular.

UNIT IV:

Bacterial culture technique – streaking, pour plate and spread plate method. Fungal culture techniques.

UNIT V:

Motility of bacteria, Growth studies.

UNIT VI:

Isolation of microbes and slide preparation – quantitative estimation of microbes. Characterization biofertilizer microbes.

REFERENCES:

1. Bucker, J.M., Caldwell, C.A., Zachgo, E.A. 1990. A Laboratory course, Academic Press.
2. Harold J. Berson 1994. Microbial Applications. WM.C. Brown Publishers.

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FIRST ALLIED COURSE I - BIOLOGICAL CHEMISTRY

UNIT I:

Adjustment of cells to diverse environments like water, temperature salts, acidity, alkalinity and pressure – adaptability of prokaryotic and eukaryotic cells.

UNIT II:

Release of energy to cells, oxidation, reduction, reactions pathways of oxidoreductions, oxidative phosphorylation.

UNIT III:

Conversion of energy in cells, energy storage, energy, exchange role of enzymes.

UNIT IV:

Transport across all membrane, pinocytosis, phagocytosis, Autophagy, permeability of water and salts, salt antagonism, Active transport.

UNIT V:

Cell Cycle – Growth of normal and cancer cells, cell divisions, Synchronized cell division, cytokinesis.

REFERENCE:

1. Cell biology – Arthur, Giese, Saunders co. 1979.
2. L. Stryer 1995 Biochemistry, Freeman company, New York.
3. Lehninger – Biochemistry, Worth Publications inc. 1982 CBS Publication, New Delhi.

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FIRST ALLIED COURSE II - IMMUNOLOGY

UNIT I:

Introduction, History and Scope of immunology. Types of immunity, Antigen-Antibody reactions.

UNIT II:

Antigen – types, immunoglobulins – distribution and functions. Lymphoid tissues – ontogeny and physiology and immune system. T & B Cells – receptors – activation and function.

UNIT III:

Cellular interactions in immune response, Hypersensitivity reactions, HCA Tissue typing, transplantation immunity, vaccine production.

UNIT IV:

Immuno diagnostics – precipitation, agglutination, ELISA and FISH.

UNIT V:

Autoimmune disorders and immunology of infectious diseases including AIDS. Introduction to tumour immunology, Immune erasion, Immune suppression, General introduction to monodonal antibodies and vaccines. Structure and functions of cytokines..

REFERENCE:

1. Immunology by I.M. Roitt, J. Brostoff and D.K. Male (1993) Gower medical publishing, London.
2. Immunology by J.Jube (1991) freeman and company.
3. Immunology – A short course by E. Benzamini, G. Sunshine and Leskpwitz, Willy – Liss 1996.
4. Introduction to medical Immunology by Gabrial Virellce, Marcel Dekkar 1993.
5. Donald M.Weir, John steward, 1993.Immunology VII edition. ELBS, London.
6. Richard M.Hyde. 1995. Immunology III edition. National Medical series, Williams and Wilkins. Harward publishing company.

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CORE COURSE III – CELL AND MOLECULAR BIOLOGY

Unit I

Diversity of cell size and shape – cell theory, structure of prokaryotic and eukaryotic cells – Isolation and growth of cells, Subcellular fractionation and criteria for functional integrity.

Unit II

Cellular organelles – plasma membrane, cell wall, their structural organization, transport of nutrients, ions and macromolecules across the membranes. Cellular energy transactions – Role of mitochondria and chloroplast, Cell cycle – molecular events and model systems, cellular responses to environmental signals in plants and animals – mechanisms of signal transductions. Cellular basis of differentiation and development – mitosis, gametogenesis and fertilization

Unit III

DNA replication, prokaryotic and eukaryotic DNA replication, enzymes and accessories proteins involved in DNA replication. DNA repair and recombination, Transcription – prokaryotic and eukaryotic transcription, RNA polymerase, general and specific transcription factors, regulatory elements and mechanisms of transcription regulations, transcriptional and post transcriptional changes – gene silencing modifications in RNA – 5' – CAP formation, transcription termination, 3' processing and polyadenylation, splicing, editing, nuclear export of mRNA, mRNA stability.

Unit IV

Translation – prokaryotic and eukaryotic translation, the translational machinery, mechanisms of initiation, elongation and termination, regulation of translation, co-and post transcriptional modification of proteins. Protein localization, synthesis of secretory and membrane proteins, import into mucleus, mitochondria, chloroplast and peroxyzomes, receptor mediation endocytosis.

Unit V

Biology of cancer – oncogenes and tumour suppressor genes with suitable examples. Programmed cell death. Brief introduction to life cycle and molecular biology of some important pathogens of AIDS, hepatitis and kalaazar – antisense and ribozyme technology – homologous recombination – mapping of genome – genome sequencing

Reference Books:

1. Principles of Biochemistry, Geoffrey L. Zubay, William, W. Parson, Dennis E. Vance, 1995, Wim C. Brown communications
2. Molecular Cell Biology, James Darnet, Harvey Lodish, David Baltimore, 1986, Scientific Americal Books Ins.,
3. Cell and Molecular Biology, E.D.P. Derobertis, E.M.F. DeRobertis, 1988, 8th edition, International edition ISBN
4. Molecular Biology of the gene, James, D. Watson, Nancy H. Hopkins, Jeffrey W. Roberts, Joan Argetsinger Steitz, Alan M. Weiner, 1987, The Benjamin / Cummings Publishing Company, Inc.
5. Biochemistry, Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, 2002, 5th edition, W.H. Freeman and Company.

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CORE COURSE IV – CELL BIOLOGY LAB.

1. Demonstration of instrumentation methods for cell biology, (microscope, microtome. etc.,).
2. Equipments used in cell culture laboratory general practice and maintenances (demo only).
3. Morphological characterization of various types of cells including tissue cells.
4. Histochemical staining techniques (students are advised to familiarize various staining techniques).
5. Chemical/enzymatic disaggregation of tissue cells.
6. Cell organelle separation by centrifugation methods.
7. Isolation of Leydig cells (testis) and Islet cells.
8. Enumeration of cell (any type of prokaryotic/eukaryotic cells).
9. Identification and characterization of different types of Blood cells.
10. Enumeration of Red Blood Cells.
11. Enumeration of White Blood Cells.
12. Identification of various stages of cell division (mitosis and meiosis).
13. Barrbody identification in cells of Buccal smear.
14. Grading the stages of chick embryo development (demo only).
15. Isolation of genomic DNA from cells.
16. Microscopic identification of chromosome in chironomous larvae.

References:

1. A manual on Molecular cloning by Sambrook et al., (1989)

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FIRST ALLIED COURSE III - BIOPHYSICS AND INSTRUMENTATION

UNIT - I

Scope and methods in Biophysics, Levels of molecular organization, Thermodynamics, Atomic structure of molecules - Conformational analysis and forces; Physical properties of Biomolecules; Molecular interaction of Biopolymers; Biophotonic and its application; Structure of ion channels – Biophysical, Biochemical aspects of ion channels; Voltage depended membrane permeability.

UNIT - II

Introduction to spectroscopy and laws of light; Microscopy – Principle and application of phase contrast, Fluorescence and Electron microscopy; Microtomy – types of microtome, material preparation and fixation – Embedding – block making; Steps involved in sectioning, staining and mounting; Cytophotometry; cryostat.

UNIT – III

Biophysical method for the determination of biopolymer structure; principles, components and application of X- Ray diffraction; UV – Visible, NMR and ESR Spectroscopy; Calorimeter, Spectrophotometer, pH meter, Principle, Design and applications; LASER – principle and application .

UNIT – IV

Tracer techniques: Radioactive isotope – Half life, GM counter, Liquid scintillation counter, Autoradiography; Fractionation techniques – Ultra centrifugation, Density gradient centrifugation.

UNIT – V

Electrophoresis –SDS – PAGE; Agarose gel, Immunoelectrophoresis; Chromatography – principle, instrumentation and application of column Chromatography, ion exchange chromatography, Thin layer Chromatography and HPLC.

Reference books

1. Advance biophysics by S.K. Agarwal, APH Publishing Corporation
2. Biophysics by Vatsala Piramal, Dominant Publishers and Distributors
3. A Biologist guide to principles and techniques of practical biochemistry by Wilson and Walkar, 5th edition, Cambrige University press (2000).
4. Modern Experimental Biochemistry by Boyer. R, 3rd edition Addison Weslery Longman, (2000)
5. Biochemical Chemistry Principles and Techniques by Upadhyay, and Nath, Himalaya Publication (1997)
6. Physical Biochemistry – Application to Biochemistry and Molecular Biology by Friefelder, WH Freeman & Co. (1994)
7. Introduction to Spectroscopy by Pavia *et al.*, 3rd edition, Brooks / Cole Pub Co., (2000)

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CORE COURSE V - MOLECULAR GENETICS

UNIT -I

Principles of Mendelian inheritance, Chromosome structure and function: Organisation of chromosomes, specialized chromosomes, chromosome abnormalities: Numerical and structural changes in chromosomes. Epistasis. Linkage and crossing over - three point cross -tetrad analysis- chromosome mapping.

UNIT- II

Human Chromosomes - Pedigree analysis, Mendelian traits and sex-linked traits in human -. Population genetics – Hardy -Weinberg genetic equilibrium.
Extra chromosomal inheritance (Episomes, Mitochondria and Chloroplast), Genetic polymorphism, Mechanism of sex determination.

UNIT -III

DNA as the genetic material – RNA as a genetic material – replication of DNA and RNA.- The law of DNA constancy and C - value paradox- genetic code-Organization and function of prokaryotic and eukaryotic genetic material,- Organization of coding sequences and repetitive sequences- Molecular basis of spontaneous and induced mutations-DNA damage – mechanism of repair – excision repair, recombinational repair.

UNIT -IV

Viruses and their genetic system**:** Life cycles (lytic and lysogenic), RNA Phages, Retro viruses.
Discovery of types and structure of plasmids - natural and artificial plasmid transfer and their applications. Insertion sequence in prokaryotes. Transposable elements – discovery and characterization.- Transposons in Bacteria, Maize, Yeast. - Insertional elements.

UNIT- V

Genetic recombination: Transformation, transduction, sexduction and conjuagtion – linkage and genetic mapping in bacteria – genetic system of Neurospora.
Regulation of Gene Expression In Prokaryotes And Eukaryotes: Operon concept: lac, trp, sigma factors-. promotor,operator, terminator and attenuator. DNA methylation- Hetero chroamatization-Environmental regulation of genes- Molecular genetics in relation to human diseases.

REFERENCES:

1. Maloy, S.R., J.Egronan and D.Friefelder.1994. Microbial Genetics. . Jones and Bartlett Publishers, Sudbury, MA, USA.
2. Dale, J.W. 1994. Molecular Genetics of Bacteria. John Wiley and Sons, Hoboken,NJ, USA.
3. Klug, W.S. and M.R. Cummings. 1997. Concepts of Genetics. Prentice Hall, NJ, USA.
4. Coriffiths.1996 Introductions to Genetic Analysis. Freeman and Co.,U.K.
5. Eckstein F, Lilley DM.(Eds.). 1996. Catalytic RNA. Springer – Verla, Berlin..
6. Friedberg EC.,WalkerCC.Siede W. 1995.DNA Repair and Mutagenesis. ASM Press, Washington D.C.
7. Gardner E.J., Simmons, M.J, Squstad, D.P. 1991. Principles of Genetics. John Wiley and Sons, California.
8. Singer M, and Berg P. 1991.Genes and Genomes. University Science Books, California.
9. The Science of Genetics by Alan G. A., Jack. R, Girton, J. F, McDonald, (200O) Saunders College Publishers, Philadelphia.
10. Genes IX by Lewin,B.(2008). Jones and Bartlett, London.
11. Molecular cell Biology, by Darnell, J.E., Baltimore, D.and Lodish, H.F. (1994). Scientific American Books, Inc., Virginia..
12. Molecular and cellular Biology, Stephen L.Wolfe, (1993). Wadsworth Publishing Co, California.

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CORE COURSE VI- MOLECULAR GENETICS LAB

1. Extraction of DNA and RNA
2. Estimation of DNA and RNA.
3. Isolation of Plasmid DNA.
4. Mutagenesis in Bacteria: The Ames test
5. Transformation in *E. coli*.
6. Biochemical characterization of selected bacteria.
7. Evaluation of transduction
8. Isolation of phage from sewage and determination of phage titer
9. Replica plate technique
10. Mutant isolation by gradient plate technique.

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SECOND ALLIED COURSE - I : BIOINFORMATICS

UNIT – I

Biological Databases: Sequence databases – Nucleic Acid sequence Databases: Genbank ;Protein Sequence Databases: Swiss Prot; Searching Sequence Databases – Non-redundant Databases – Low Annotation Databases – Specialized sequence Databases – Structural Databases – Motif Databases – Genome Databases – Proteome Databases.

UNIT – II

Tools for Bioinformatics: Pairwise alignment – Dotplots – scoring matrices – Blosum Matrices – PAM Matrix – Gap Penalty – Alignment Algorithms: Needleman – Wunsch Global Alignment Algorithm ; Smith – Waterman Local Alignment Algorithm.

UNIT - III

Pairwise Sequence Analysis Tools : BLAST– Steps involved in using BLAST – Interpreting BLAST results; FASTA – Alignment Scores -Multiple Alignment — ClustalW – Phylogenetic Tree – Sequence Analysis using EMBOSS.

UNIT – IV

Protein Structure Prediction: Secondary structure Prediction –PDB-FSSP-SCOP-CATH-Chou-Fasman – Jpred – Q_3 – Transmembrane protein prediction – Tertiary structure prediction – Comparative Modelling – Fold recognition – Ab initio prediction – modeler – RASMOL.

UNIT – V

Emerging Areas of Bioinformatics: DNA microarrays – Structural genomics -Functional Genomics – Proteomics Comparative Genomics - Phylogeny – Whole Cell Simulation –Human Genome Project- Systems biology - Biodiversity informatics.

REFERENCES:

1. Harshawardhan, P. (2005) Bioinformatics principles and application.Tata Mc Graw Hill Publishers.New Delhi.
2. Manikand Vijayaraj, 2002. Bioinformatics for beginners, Kalaikathir Achchagam, Coimbatore
3. Mount, D.W. 2005. Bioinformatics Sequence and genome analysis (II edition) CBS Publishers. New Delhi
4. Sundarajan. S. and R. Balaji.(2005), Introduction of Bioinformatics, Himalaya Publishing house, Mumbai.
5. Westhead, D.R, H.J. Parish and R.M. Twyman. (2003) Bioinformatics Viva books Private Ltd. New Delhi.

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SECOND ALLIED COURSE - II: BIOINFORMATICS LAB

1. Study of Nucleic acid sequence databanks – GenBank, EMBL nucleotide sequence databank, DDBJ, UniGene.
2. Study of protein data banks - PIR,Swiss-PROT, UniPROT.
3. Study of Protein Structure and Classification databases – PDB, SCOP, CATH, FSSP,PDBSUM.
4. Study of Domain / Motif databases – BLOCKS, PRINTS, SBASE and PFAM.
5. Gene structure and function prediction (using GenScan, GeneMark)
6. Sequence similarity searching (NCBI BLAST)
7. Protein sequence analysis (ExPASy proteomics tools)
8. Multiple alignment - CLUSTALW
9. Building tructure for a given sequence using Homology modeling
10. Evaluation of protein structure by Swiss PDB viewer and by other molecular visualization tools.

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NON MAJOR ELECTIVE I: BIOTECHNOLOGY AND HEALTH

UNIT- I

Human Genetics and Human Genome: History and development of human genetics; organization of the human genome. – chromosome and gene organization -Inherited human diseases-single gene diseases,complex traits.

UNIT- II

Gene Therapy: Identification and isolation of disease genes –Cancer genetics - Genetic counselling. Gene therapy.
Infectious Diseases: Classification: fungal, protozoal, helminthic, bacterial and viral; Vaccines - types. Hospital-acquired infections (nosocomial), water-borne diseases.

Unit -III

Immunology, Vaccines and Transplantation Technology
Antigens and Antibodies –Acquired and Innate Immunity, Immune system, Immune diseases,Allergy. Immunity to infections by viruses, bacteria, fungi and parasites. Blood groups. Monoclonal antibodies.

Unit -IV

Embryonic Stem cells: Culture & Therapy. Artificial Blood. Aminocentosis. Biochemical and Molecular Diagnostics.

UNIT- V

Social, Ethical and Legal Issues in Medical Biotechnology
IPR : patents and copyrights. Human cloning. Pre-natal sex determination and foeticide. Genetically Modified Organisms.

REFERENCES:

1. Schacter, Bernice (Ed.).2006. Biotechnology and Your Health: Pharmaceutical Applications. Chelsea House Publications, Nw York.
2. Dinesh, K.P. and Chetan, D.M.2007. Health and Pharmaceuticals Biotechnology. Laxmi Publications (P) Ltd., India.
3. Crommalin, D.J.A., R.D. Sindeler and B.Meibohm (Eds). 2007. Pharmaceuticals Biotechnology: Fundamentals and Applications. Informa Health Care, London.

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CORE COURSE VII- rDNA TECHNOLOGY

UNIT- I

Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, exonuclease & endonuclease, Concept of restriction and modification - Restriction endonucleases, DNA modifying enzymes, Ligases. Different Kinds of Vectors - Plasmids, Phage vectors, Cosmids, Phagemids, Virus vectors, Shuttle vectors and expression vectors- YAC, BAC- *S. cerevisiae* system as a model.

UNIT -II

Host-vector system - Cloning vectors for *E. coli*., Cloning vectors for Eukaryotes- methods of transformation - Cloning strategies, construction of genomic libraries and cDNA Libraries. Probe construction, recombinant selection and screening, Molecular cloning.

UNIT -III

Analysis of expression. Analysis of recombinant DNA (Selection methods – antibiotics, expression basis, GUS expression), sequencing (chemical degradation; chain termination and automated sequence). mutagenesis, altered expression and engineering genes. Site-directed mutagenesis.
DNA amplification using polymerase chain reaction (PCR): key concepts, Analysis of amplified products. Southern blot, Northern blot and Western blot Applications of PCR : Ligase chain reaction. RFLP, RAPD, DNA Finger printing.

UNIT -IV

Application of rDNA Technology in plants: Transgenic plants with reference to virus and pest resistances, herbicide tolerance and stress tolerance (cold, heat and salt); cytoplasmic male sterility; delay of fruit ripening; resistance to fungi and bacteria, Bio-pharmaceuticals and secondary metabolite production.

UNIT -V

Application of rDNA Technology in animals: Transgenic animals –pharmaceutical production; insulin production. farm animal protection; Gene therapy – haemopoietic cells, genetically engineered bone marrow cells, skin fibroblasts, hepatocytes, myoblast and genetically modified lymphocytes – Recombinant Technology in the production
of vaccines.

REFERENCES

1. Old, R.W and S.B. Primrose. 1996. Principles of Gene Manipulation: An Introduction to Genetic Engineering. Blackwell Scientific Publications, Oxford.
2. Glover, DM. and BD. Hames .1995. DNA Cloning: A Practical Approach.. IRL Press, Oxford.
3. Innis, M.A., D.H. Gelfand and J.J. Sninskey .1995. PCR Strategies.. Academic Press, San Diego.
4. Persing, D.H., K T.F Smith, F.C. Teower and T.J.While. 1993. Diagnostic Molecular Microbiology. ASM Press, Washington D.C.
5. Watson J.D.,Gilman M., Witkowski,J., and Zoller M. 1992. Recombinant DNA. Scientific American Books, New York.
6. Tvan R.S. 1997. Recombinant Gene Expression Protocols. Humana Press Inc., Tokowa.

CORE COURSE VIII - rDNA TECHNOLOGY Lab

1. Preparation of plasmid DNA and genomic DNA from *E.coli.*
2. Preparation of genomic DNA from animals/ human/plant.
3. Agarose gel electrophoresis of plasmid and genomic DNA.
4. Restriction digestion of DNA. - Single and double digestion.
5. PCR amplification, RFLP*.
6. Southern blotting*
7. Ligation*.
8. Transformation of *E. coli* with plasmid DNA using CaCl2 *.

* Practical by demonstration only.

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SECOND ALLIED COURSE – III: BIOSTATISTICS

UNIT - I

Bio-statistics: Concepts of statistics-types of data, methods of collection of data. sampling design – essentials of sampling – census methods - sampling methods – statistical laws – statistical error – test of reliability of sample.

UNIT – II

Experimental designs. Classification and tabulation of data. Diagrammatic and graphical representation of data.

UNIT - III

Measures of central tendency – mean, median and mode. Measures of dispersion: Mean deviations, standard deviation.

UNIT - IV

Correlation analysis (Karl Pearson's and Spearman's Rank) Regression analysis – simple linear.

UNIT – V

Tests of significance -'t'-test, Chi-square and goodness of fit, 'F' test Analysis of variance (ANOVA): One-way.& Two-way.

REFERENCES:

1. Sokal, R.R. and F.J. Rohlf. 1981. Biometry. W.K. Freeman. San Francisco.
2. Zar, J.H. 2003. Biostatistical Analysis. Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi.

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NON-MAJOR ELECTIVE II: BIOTECHNOLOGY IN AGRICULTURE

UNIT- I

Conventional methods for crop improvement:– vegetative propagation methods - Grafting – Rapid multiplication techniques.

UNIT -II

Tissue culture in crop improvement – Transgenic crops. Genetic engineering for increasing crop productivity by manipulation of Photosynthesis.

UNIT -III

Genetic Engineering for biotic stress tolerance: insects, fungi, bacteria, viruses- Genetic engineering for abiotic stress tolerance -drought, salt and temperature.

UNIT- IV

Major pests of Agricultural Crops (elementary account) - Developing pest resistant species - Biocontrol methods - Bioengineered biocontrols – Biotechnology of weed control – Biopesticides and Biofertilizers.

UNIT- V

Agricultural biotechnology and Law – plant variety certification and protection- Farmers rights – patenting – IPR – Ethical aspects – Public acceptance of bioengineered GM foods and organisms.

REFERENCES:

1. Jones, L. 1991. Biotechnological innovation in Crop improvement, Butterworth- Hiemann, London.
2. Altman, Arie .1998, Agricultural Biotechnology , Marcel Dekker, Inc.New York.
3. Forbes, J.C.,and RD Watson ,1992 , Plants in Agriculture ,Cambridge Univ. Press, Great Britain.
4. Erbish, F.H. and M. Maredia ,1998, Intellectual Property Rights in Agricultural Biotechnology. Universities Press, India.
5. Maarten J. Chrispeels and David E. Sadava ,1994, Plants, Genes and Agriculture, Jones & Barleft Publishers, London.
6. Chrispeels, M.J. and David E. Sadava, Eds.2003. Plants, Genes, and Crop Biotechnology.. Jones and Bartlett,Boston.
7. Joshi, N K. 2007. Biotechnology In Agriculture. Aavishkar Pub., Jaipur, India.
8. Ramniwas Sharma (Ed.). 2005.Biotechnology In Agriculture. Saujanya Books, New Delhi.

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CORE COURSE IX - ANIMAL BIOTECHNOLOGY

UNIT -I

Embyology: Gametogenesis and fertilization in animals, Molecular events during fertilization, genetic regulations in embryonic development - Invitro felitizations and embryo transfer, Collection and preservation of embryo, culture of embryos, culture of embryonic stem cells and its applications.

UNIT -II

Animal cell culture: Fundamentals. Facilities and Applications. Media for Animal cells.Types of cell culture: Primary cell culture, secondary culture, cell transformation, cell lines, Insect cell lines,stem cell cultures, cell viability and cytotoxicity. Biology of cultured cells, measurement of growth, cell synchronization, senescence and apoptosis Organ culture. Cryopreservation.

UNIT -III

Genetic engineering in animals: methods of DNA transfer into animal cells- calcium phosphate co precipitation, micro-injection, electroporation, Liposome encapsulation, Biological vectors. Hybridoma technology, Vaccine production.

UNIT -IV

Gene therapy, mapping of human genome. RFLP and applications. DNA finger printing and Forensic Science. Molecular diagnosis of Genetic disorders.

UNIT -V

Transgenics: Transgenic animals. Production and recovery of products from animal tissue cultures: cytokines, Plasminogen activators, Blood clotting factors, Growth hormones.- Transgenic animals – Merits and demerits -Ethical issues in animal biotechnology.

REFERENCES:

1. Freshney, E. D.2000. Animal Cell Culture: A practical approach. John Wiley Pub.,New York.
2. Mather, J.P. and Barnes, D. (Eds.). 1998. Animal Cell Culture Methods (Methods in Cell Biology. VOL. 57). Academic Press, London.
3. Butler, M. (Ed.). 1990. Mammalian Cell Biotechnology- A Practical Approach. Oxford Univ. Press, Oxford.
4. Singer, M. and P. Berg. (Ed.). 1997. Exploring Genetic Mechanisms. University Science Books, Sausilato, CA, USA.
5. E.J. Murray (Ed) .1991. Gene Transfer and Expression Protocols – Methods in Molecular Biology Vol.7. Humana Press,Totowa, NJ.
6. Watson, J.D., N.H.Hopkins, T.W.Roberts, J.A.Steitz and A.M. Weiner.1987.Molecular Biology of Gene. Benjamin Cummins, San Franscisco..
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8. Puller, A. (Ed) .1993. Genetic Engineering of Animals. VCH Publishers, New York.
9. Balinsky, B.I. 1975. An Introduction to Embryology. Saunders, Philadelphia.
10. Beril, N.J. 1974. Developmental Biology. Tata McGraw -Hill Publishing Company Ltd. New Delhi

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CORE COURSE X - PLANT BIOTECHNOLOGY

UNIT -I

Conventional methods of crop improvement- Selection, mutation, polyploidy and clonal selection; Plant tissue culture- Callus culture, organogenesis, meristem culture, anther, pollen,embryo culture and their applications. Somatic hybridization Somatic embryogenesis,cybrids.

UNIT -II

Plant genome organization. Organisation of chloroplast genome, organization of mitochondrial genome, cytoplasmic male sterility. Genomic interaction – Protoplasmic fusion.

UNIT -III

Genetic engineering in plants, Genetic engineering of plants for pest resistance, Herbicide resistance. Resistance to fungi and Bacteria, Delay of fruit ripenning.
Regulation of gene expression in plant development. Plant hormones and phytohormone. Seed storage proteins.

UNIT- IV

Molecular Biology of plant – pathogen interactions (an overview) - Importance of RFLP in plant Breeding.- Ti plasmid vectors for plant transformation,. Classification of plant viruses-management aspects of plant genetic engineering- tagging and cloning of plant genes.

UNIT -V

Biochemistry and molecular biology of Nitrogen fixaction in legumes by Rhizobium. Molecular biology of plant stress response (abiotic). Agrobacterium and crown gall tumour. Synthetic seed.

REFERENCES:

1. Grierson,D., and S.N. Covey. 1988. Plant Molecular Biology. Blackie& Sons. Ltd. Glascow.
2. Lycett, G.W. and D. Grierson (Eds) .1990.Genetic Engineering of Crop Plants. Heinemann, London.
3. Chrispeeds, M.J. and D.F. Sadava .1994. Plants, Genes and Agriculture.. Jones and Bartlett, Boston.
4. Mantel. S. H, Mathews. J. A, Mickee. R.A. 1985. An Introduction to Genetic Engineering in Plants. Blackwell Scientific Publishers, London.
5. Marks. J.L. (Ed.). 1989. A Revolution on Biotechnology. Cambridge Univ.Press, Cambridge.
6. Dodds J.H. 1985. Plant Genetic Engineering. Cambridge Univ.Press, Cambridge.
7. Bernard R Glick. and J.J. Pasternak. 2002. Molecular biotechnology, Principle and Applications of Recombinant DNA. ASM Press, Washington, D.C.
9. Monica A. Hughes. 1996. Plant Molecular Genetics. Addison Wesley Longman, Harlow, England.

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CORE COURSE XI - MICROBIAL BIOTECHNOLOGY

UNIT- I

Microbial Biotechnology: Scope and applications -horizons of Microbial Technology. Microbes: Living factories for macromolecules-Production of proteins in Bacteria and yeast; recombinant and synthetic vaccines; microbial enzymes- application in starch processing , textile designing, detergents, cheese making, polysaccharides and polyesters. – immobilization of cells and enzymes.

UNIT -II

Microorganisms in fermentation-Ethanol from feed stocks to fermentable sugars, from sugars to alcholos, Clostridial fermentation, lactic acid fermentation, acetic acid production and industrial production of various milk products.

UNIT -III

Metabolites from microorganisms-amino acids; antibiotics-antibacterial agents (□-lactams, tetracyclines, peptides, amino glycosides), antifungal agents, anti-tumor antibodies; Biotechnological potential of micro algae – food – fuel production – pharmaceutically valuable compounds of micro algae. SCP, Mycoprotein.

UNIT -IV

Biopesticides; Bio control of insects – microbial insecticides (*Bacillus.thuringiensis, B.spaerinus, B.papilliae* and Baculo-Viruses).
Biofertilizers (nitrogen fixing Bacteria, mycorrizha and phosphate solubilizing Bacteria)-genetically engineered organisms.

UNIT -V

Bioremediation, Biosorption, Environmental clean-up by microbes: Application of microbial biotechnology in sewage and wastewater treatment, degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents.
Public concerns about the microbial biotechnology and Economics of microbial biotechnology.

REFERENCES:

1. Glick, B.R. and Pasternack, J.J. 1994. Molecular Biotechnology. ASM Press, Washington, D.C.
2. Desmond, S.T., Nicholl. 1994. An Introduction to Genetic Engineering. Cambridge Univ. Press, Cambridge.
3. Old R.W. and Primrose S.B. 1994. Principles of Gene Manipulation. 4th edition. Blackwell Scientific Publication, London.
4. Cresswell RC. Ress TAV and Stah, H 1989. Algal and Cyanobacterial Biotechnology. Longman Scientific and Technical, NewYork.
5. Prave, P., Faust, U. Sitting, W. Suktasch D. A. 1987. Fundamentals of Biotechnology. VCH verlasgetell Schafor MBH, Weinhkeim, Germany.
6. Glazer, A.N. and Nikaido, H. 1995. Microbial Biotechnology. W.H.Freeman & Co.,New York
7. Encyclopedia of Microbiology. 1992. Vols.1-4. Academic Press, London.
8. Stanbury, P.F. Whittaker, A, Hall, S.J. 1995. Principles of Fermentation Technology. Butterworth Heinemann, London.

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CORE COURSE XII: PRACTICALS COVERING CC IX, X, XI

LAB IN ANIMAL BIOTECHNOLOGY

1. Preparation of tissue culture medium
2. Preparation of single cell suspension from spleen and thymus.
3. Cell counting and viability
4. Cryopreservation and thawing
5. Preparation of metaphase chromosome from cultured cell.

LAB IN PLANT BIOTECHNOLOGY

1. Surface sterilization
2. Micropropagation – Direct and Indirect Organogenesis
3. Protoplast Isolation and culture
4. Cytological examination of regenerated plants

LAB IN MICROBIAL TECHNOLOGY

1. Isolation of single colonies of bacteria. Measurement of growth of bacteriophages.
2. Biochemical tests for identification of bacteria. Isolation of any Enzyme (amylase, urease, invertase etc) and its purification.
3. Isolation of microorganisms from mining and their characterization.
4. Immobilization of algal cells and enzymes.
5. Induced mutagenesis, Ligation, restriction enzymes and determination of activity.

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MAJOR BASED ELECTIVE – I: PLANT TISSUE CULTURE

UNIT- I

Basic techniques and tools:Establishment of plant tissue culture lab: equipment, culture vessels, surface sterilization of various explants,pretreatment of explant, subculture and repeated transfer of explants and cultures.

UNIT- II

Composition of various tissue culture media and their preparation- Establishment of callus, suspension cultures, organogenesis and embryogenesis,- Meristem tip culture- Hardening of plants.

UNIT- III

Techniques of anther, embryo and ovule culture- Protoplast isolation, culture and fusion.- Artificial seed (synthetic seed) - Cell line selection using selection pressure- Production of secondary metabolites- Cryopreservation.

UNIT -IV

Isolation and characterisation of nuclei and nucleoli, isolation and functional analysis of mitochondria, chloroplast. Preparation and analysis of genetic material -cell autoradiography, aspetic technique and media preparation of primary cultures, maintenance of secondary culture - cell line propogation -cells in suspension.

UNIT -V

Analysis of biosynthesis of cellular components by radioactive labeling of cultured cells. Plant cell structure and organisation of cell groups in tissue system. Mass culture of plant cell suspension, somaclones, mericloning, micropropagation.

REFERENCES:

1. Hurse P.I. and Patterson., M.K.Tissue culture, methods and applications,
2. Marchan,D.J. 1964.Handbook of Cell and Organ Culture (2nd ed).Burgess Pub.Co., Minneapolis, USA.
3. Animal cell culture course manual – cold spring warbor laboratory, Newyork.
4. Shanmugam, Laboratory Manual of Cell Biology,Macmillan, India.
5. Dixon, L.A. and R.A. Gonzales. Plant cell culture – A Practical Approach. Revan Press, New York.
6. Quak, F. 1981. Plant Tissue Culture: Methods and Applications in Agriculture. Academic Press, New York.

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CORE COURSE XIII: BIOPROCESS TECHNOLOGY

UNIT -I

Isolation, Preservation and Maintenance of Industrial Microorganisms .Kinetics of microbial growth and death. Media for industrial fermentation. Air and Media Sterilization.

UNIT- II

Types of fermentation processes: Analysis of batch, Fed-batch and continuous bioreactions; Air-lift, stirred tank, tower, fluidized bed, packed bed, pulsed, photobioreactors- Measurement and control of bioprocess parameters.

UNIT -III

Downstream Processing: Introduction, Removal of microbial cells and solid matter, foam reparation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction chromatography, Membrane process, Drying and Crystallization. Effluent treatment: D.O.C. and C.O.D. treatment and disposal of effluents.

UNIT- IV

Industrial Production of Chemicals: Alcohol (Ethanol), Acids (Citric,) Antibiotics (penicillin,), Amino acids (lysine,), Single Cell Protein (algae/fungi).

UNIT- V

Introduction to Food Technology-Elementary idea of canning and packing; Food Preservation - Sterilization and Pasteurization of food products.

REFERENCES:

1. Stanbury, P.F. and Whitaker, A.,(Eds).Principles of Fermentation Technology. 1984. Pergamon Press, Oxford.
2. Arnold L Demain and Julian E.Davies. 1999. Manual of Industrial Microbiology and Biotechnology, III edition .ASM press, Washington DC.
3. Frazier, W.C. and Dennis, C. Westhoff. 1995 Food Microbiology, Tata McGraw Hill Publlishing Company, New Delhi.
4. Casida, L.E. 2003. Industrial Microbiology. New Age International (P) Ltd., New Delhi.
5. Michael Shuler and Fikret Kargi. 2002.Bioprocess Engineering: Basic Concepts, 2nd Edition, Prentice Hall, Englewood Cliffs, NJ,
6. Pauline M. Doran. 1995. Bioprocess engineering principles, 1 Edition, Academic Press
7. Bailey, J.E. and D.F Ollis. 1986. Biochemical Engineering Fundamentals, 2nd ed. McGraw-Hill Chemical Engineering Series, Berkshire, U.K.
8. Aiba. S., Humphrey, A.E.and Millis N.F. 1973. Biochemical Engineering. University of Tokyo Press, Tokyo
9. Aktinson B. 1974. Biochemical Reactors. Pion Ltd., London
10. Jackson, A.T . 1991. Process Engineering in Biotechnology. Prentice Hall, Engelwood Cliffs, NJ, USA.
11. Enfors, S. O. and Haggstrom, L.H. 1998. Bioprocess Technology – Fundamentals and Application. KTH, Stockholm.

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CORE COURSE XIV – ENIVIRONMENTAL BIOTECHNOLOGY

UNIT - I

Basic Concepts: Interactions between environment and biota; Concept of habitat and ecological niches; Limiting factor; Ecosystem dynamics and management: Stability and complexity of ecosystems; Energy flow, food chain, food web and tropic levels; Ecological pyramids and recycling, biotic community-concept, structure, dominance, fluctuation and succession; N.P.C and S cycles in nature.-Population ecology - community structure-; Principles of conservation; Speciation and extinctions Conservation strategies; sustainable development. - environmental impact assessment.

Unit II

Environmental Pollution: Water Pollution: sources of pollution and pollutants .Industrial effluents, Domestic wastes . Agrochemical . Heavy metals . Effects of Water pollution, prevention and control of water pollution. Water pollution analysis and monitoring. **Soil pollution**- sources, effects and its control. **Air pollution**- sources, air pollutants, effects, control measures. Ozone depletion, global warming. Air pollution analysis and monitoring- **Noise pollution, Radioactive pollution, Thermal pollution:** their Sources, effects, prevention and control measures.

UNIT -III

Bioremediation and Bio-leaching: Environmental impact of pollution and measurement methods -Composting of organic wastes, microbial bioremediation of oil spills; Waste water treatment - sewage treatment and common industrial effluent treatment ; Concepts of bioremediation (in-situ and ex-situ), Bioremediation of toxic metal ions – biosorption and bioaccumulation principles. Concepts of phytoremediation; Microbial biotransformation of pesticides and xenobiotics; Microbial leaching of ores – direct and indirect mechanisms.

UNIT -IV

Biofertilizers and Biopesticides: Biofertilizers and their importance in crop productivity; Algal and fungal (mycorrhizae) biofertilizers Bacterial biofertilizers (rhizobial, free living N2 fixers and phosphate solublizing bacteria), their significance and practice; Biopesticides : Bacterial (Bt pesticides), fungal (Trichoderma); Viral biopesticides – Baculovirus, NPV insecticides; Production of biofertilizers and biopesticides for large scale application.

UNIT -V

Genetic Engineering in Environmental Biotechnology: Genetically engineered microorganisms in environmental health-Genetically engineered plants and microorganisms in agriculture and productivity-Genetically engineered bacteria in bioremediation of organic pesticides, insecticides oil spills-Hazards of genetically engineered microorganisms, plants and animals-Policies of genetic engineering research.

REFERENCES

1. Alan Scragg. 1999. Environmental Biotechnology. Pearson Education Limited, England.
2 Jogdand, S.N. 1995. Environmental Biotechnology. Himalaya Publishing House, Bombay.
3. Technoglous, G., Burton,F.L. and Stensel, H.D. 2004. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy, Inc.,Tata Mc Graw Hill, NewDelhi.

4. De, A.K. 2004. Environmental Chemistry. Wiley Eastern Ltd. NewDelhi.
5. Allsopp, D. and K.J. Seal. 1986. Introduction to Biodeterioration. ELBS/Edward Arnold, London.
6. Athie, D. and C.C. Cerri. 1990. The Use of Macrophytes in Water Pollution Control, Pergamon Press, Oxford.
7. Chin, K.K. and K. Kumarasivam. 1986. Industrial Water Technology Treatment, Resuse and Recycling . Pergamon Press, Oxford.
8. Henze, M. and W. Gujer 1992. Interactions of Wastewater: Biomat and Reactor Configurations in Biological Treatment Plan - Pergamon Press, Oxford.
9. Jenkins, D. and B.H. Olson(Eds). 1989. Water and Wastewater Microbiology. Pergamon Press, Oxford.
10. Fry, F.C., Gadd, G.M. Herbert, R.A. , Jones, C.W., and Watson-Craik,J.A.(Eds.) 1982. Microbial Control of Pollution . Cambridge University Press, New York.
11. McEldowney, Sharon, Hardman, David, J.,and Waite, Stephen. (Eds). 1993 .Pollution, Ecology Biotreatment . Longman Scientific & Technical, Harlow, England.
12. Kaul,T. Nady and Trivedy, R.K.1993. Pollution Control in Distilleries. Enviromedia, Karad, India.
13. Sastry, C.A., Hashim, M.A.,and Agamuthu, P.(Eds.)1995. Waste Treatment Plants . Narosa Publishing House, New Delhi, India.
14. Dart, R.K. and R.J. Stretton, 1994. Microbiological Aspects Pollution Control.Elsevier Pub.Co., Amsterdam:New York.
15. John Cairns and Todd V. Crawford 1990. Integrated Environmental Management . Lewis Publishers Inc., Chelsea, Michigan.

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CORE COURSE XV: PRACTICALS COVERING CC XIII & XIV

LAB IN BIOPRECESS TECHNOLOGY

1. Isolation of industrially important microorganisms for microbial processes
2. Determination of thermal death point and thermal death time
3. Comparative studies of ethanol production using different substrates
4. Microbial production of citric acid using *Aspergillus*
5. Microbial production of antibiotics

LAB IN ENVIRONMENTAL BIOTECHNOLOGY

1. Detection of coliforms for determination of purity of fresh water.
2. Determination o total dissolved solids of water.
3. Determination of COD and BOD of sewage samples.
4. Estimation of nitrates in drinking water.
5. Study of biogenic methane production in different habitats.

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MAJOR BASED ELECTIVE II : IPR, BIOSAFETY AND BIOETHICS

UNIT -I

Biosafety: Introduction; biosafety issues in biotechnology-historical background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals.

UNIT -II

Biosafety Guidelines: Biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations of Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

UNIT -III

Introduction to Intellectual Property: Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications- importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – world intellectual property rights organization (WIPO). Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology – few Case Studies.

UNIT -IV

Patent Filing Procedures: National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes Patent licensing and agreement Patent infringement-meaning, scope, litigation, case studies.

Agreements and Treaties: History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments.

UNIT -V

Bioethics: Introduction to ethics/bioethics – framework for ethical decision making; biotechnology and ethics –benefits and risks of genetic engineering – ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and biowarfare; Ethical implications of cloning: Reproductive cloning , therapeutic cloning ; Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research-GM crops and GMO's – biotechnology and biopiracy – Ethical implications of human genome project

REFERENCES:

1. Ethics in engineering, Martin. M.W. and Schinzinger.R. III Edition, Tata McGraw-Hill, New Delhi. 2003.
2. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
3. Kankanala, K . C. 2007. Genetic Patent Law & Strategy, 1st Edition. Manupatra Information Solution Pvt. Ltd.,.Noida, India.
4. Jose B. Cibelli, Robert P. Lanza, Keith H. S . Campbell, Michael D.West. 2002. Principles of Cloning, Academic Press, SanDiego, Gurdon.
5. Hoosetti, B.B.2002. Glimpses of Biodiversity. Daya, New delhi.
6. Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Biotechnology Management. Jasen Publications, Tiruchirapalli, India.
7. http://www.cbd.int/biosafety/background.shtml
8. http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section 3.html

MAJOR BASED ELECTIVE III: BIODIVERSITY

UNIT-I

Biodiversity-Definition-Types-Diversity of Genes (genetic diversity) species (species diversity) and ecosystems (ecosystem diversity). Genetic diversity-Nature and origin of genetic variation-The need for preservation of wild relatives of domestic animals. Centres of origin of domesticated animals. Species diversity- Measurement, concepts, richness and turnover. Species - area relationships - Global distribution of richness - Centres of species diversity- Mega diversity centres- Hot spot analysis.

UNIT-II

Loss of biodiversity- Species extinction- Fundamental causes- Deterministic and stochastic processes- Current and future extinction rates-Methods of estimating loss of biodiversity-Threatened species- The IUCN threat categories (Extinct, Endangered, Vulnerable, Rare, Intermediate, and Insufficiently known). The threat factors (Habitat loss, Over exploitation for uses, introduction of exotics, Diseases, Habitat fragmentation etc.,) Common threat animal taxa of India- Red data books.

UNIT- III

Uses and values of Biodiversity- Uses of bio resources- animal uses; food animals (terrestrial and aquatic), non-food uses of animals, domestic livestock. Values of Biodiversity- Instrumental (Goods, Services, Information and Psycho spiritual values) and inherent or intrinsic values, ethical and aesthetic values- An outline account on methods of valuing biodiversity.

UNIT -IV

Conservation and sustainable management of Biodiversity and Bioresources- National policies and instrument relating the production of the wild / domesticated fauna as well as habitats-International policies and Instruments- A general account on multilateral treaties – the role of CBD, IUCN, IBPGR, NBPGR, WWF, FAO, UNESCO, AND CITES- bioresources. Biotechnology and intellectual Property Rights: An elementary account on WTO, GATT, and TRIPs, Bio prospecting and IKS, Bio-pyracy rights of farmers, breeders, and indigenous people-An elementary account on biodiversity/ bio resources data.

UNIT -V

Conservation of biodiversity- Why conservation biology? Current practices in conservation-Habitat or ecosystem approaches- Species based approaches- Social approaches- Chipko movement- *In situ* (Afforestration, Social forestry, Agro forestry, Zoos, Biosphere reserves, National parks, Sanctuaries), and *ex situ* (Cryopreservation, Gene banks, Sperm banks, DNA banks, Tissue culture and Biotechnological strategies). Eco restoration, environmental and biodiversity laws, environmental education.

REFERENCES:

1. Primack, R. B. 1993. Essentials of Conservation Biology, Sinauer Associates, USA
2. Meffe,. G. K. and C. R. Carroll. 1994. Principles of Conservation Biology, Sinauer Associates, USA

3. Groom bridge, B. 1992. Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.
4. Mittermeier, R. A., 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. Mittermeier, R. A., P.R. Gil and C. G. Mittermeier 1997. Megadiversity: Earth's Biologicals Wealthiest Nations, Cemex, SA
6. Soule, M.E. 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA.
7. Reaka - Kudla, . M. L., D. E. Wilson and E. O. Wilson 1997. Biodiversity II: Understanding and Protecting our Biological Resources. Joseph Henry Press, Washington, DC.
8. Clark, T. W., R. P. Reading and A.L.Clarke 1994. Endangered Species Recovery:Finding the Lessons, Improving the process. Island Press, Washington, DC.
9. Anon. 1992. Convention on Biological Diversity - Text and annexes. World Wide Fund for Nature - India.
10. http://www.redlist.org
11. Reid, W. V and K.R. Miller 1989. Keeping options Alive. World Resources Institute.
12. Anon. 1997. Wildlife (Protection) Act of India, Nataraj Publishers, Dehradun
13. Gaston, K. J. 1996. Biodiversity: Biology of numbers and Difference. Blackwell

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