

**DEPARTMENT OF PLANT BIOLOGY AND
BIOTECHNOLOGY**

PG SYLLABUS

Restructured from the Academic Year 2012 – 2013

LOYOLA COLLEGE

Autonomous

College Conferred with Potential for Excellence by UGC

Re-accredited at A+ Level by NAAC

Chennai – 600 034

SEMESTER I

No	Code	TITLE OF THE PAPER	CATEGORY	CONTACT HOURS	CREDITS
T1	BT 1825	Molecular Biology & Mol. Genetics	MC	4	3
T2	BT 1826	Biochemistry & Biophysics	MC	4	3
T3	BT 1827	Microbiology	MC	4	3
T4	BT 1828	Immunology & Immunotechnology	MC	4	3
L1	BT 1829	Practical I (Mol.Bio & Mol Gen./Biochem & Biophy.)	MC	6	4
L2	BT 1830	Practical II (Microbiology / Immuno & Imm.tech.)	MC	6	4
-	-	Seminar	-	2	-
		LEAP		OUTSIDE CLASS HOUR
		Total contact hours and credits		30H	20C

SEMESTER II

No	Code	TITLE OF THE PAPER	CATEGORY	CONTACT HOURS	CREDITS
T5	BT 2823	Gene Manipulation Technology	MC	4	3
T6	BT 2824	Bioinformatics & Research Methods	MC	4	3
T7	BT 2825	Enzymology & Enzyme Technology	MC	3	3
T8	BT 2826	Environmental Biotechnology	MC	3	3
L3	BT 2827	Practical III (Gene Manip. Tech & Bioinform & Res. Meth)	MC	5	4
L4	BT2828	Practical IV (Enzy.Tech. & Env. Biotech.)	MC	5	4
		TOTAL(MC)		24H	20C
ES1 or ES2	BT 2955	Cell Signaling	ES	4H	3C
	BT 2956	Cancer Biology			
LST	FS	LIFE SKILLS TRAINING (LST)	FS	2h (INSIDE)+ 2h(OUTSIDE)	2C
	LEAP	Extension activities		OUTSIDE	3C
		Total contact hours and Credits		30+2h	23+5C
STP		Summer Internship* (Each student will register under a staff guide who will be in charge of monitoring the summer internship as per Dept. guidelines)		3-4 weeks	1C

SEMESTER III

No	Code	TITLE OF THE PAPER	CATEGORY	CONTACT HOURS	CREDITS
T9	BT 3822	Animal Biotechnology	MC	4	3
T10	BT 3823	Plant Biotechnology	MC	4	3
T11	BT 3824	Nanotechnology& Medical Biotechnology	MC	3	3
T12	BT 3825	Bioprocess &Pharmaceutical technology	MC	3	2
L5	BT 3826	Practical V (Animal Biotechnology)	MC	3	2
L6	BT 3827	Practical VI (Plant Biotechnology)	MC	3	2
		TOTAL (Major core)		20H	15C
ES3 or ES4	BT 3955	Molecular Pathology	ES	4H	3C
	BT 3956	Functional Genomics			
ID	FP 3875	INTER DISCIPLINARY (ID) PAPER Food Processing Technology Name of the collaborating Dept. for ID Food Chemistry and Food Processing	ID	6H	5C
SSP		SELF STUDY PAPER*	SSP	OUTSIDE CLASS HOURS	2C
		Total contact hours and Credits		30H	23+2C

*Staff guide will allot the self study paper to each student and monitor the same.

SEMESTER IV

No	Code	TITLE OF THE PAPER	Nature	CONTACT HOURS	CREDITS
P	BT 4804	Project (Dissertation & Viva voce), Course seminars and Work Presentation	MC	30	24
		Total contact hours and Credits		30	24
Overall Hours & Credits				120+2H	90+6+2C

BT 1825 MOLECULAR BIOLOGY & MOLECULAR GENETICS

SEMESTER : I

CREDITS : 3

CATEGORY : MC

NO.OF HOURS /WEEK: 4

Objectives:

1. To make the learners understand the functional aspects of the cell at molecular level.
2. To focus on the up-coming molecular mechanisms involving the membrane organization and signal transduction.
3. To understand the inheritance pattern at molecular level.

Unit I -Genome organization

Organization of bacterial genome- Structure of eukaryotic chromosomes - Role of nuclear matrix in chromosome organization and function - Matrix associated regions - DNA reassociation kinetics (Cot curve analysis) - Repetitive and unique sequences; Satellite DNA

Unit II – The Central Dogma

Transcription – Basic Principles and Mechanism- Regulation in eukaryotes – galactose metabolism in yeast, transcriptional activator proteins, transcriptional enhancers and silencers - RNA polymerases in eukaryotes; eukaryotic transcription factors - RNA processing events - Protein synthesis – the translational machinery - Post translational modifications

Unit III – DNA synthesis and Recombination

Histone proteins, higher order coiling, hetero and euchromatin, centromeric DNA - Genetic Code – characteristics of genetic code, codon bias - DNA replication – semi conservative mode - Recombination- Holliday Model, Enzymatic Mechanism, Site-specific

Unit IV – Membrane Biology and Signal Transduction

Membrane organization; membrane proteins - Transport across cell membranes (passive and active) - Internalization of macromolecules and particles -Signal molecules, receptors and second messengers

Unit V – Molecular Genetics of the Cell

Mendelian Genetics - Linkage and crossing over - Extranuclear inheritance patterns - Quantitative inheritance - Population Genetics and Evolution

Text Books

1. Satyanarayana U. 2007. Biotechnology. Books and allied (P) Ltd
2. Verma P.S and Agarwal V.K. 2006. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd
3. Lewin B. 2008. Genes IX. Jones and Bartlett publishers

References:

1. Darnell J, Lodish H and Baltimore D 1986. Molecular Cell Biology. Scientific American Books.
2. Watson JD, Hopkins NH, Roberts JW *et al.* 1987. Molecular Biology of the Gene (4th ed.) The Benjamin/Cummings Publishing Company, Inc
3. Alberts B, Bray D, Lewis J *et al.* 1989. Molecular Biology of the Cell. Garland publishing Inc
4. Pasupuleti M. 2006. Molecular Biotechnology. MJP Publishers
5. Hartl DL and Jones EW. 2000. Genetics – Analysis of Genes and Genomes (5th ed.) Jones and Barlett Publishers.
6. Tamarin RH. 1999. Principles of Genetics (6th ed.) WCB McGraw-Hill
7. Karp G. 1998. Cell and Molecular Biology (2nd ed.) John Wiley and Sons, Inc
8. Lodish H, Berk A, Matsudaira P *et al.* 2004. Molecular Cell Biology (5th ed.) W.H. Freeman and Company, New York.
9. Becker MW, Kleinsmith LJ and Hardin J. 2007. The world of the Cell (6th ed.) Tata McGraw Hill Publications.
10. Raven PH, Johnson GB, Losos JB and Singer SR. 2006. Biology (7th ed.) Tata McGraw Hill Publications

Journals:

1. Journal of Molecular Biology
2. Molecular Genetics & Genomics

Websites

1. www.journals.elsevier.com/journal-of-molecular-biology/
2. www.springer.com › Home › Life Sciences › Cell Biology

BT1826 BIOCHEMISTRY & BIOPHYSICS

SEMESTER : I

CREDITS : 3

CATEGORY : MC

NO.OF HOURS /WEEK: 4

Objectives:

1. To provide details about the importance of the biomolecules present in our system and the regulation of metabolic pathways.
2. To expose the students to the biophysical methods used to study the biomolecules.

Unit I Chemical Foundations of Biology

Laws of thermodynamics, concept of free energy, standard free energy - High-energy phosphate compounds: introduction, phosphate group transfers - Water – physical properties, structure - pH scale, pH measurements, pH maintenance, pK, Acid-base balance - Buffers and action of biological buffers.

Unit II Chemistry of Biomolecules

Classification of Carbohydrates - Lipids Classification - Amino acids Classification, Protein Architecture - Nucleotide structure and properties: introduction to DNA, RNA - Vitamins: General Properties & classification.

Unit III Metabolism

Metabolism of carbohydrate - Amino acid metabolism - Metabolism of lipids - Nucleotide metabolism - Regulation of Metabolism - Inherited metabolic disorders.

Unit IV Biophysical techniques -I

Sedimentation -differential centrifugation, density gradient, preparative and analytical ultracentrifugation techniques, subcellular fractionation - Spectroscopy: Beer-Lambert law, Principle & theory, instrumentation of Ultraviolet Spectroscopy - Chromatography: Paper chromatography, TLC, HPLC, GLC, Ion Exchange chromatography, Affinity chromatography - *In vivo* imaging and functional studies of brain, thyroid, heart, biliary tract, liver, kidney, spleen, tumors, bones using radionuclides.

Unit V Biophysical techniques- II

Electrophoresis: basic principle of electrophoresis- AGE, NATIVE PAGE, SDS PAGE, 2D electrophoresis, isoelectric focusing - Elementary crystallography: Introduction to crystallography, X-ray diffraction and Bragg's equation – NMR, Mass spectrometry - Molecular modeling- basic principle of modeling, modeling by energy minimization technique, Ramachandran plot, molecular dynamics basic principles.

Text Books:

1. Nelson, L. D. and M. M Cox Lehninger's Principle of Biochemistry: (5th ed. 2008), Macmillan, Worth Publication Inc
2. Berg J.M., Tymoczko J.L. and Stryer.L.2007. Biochemistry (7th ed.) W.H.Freeman and Company, New York.
3. Wilson. K and Walker.J. Principles and techniques of practical biochemistry. 2010. Cambridge University Press.

References:

1. Voet .D and Voet . J.G 1995. Biochemistry (2nd Ed.) John Wiley and Sons, Inc.
2. Deb.A.C. 2006. Concepts of Biochemistry (Theory and Practical). Books and Allied (P) Ltd., Kolkata.
3. Williams .M.C. & Maher L. J. 2010. Biophysics of DNA-Protein Interactions: From Single

Molecules to Biological Molecules.

4. Cotterill. R, 2003. *Biophysics: An Introduction*. John Wiley & Sons.
5. Igor N. Serdyuk, Nathan R. Zaccai, Giuseppe Zaccai. 2007. *Methods in Molecular Biophysics: Structure, Dynamics, Function*. Cambridge University Press.

Journals

1. *Indian Journal of Biochemistry & Biophysics*
2. *The Journal of Biological Chemistry*.
3. *The Journal of Biochemistry*.

Websites:

1. <http://www.una.edu/faculty/aecrews/Biochemistry/LectureNotes.htm>
2. http://chemistry.about.com/od/lecturenoteslab1/Biochemistry_Lecture_Notes_Labs.htm

BT 1827 MICROBIOLOGY

SEMESTER : I

CATEGORY : MC

CREDITS : 3

NO.OF HOURS /WEEK: 4

Objectives:

1. To enable the students to understand the basic concepts in microbial diversity, metabolism and genetics.
2. To deal with microbial products and pathogenesis. It also introduces the students to some key aspects of virology.

Unit I Fundamentals of Microbiology

History and Scope of Microbiology - Microbial Diversity- Five kingdom system – Three domain concept - Prokaryotic cell structure and function - Sporulating Bacteria- Molecular architecture, stages and factors affecting sporulation.– Eukaryotic cell structure and function - Tools for investigating the microbial world- Brightfield microscopy, Darkfield microscopy, Phase-contrast microscopy, Fluorescence microscopy, Electron microscopy - Concept of species and hierarchical taxa-classical and quantitative methods of taxonomy of microorganisms-major characteristics used in taxonomy-major groups of microbes - Sterilization and Disinfection- Physical agents- heat, filtration, radiation, Chemical agents- Phenolics, alcohols, aldehydes, halogens, heavy metals, gaseous chemosterilizers

Unit II Microbial growth and metabolism

Culture media- Types: synthetic or defined media, complex media, media based on applications - Growth pattern- Managing bacterial growth, reproduction and exponential growth, process of binary fission, potential of bacterial growth - Factors influencing microbial growth- Nutritional requirements: water, energy and carbon sources, essential elements, organic growth factors. Physical requirements: temperature, pH, Mol O₂, CO₂, osmotic pressure, hydrostatic pressure,

stress response -Measuring microbial concentration- Direct counts, Indirect counts, Microbial assays - Energy acquisition by phototrophs and chemotrophs- respiration, chemosynthesis, photosynthesis in cyanobacteria and bacteria - Energy utilization for life processes- carbon assimilation, lipid metabolism, polysaccharide metabolism, protein metabolism, nucleic acid metabolism, metabolism of aromatic compounds.

Unit III Microbial Genetics and Microbial Products

Bacterial transformation- competence, DNA uptake, mechanism of transformation, detection of transformants - Bacterial conjugation- mechanism, Hfr transfer - Bacterial transduction- generalized transduction, co-transduction and linkage, specialized transduction and sexduction. - Industrial Products for health industry- search for new antibiotics, purification, yield increase, penicillin and beta lactum, tetracycline, vitamin production.

Unit IV Classification, Morphology and Cultivation of Viruses

Cataloging the virus through virus classification schemes of ICTV/ ICNV- Morphology and ultra-structure of viruses. Virus related agents and prions - Cultivation of viruses using embryonated eggs, experimental animals and cell cultures (Cell-lines, cell strains and transgenic systems) - Purification of viruses by adsorption, precipitation, enzymes serological methods- haeme agglutination and ELISA.

Unit V Viral Multiplication and Pathogenesis

Mechanism of virus adsorption and entry into the host cell, DNA and RNA synthesis, assembly, exit and maturation of progeny, virions, multiplication of bacteriophages - Host and virus factors involved in pathogenesis, patterns of infection, pathogenesis of animal viruses - Hepatitis virus, Picorna virus, Poxvirus and Orthomyxovirus, H1N1 virus, pathogenesis of plant [TMV] and insect viruses [NPV] - Structure, genomic organization, pathogenesis and control of Human Immunodeficiency virus. Emerging issues.

Text Books:

1. Mc Kane .,L.and Kandel, J.1995- 'Microbiology Essentials and Applications'; Second Edition Mc.Graw Hill Inc.
2. Prescott, Harley, Klein's, 1996- 'Microbiology' Willey, Sherwood; Seventh Edition, Mc. Graw Hill Inc.
- 3.Dulbecco and Ginsberg,H.S. 1998 – 'Virology'; Second Edition, Raven Press,NY

References

1. Madigan M.T.,.Martinko J. M, 2006- 'Biology of Microorganisms'; Eleventh Edition, Pearson Prentice.
2. Lim,D 1996- 'Microbiology'; Second Edition, WCB Mc Graw Hill Inc.
3. Reddy C A, Beveridge, Breznak, Marzluf, Schmidt, 2007- 'Methods for General and Molecular Microbiology'; Third Edition
4. Ananthanarayan and Panicker 2009- 'TextBook of Microbiology'; Eighth Edition, Universities Press.

5. Dubey R.C and Maheshwari D.K, 2002- 'A Textbook of Microbiology'; Seventh Edition, S.Chand & Company Ltd.
6. Dimmock N J, Primrose S.B.1994- 'Introduction to Modern Virology'; Fourth Edition Blackwell Scientific Publications, Oxford.
7. Conrat H.F., Kimball P.C. and Levy J.A, 1994- 'Virology'; Third Edition. Prentice Hall, Englewood Cliff, New Jersey.

Journals

1. Journals.ASM.org
2. Journal of Bacteriology
3. Journal of Virology

BT 1828 IMMUNOLOGY & IMMUNOTECHNOLOGY

SEMESTER	: I	CREDITS	: 3
CATEGORY	: MC	NO.OF HOURS /WEEK:	4

Objectives:

1. To help students to gain a full understanding of the organization of the immune system, way it functions and the consequences of immune system failure.
2. To acquaint the students with the applications and methodology of different immunotechniques.
3. To reason and to understand of immunological research methodologies will be highlighted within the course.

UNIT I Basic organization of the immune system

Haematopoiesis; Cells and organs of the immune system; Nature of antigens, superantigens and haptens; Structure, types and functions of antibodies; Innate and adaptive immune responses; Concept of immunological tolerance; Major histocompatibility complex molecules – types, structure and function; Cellular and humoral immunity; Cytokines; T-cell receptor and activation; B-cell activation and clonal selection; Antigen processing and presentation; Complement system.

UNIT II Immunogenetics and immune response to infections

Immune response to parasites, bacteria and fungi; Immune to response to viruses and viral evasion of the immune system. Immunoglobulin genes: chromosomal location, structure and mechanism of gene. rearrangements; MHC genes: chromosomal location, structure of the gene complex, MHC polymorphism, Pattern of inheritance of MHC alleles, MHC-disease associations.

Chromatin structure and gene regulation in the immune system; Role of microRNAs in immunoregulation; Hormonal regulation of the immune system.

UNIT III Clinical manifestations of immune dysfunction

Transplantation: types of transplantation, immune mechanisms in tolerance and rejection of grafts, HLA typing, prevention of graft rejection -Tumour immunology: tumour antigens, immune response to tumours and evasion of immune responses by tumours, cancer immunotherapy - Immunodeficiency disorders – Primary and secondary immunodeficiencies. Autoimmunity – types, induction and treatment; Hypersensitivity – types, induction and treatment.

UNIT IV Vaccine and monoclonal antibody production

Vaccines: history, conventional vaccines, large-scale vaccine production; doses and modes of administration, immune response to vaccines, use of adjuvants; recombinant vaccines (subunit, peptide, live attenuated and vector vaccines), current advances and issues in vaccine development for swine flu, bird flu, AIDS, cancer. Hybridoma technology – History, methodology, characterization, purification and applications of monoclonal antibodies, humanized monoclonal antibodies. Abzymes – definition, mode of catalysis and applications.

UNIT V Immunotechniques

Cell separation techniques – immune panning, magnetic sorting, FACS; Agglutination tests, Immunoprecipitation techniques, Enzyme-linked immunosorbent assay, Elispot assay, Immunofluorescence, Epitope mapping, Antibody engineering in *E. coli*, Radioimmunoassay, Western blotting, Immunochromatography, Immuno-PCR, Gene expression analysis of immune system cells, Immunoscreening of recombinant libraries, Solid-phase membrane immunobead assay (MIA), Immunoelectron microscopy, Immunosensors.

Textbooks:

1. Bona C. A., Bonilla F. A. (1996) *Textbook of Immunology*, Harwood Academic Publishers.
2. Kindt T. J., Goldsby R.A., Osborne B. A., Janis Kuby, 2002 *Immunology*, 6th Edition, Freeman.

References:

1. Brostoff .J, Seaddin J.K, Male D, Roitt IM, 2002, *Clinical Immunology*, 6th Edition, Gower Medical Publishing.
2. Janeway et al., *Immunobiology*, 4th Edition, 1999, Current Biology Publications.
3. Paul, 1999, *Fundamentals of Immunology*, 4th edition, Lippencott Raven.
4. Goding, 1985, *Monoclonal antibodies*, Academic Press.

Journals:

1. *Cellular & Molecular Immunology*
2. *Nature Immunology*
3. *Journal of Immunology*

Websites

1. www.immunology.org
2. www.aaaai.org
3. www.imat.cines.fr

BT1829 PRACTICAL I

(MOL.BIOL&MOL.GENETICS/BIOCHEMISTRY & BIOPHYSICS)

SEMESTER : I **CREDITS** : 4
CATEGORY : MC **NO.OF HOURS /WEEK:** 6

Objective:

1. To enable the learners to grasp the basic concepts of molecular biology through hands-on laboratory experiments.
2. To help the learners to handle biochemical assays and procedures by exposing them to many analytical and separative techniques in biochemistry.

MOL.BIOL&MOL.GENETICS

1. Mitosis
2. Meiosis
3. Karyotyping
4. Isolation of Genomic DNA from Mammalian blood/Plant source
5. Isolation of genomic DNA from Bacterial Culture
6. Estimation of DNA by spectrophotometer
7. Agarose gel electrophoresis of isolated DNA

BIOCHEMISTRY & BIOPHYSICS

1. Qualitative Analysis of Carbohydrates.
2. Qualitative Analysis of Aminoacids.
3. Acid – Base titration using pH meter and Determination the pK values.
4. To analyze of Oil-Iodine number, saponification value & acid number.
5. To verify the Lambert Beer's law.
6. To study the characteristics of UV absorption spectra of Aromatic Amino Acids.
7. To estimate proteins by Biuret assay.
8. Estimation of proteins using Bradford assay.
9. To estimate the Protein by Folin's-Lowry method
10. TLC of Amino acids.
11. One-dimensional Paper chromatography of Amino acids.
12. Column Chromatography for Pigments.

13. Polyacrylamide Gel Electrophoresis (PAGE).
14. Density Gradient centrifugation.
15. Differential centrifugation.
16. Demo: HPLC, NMR, MS, GC-MS.

BT 1830 Practical II

(MICROBIOLOGY / IMMUNOLOGY & IMMUNOTECHNOLOGY)

SEMESTER	: I	CREDITS	: 4
CATEGORY	: MC	NO.OF HOURS /WEEK:	6

Objective:

1. To provide hands on experience in microbiological and immunological techniques to students and will introduce them to experimentation, problem solving, data gathering, and scientific interpretation.
2. To lay a good foundation for research work in these areas.

MICROBIOLOGY & VIROLOGY

1. Preparation of liquid and solid media for the growth of microbes
2. Isolation and maintenance of organisms by plating, streaking and serial dilution methods; slants and stab culture.
3. Storage of microorganisms
4. Isolation of pure cultures from specific sources (soil, water, air)
5. Growth curve; measurement of bacterial population by turbidometry
6. Microscopic examination of bacteria, yeast and molds; biochemical tests; study of organisms by Gram stain.
7. Bacterial transformation
8. Actinomycetes – isolation and characterization
9. Test for production of amylase and starch
10. One step growth curve for determination of virus titre (Demo)
11. Phage typing of *E.coli* bacteriophages (Demo)
12. Studies on Specialized transduction (Demo)

IMMUNOLOGY & IMMUNOTECHNOLOGY

1. Differential staining and identification of leucocytes
2. Isolation of lymphocytes from peripheral blood using Ficoll Hypaque
3. Preparation of serum from whole blood and isolation of immunoglobulins from serum
4. Purification of IgG by affinity chromatography
5. Quantitative precipitin assay

6. Characterization of antigens by immunodiffusion
7. Determination of antigen concentration by rocket immunoelectrophoresis
8. Haemagglutination assay
9. Immunochromatography test for detection of antibodies
10. Immunohistochemistry using enzyme-linked antibodies
11. Determination of antigen concentration by competitive ELISA
12. Western blotting

BT 2823 GENE MANIPULATION TECHNOLOGY

SEMESTER : II
CATEGORY : MC

CREDITS : 3
NO.OF HOURS /WEEK: 4

Objectives:

1. To provide information about the gene manipulation techniques, and introduces the students to the concepts and advancements in molecular cloning.
2. To understand the diversity of vectors used for cloning purposes, and appreciate the applications that genetic engineering has in a variety of fields.

Unit I – Tools in Gene Manipulation

Engineering the genes- Scope and Principle - Cocept of restriction and modification - Restriction endonucleases – types, properties, recognition sites, nomenclature, Factors influencing restriction - Modifying enzymes – phosphatases, polymerases, exonucleases, methylases – Ligases - Cloning strategies – vectors, markers, transformation (competent cells), hosts, - Screening and analysis of recombinants, promoters, linkers and adapters

Unit II- Cloning and Expression vectors

Plasmids – desirable properties, types, examples; construction and characterization of pBR 322 - Bacteriophage M13 – General biology, design of vectors, DNA sequencing and M13, derivatives (pBluescript) - Bacteriophage lambda – General biology, cloning in Lamda, Lambda ZAP - Cosmids as replacement vectors - Cloning in gram positive bacteria – *Bacillus subtilis*

Unit III – Cloning using other organisms

Saccharomyces cerevisiae as vectors – fungal markers, YCp, YEp; construction and application of YACs - Vascular plants – *Agrobacterium* mediated transfer - Viral vectors – SV 40 vectorology – basic properties, strategies, construction and application - Baculovirus vectors for insect cells

Unit IV – Means and products in cloning

Construction of genomic and cDNA libraries - Screening of libraries - Nucleic acid probes and labeling; autoradiography - Hybridization – techniques and methods - Synthesis of protein – *in vitro* translation - cDNA mapping, gel retardation assay and foot-printing

Unit V – Advanced Techniques and Applications of Recombinant DNA

DNA sequencing – Maxam Gilbert method; Sanger’s dideoxy procedure; Automated sequencing - PCR Technology – Principle and component parts; modifications of PCR (any 5 types); primer designing - Pulsed Field Gel electrophoresis; RFLP and RAPD - Mutagenesis – point, site-directed and PCR mutagenesis - Applications of cloning- recombinant proteins, GMOs - Ethics in Gene Cloning

Text Books

1. Satyanarayana. U. 2007. Biotechnology. Books and allied (P) Ltd
2. Lewin. B. 2008. Genes IX. Jones and Bartlett publishers
3. Old.R.W. and Primrose S.B. 1994. Principles of Gene Manipulation – An introduction to genetic engineering (5th ed) Oxford Blackwell Scientific Publications

References

1. Howe C. 1995. Gene Cloning and Manipulation. Cambridge University Press.
2. Glick BR and Pasternak J. 1998. Biotechnology – Principles and Applications of Recombinant DNA. ASM Press, Washington , D.C.
3. Brown. T. A . 2001. Gene cloning and DNA Analysis (4th ed) – An introduction. Blackwell Science.
4. Primrose.S.B. and Twyman. R. M. 2006. Principles of Gene Manipulation and Genomics. Blackwell Publishing Ltd.
5. Sambrook J and Russell DW. 2001 . Molecular Cloning – A Laboratory Manual (3rd ed) (Vol 1, 2, 3) Cold Spring Harbor Laboratory Press. New York
6. Freifelder. D 2007. Molecular Biology (2nd ed.) Narosa Publishing House

Journals:

1. Journal of Genetic Engineering and Biotechnology - Elsevier
2. Journal of Genetic Engineering and Biotechnology sciencedirect

Websites:

- 1.<http://dwb4.unl.edu/Chem/CHEM869N/CHEM869NLinks/www.dur.ac.uk/~dbl0www/Staff/Croy/cDNAfigs.htm>
2. <http://www.ibguides.com/biology/notes/genetic-engineering-and-biotechnology>

BT2824 BIOINFORMATICS & RESEARCH METHODS

SEMESTER : II CREDITS : 3
CATEGORY : MC NO.OF HOURS /WEEK: 4

Objectives:

1. To detail the various web based resources for biological information.
2. To provide a platform for molecular understanding of the structure- function relations in DNA/RNA/Proteins.

3. To equip students with the knowledge of scientific data analysis and presentation.

Unit I – Bioinformatics: An introduction

Internet Basics-world wide web-Internet resources for research - Emergence of bioinformatics - Historical overview - Biological Databases-Primary, Secondary databases - Sequence Databases for DNA& Proteins - Structure Databases - Information Retrieval from biological databases.

Unit II –Predictive methods in DNA sequences

Gene predictions- *Ab initio* & comparative gene predictions- GRAIL, GENSCAN, FGENESH, sgp2 - ESTs,EST Clustering,ESTs& gene discovery - Genomic map elements, Types of Maps - Mapping databases - Human Genome Map.

Unit III – Predictive methods in Proteins

Protein identity based on composition & Physical properties - Motifs & patterns - Prediction of Post translational modifications of proteins - Protein structure prediction and analysis.

Unit IV Research methods –An Introduction.

Objectives of Research - Formulation of Research problem - Hypothesis development and Testing - Writing a Research Proposal - Collection of review of scientific literature, on-line and off-line sources - Design of experiments – principle, procedure in effective design. Experimental methods – control, natural, observational, field experiments - Data – types, collection and classification - Sampling – types, methods, sample size.

Unit V – Data analysis & Presentation

Biostatistical methods of analysis- Descriptive statistics (Measures of Central tendency ,Dispersion, Skewness and Kurtosis)- Inferential Statistics – ANOVA, Regression and Correlation analysis, Multivariate analysis, Spatial Statistics, SPSS Package and MS- EXCEL - Data representation (tabulation, diagrammatic, graphical – Venn diagram, Pie chart, graphs , Bar-chart, Histogram)- Writing a thesis or dissertation (all the parts of a thesis in detail, including title page and references), report & scientific article.

Text Books:

1. Mount, D. W. 2004. *Bioinformatics: sequence and genome analysis. Cold Spring Harbour Laboratory Press.*
2. Kothari, C.R. Research Methodology: Methods and Techniques (2nd revised edition). 2008. *New Age International.*

References:

1. Baxevanis A. D., Ouellette B. F. F., (3rd edition) 2005. *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Wiley's Publications.*
2. Ramsden, J. 2009. *Bioinformatics: An introduction. Kluwer Academic Publishers.*
3. Venkatarajan S. M., Pandjassarame K. 2009. *Bioinformatics: A Concept-Based Introduction.*

Springer publications.

4. R.P. Pathak, 2008. Methodology of Educational Research. *Atlantic Publishers & Dist*

Journals:

1. BMC *Bioinformatics*.
2. *Journal of Mixed Methods Research*.
3. *Journal of Research Methods and Methodological Issues*.

Websites:

1. http://www.bioinformatics.wsu.edu/bioinfo_course/notes.htm
2. <http://www.bioinformaticszen.com/>
3. <http://socialinquiry.wordpress.com/2011-2012/syllabus-2011-2012/>

BT 2825 ENZYMOLOGY & ENZYME TECHNOLOGY

SEMESTER	: II	CREDITS	: 3
CATEGORY	: MC	NO.OF HOURS /WEEK:	3

Objectives:

1. To create a basic understanding of the importance of enzymes as cellular catalysts.
2. To enable the learner to realize the importance of enzymes in daily life, the properties of enzymes, the use of enzymes in industry, research and human health, and methods for the discovery of novel enzymes will be thoroughly explored

UNIT I Basic concepts in enzyme science

History of enzymology; Definition of enzymes; Characteristic features of enzyme – catalytic power, catalytic strategies and substrate specificity; Lock and key, induced fit hypotheses; Active site – Structure, substrate binding, role of catalytic amino acid residues; Enzyme cofactors; Nomenclature and classification of enzymes; Regulation of enzymes; Types of enzyme inhibition; Thermodynamics of enzyme-catalyzed reactions; Coupled reactions; Kinetics of enzyme-catalyzed reactions, Effect of pH and temperature on enzyme activity.

UNIT II Catalytic mechanisms of enzymes and their isolation

Active site and Catalytic mechanisms of Lysozyme, Serine proteases, Chorismate mutase - Multienzyme complexes – tryptophan synthase, anthranilate synthase, alpha keto dehydrogenase - Zymogens, Isozymes – Lactate dehydrogenase, Creatine kinase - Ribozymes, Deoxyribozymes, Artificial enzymes - Sources of enzymes – microbial, plant and animal sources; Isolation and purification of enzymes; Quantitation of enzymes - enzyme activity, specific activity, turnover number.

UNIT III Enzyme discovery and design of novel enzymes

Strategies for the discovery of improved and novel enzymes for industrial applications (homology and structure based approaches, screening methods, use of mutants); Expression

cloning of enzyme genes; Optimization of industrial enzymes by mutagenesis, *in vitro* recombination; Protein engineering strategies to improve enzyme stability, specificity and activity; Enzyme immobilization – types, advantages, drawbacks and applications.

UNIT IV Industrial and therapeutic enzymes and enzyme biosensors

Enzymes used in different industries; Functions of enzymes used in genetic engineering – restriction endonucleases, methylases, DNA and RNA polymerases, DNA and RNA nucleases, modifying enzymes (alkaline phosphatase, DNA ligase, T4 polynucleotide kinase), reporter enzymes (β -galactosidase, luciferase, β -glucuronidase (GUS), chloramphenicol acetyl transferase (CAT)) - Enzyme replacement therapy – definition, modes of administration, enzyme therapy for digestive disorders, cancer, inborn metabolic disorders, cystic fibrosis, cosmetic benefits -Enzyme-based biosensors.

UNIT V Diagnostic enzymes and enzyme deficiencies

Cell organelle-specific marker enzymes - Enzymes in clinical diagnosis: Primary and secondary serum enzymes, considerations for reliable serum enzyme assays, intracellular distribution of diagnostic enzymes, Enzymes in the diagnosis of hepatic disorders, myocardial infarction, cancers and neurological disorders - Enzyme markers of xenobiotic toxicity - Pharmacogenomics related to polymorphism of drug metabolizing enzymes - Enzyme deficiency disorders.

Textbook:

1. Chaplin M.,and Bucke C. (1990) *Enzyme Technology*, Cambridge University Press.

References

1. Garrett R. and Grisham C. M., 2010, Biochemistry, 4th Ed, Brooks/Cole.
2. Aehle W., 2008, Enzymes in industry - production and applications, Wiley-VCH.
3. Glick B. R., Pasternak J. J., Patten C. L.2007. Molecular Biotechnology, principles and applications of recombinant DNA, 4th ed, ASM Press, Washington DC.
4. Price N. C.and Stevens L., 2004. *Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins*, Oxford University Press

Journals:

1. *Methods in Enzymology*
2. *Enzyme and Microbial Technology*
3. *Nature Chemical Biology*

Websites :

1. www.divbiolchem.org
2. www.ercenzymes.com

BT 2826 ENVIRONMENTAL BIOTECHNOLOGY

SEMESTER : II

CREDITS : 3

CATEGORY : MC

NO.OF HOURS /WEEK: 3

Objectives:

1. To expose the students to the concept of ecology, environmental problems and their consequences.
2. To give an insight to the students as how to exploit various biotechnological strategies to solve these environmental hazards, with special attention on the byproducts of different industries.

Unit I – Fundamentals of Ecology

Principles of ecology; food chain, food web - Bio-geo chemical cycles – Methane: the central molecule of carbon cycle; nitrogen cycle; sulphur cycle - Aquatic biology – types of aquatic environments and organisms; indicator microbes in polluted water -Terrestrial environment (solid and liquid phase, soil atmosphere, vadose zone) - Aeromicrobiology – microbial distribution in air, bioaerosols, aeromicrobiological pathway; Extreme environments – extremophiles; thermophiles, halotolerant organisms, acidophiles, barophiles; archaeobacteria- Remote sensing - principle and applications

Unit II – Environmental Microbiology of Waste Water Treatment

Overview of waste water treatment - Activated sludge process – biology, nutrient removal, pathogen removal; bulking and foaming - Trickling filters – for attached microbial growth; process; biofilm kinetics; rotating biological contactors - Anaerobic digestion – one stage and two stage digestion; methanogen detection; factors controlling anaerobic digestion; advantages and disadvantages - Drinking water – microbiological quality; conventional filter plants and softening plants; pre-chlorination, coagulation, flocculation, sedimentation, filtration (slow sand, rapid sand, diatomaceous earth – activated carbon) - Organic carbon in drinking water – AOC, DOC, BDOC, TOC -Biofilm – cell growth, biofilm ecology, detachment, biofilm control

Unit III – Bioremediation Strategies

Types (*In situ*: intrinsic and engineered, and *ex situ*: composting, aerated lagoons, low-shear airlift reactors); scale-up process for bioremediation - Bioremediation of xenobiotics; petrochemical compounds; crude oil and product release; inorganic wastes; heavy metals - Use of genetically engineered bacterial strains for bioremediation - Microbial leaching (biology, chemistry and types)

Unit IV – Problems and Remedies in Industrial Biotechnology

Pulp and paper industry – microbial utilization, colour removal, paper mill effluent waste, bioconversion methods - Pesticides industry – classification and chemistry of pesticides; degradation pattern; microbial methodology for waste disposal - Sugar and Distillery industry –

microbial processes in sugar mill operation; sugar industry waste-water on biodegradation of organic matter; brewery waste water - Leather tanning industry – leather processing; tannery solid wastes; microbial applications; effluent treatment - Petroleum industry – refinery waste water; characterization of petrochemical effluent; carboxylation of phenol to benzoic acid by methanogenic consortium - Soaps, surfactants and dyes – microbial growth in soaps (prevention, control and cure); treatment technologies of dyes

Unit V – Novel Approaches in Environmental Biotechnology

Microbial polymers; biolubricants; bioenergy from wastes - *Dehalococcoides* to clean up toxic mess; *Rhodoferrax ferrireducens* – bacterial batteries; *Deinococcus radiodurans* – toughest microbe; - Viral sampling from soil – elution, concentration, CPE assays, plaques, detection of bacteriophages and plant viruses - Commonly used molecular markers for environmental monitoring of microbes - Biocides; soil enzyme assays

Text books:

1. Scragg, A 2007. Environmental Biotechnology (2nd ed.) Oxford University Press.
2. Mohapatra, P.K. 2007. Textbook of Environmental Biotechnology. I.K.International Publishing House Pvt.Ltd.

References:

1. Bhatia, S.C. 2008. Handbook of Environmental Microbiology (1, 2 and 3). Atlantic Publishers and Distributors (P) Ltd.
2. Thakur, I.S. 2006. Industrial Biotechnology – Problems and Remedies. I.K.International Pvt.Ltd.
3. Sharma, P.D. 2006. Environmental Microbiology. Narosa Publishing House
4. Murugesan, A.G. and Rajakumari, C. 2005. Environmental Science and Biotechnology – Theory and Techniques. MJP Publishers, Chennai.
5. Asthana, D.K. and Asthana, M. 2006. A Textbook of Environmental Studies. S.Chand & Company Ltd., New Delhi.

Journals:

1. omicsonline.org/jpebhome.php - United States
2. www.elsevier.com/wps/find/subject_all_products.../05134?...Y
3. journalseek.net/cgi-bin/journalseek/journalsearch.cgi?...biotech

BT2827 PRACTICAL – III

(GENE MANIPULATION TECHNOLOGY/ BIOINFORMATICS & RESEARCH METHODS LAB)

SEMESTER : II

CREDITS : 4

CATEGORY : MC

NO.OF HOURS /WEEK: 5

Objectives:

1. To enable the students to get a hands-on experience in handling the nucleic acid samples and their products.
2. To advance the skills like PCR and sequencing help them for further research in Gene manipulation.
3. To provide in depth knowledge on analyzing molecular data and interpreting the results.
4. To help in exhaustive biological data analysis using SPSS.

GENE MANIPULATION TECHNOLOGY

1. Preparation of Plasmid DNA
2. Agarose gel electrophoresis of isolated DNA
3. Restriction enzyme digestion of DNA
4. Ligation reaction
5. Preparation of competent cells
6. Transformation of plasmid DNA
7. Isolation of total RNA
8. RT- PCR
9. Polymerase Chain Reaction
Demo: Automated sequencing

BIOINFORMATICS & RESEARCH METHODS LAB

1. An introduction to the computing platforms.
2. Molecular databases.
3. Database searches (BLAST and FASTA).
4. Prediction of ORF, splice sites & promoter elements of DNA.
5. Gene finding strategies in genomic DNA.
6. Estimating protein secondary structure and physical attributes.
7. Multiple sequence alignment.
8. Secondary structure of proteins.
9. Molecular modeling and visualization.

10. Getting familiar with SPSS.
11. Calculating the measures of central tendency, dispersion.
12. Hypothesis Testing.
13. Comparing Means using SPSS.
14. Correlation & regression analysis using SPSS.

BT 2828 PRACTICAL IV

(ENZYMOLOGY & ENZYME TECHNOLOGY/ ENVIRONMENTAL BIOTECHNOLOGY)

SEMESTER : II
CATEGORY : MC

CREDITS : 4
NO.OF HOURS /WEEK: 5

Objectives:

1. To enable the learners to develop skills in experimenting with enzymes and exploring the practical uses of enzymes.
2. To provide good exposure in handling and studying environmental samples so that the learner is well equipped to can handle current environmental issues.

ENZYMOLOGY & ENZYME TECHNOLOGY

1. Cell fractionation and identification of mitochondrial fraction using a marker enzyme
2. Isoenzyme analysis – LDH (liver, muscle, heart)
3. Isolation and purification of lysozyme from egg white
4. Assay of alkaline and acid phosphatases from liver/serum samples
5. Cellulase assay
6. Screening of microbes for amylase production on starch agar plates.
7. Protease assay
8. Lipase assay
9. Study of enzyme kinetics, optimum pH and temperature of invertase
10. Amylase Enzyme immobilization
11. Yeast Cell immobilization for sucrose hydrolysis by invertase

TECHNIQUES IN ENVIRONMENTAL BIOTECHNOLOGY

1. Estimation of biomass from planktonic organisms.
2. Physicochemical and biological analysis of soil.
3. Biodegradation of environ-friendly materials.
4. To measure the amount of biodegradable organic matter in waste water.
5. To detect coliform and faecal coliform bacteria in water by membrane filter method.
6. Bacteriological examination of water (presumptive, confirmation and concluding tests)
7. Determination of hardness of water.
8. Estimation of chloride ion in water.

9. Estimation of fish protein.
10. To measure the amount of dissolved oxygen in water sample.
11. To measure the amount of biological oxygen demand in water sample.

BT 2955 CELL SIGNALLING

SEMESTER : II
CATEGORY : ES

CREDITS : 3
NO.OF HOURS /WEEK: 4

Objectives:

1. To enable students to know the mechanisms involved in cell signaling and develop a deeper understanding on the significant networks of cellular communications.

Unit –I Basic concepts in cell signaling

Principles of cell signaling systems- Signaling- need for signaling in multicellular organisms - Receptors-cell surface & inside the cell- Major types of signaling-paracrine signaling, synaptic signaling, endocrine signaling, autocrine- Two component signaling

Unit-II Cell-Cell communication and signaling

Gap junctions, Plasmodesmata- General introduction and introduction to G Protein-Coupled Receptor (GPCR) Signaling - Structure of GPCRs, G proteins, and GTPases - GPCRs and their modulation - G Protein effectors

Unit-III Signal transduction through ion channels

Signal transduction through ion channels - Ligand-gated channels - Regulation of ion channels by G Proteins - Transient receptor protein (TRP) channels.

Unit-IV Important signalling pathways

Growth factor/ Receptor Tyrosine kinases (RTKs) and Wnt receptors - Ras to Mitogen-Activated protein kinase (MAPK) pathway- Proteases and Signaling – Apoptosis - Cytokine receptors - Toll-like receptors.

Unit-V Genetic regulation of cell signalling

Regulation of transcription and translation - Nuclear transactivators and repressors - Chromatin Remodeling - Techniques to study cell signalling components.

Text Books:

1. Helmreich .E. J. M. 2001. The biochemistry of cell signaling. Oxford University Press.
2. Hancock J. T.2010 .Cell signaling. Oxford University Press

Reference books:

1. Nelson J. 2008. Structure and Function in Cell Signalling. Wiley's publication.
2. Henderson .B, Pockley A. G. 2005. Molecular Chaperones and *Cell Signalling*. Cambridge University Press.
3. Parker P. J., Pawson T. 1996.*Cell Signalling*. Cold Spring Harbor Laboratory Press

Journals :

1. *Cellular Signalling* - Elsevier
2. *Journal of Molecular Signaling*

Websites:

1. <http://alevelnotes.com/Cell-Signalling/131>
2. <http://faculty.weber.edu/btrask/Chapter%2016%20Notes.pdf>

BT 2956 CANCER BIOLOGY**SEMESTER : II****CATEGORY : ES****CREDITS : 3****NO.OF HOURS /WEEK: 4****Objectives:**

1. To explore the cellular and molecular mechanisms underlying cancer development with the aim of understanding how changes in the normal growth and division processes lead to the formation of tumours.
2. To understand the current concepts of cancer, including cancer diagnosis, cancer treatment and prevention

UNIT I Process of cancer development

Definition of cancer; Forms of cancers - benign, malignant; Classification of cancers – carcinoma, sarcoma, lymphoma, myeloma, leukemia; Causes of cancer; Cellular and molecular alterations in cancer cells; Multistep tumorigenesis – tumour initiation, promotion, progression; Process of metastasis; Stage and grade of neoplasms; Mechanisms of apoptosis evasion in cancer cells.

UNIT II Factors that promote cancer development

Role of growth factors in cancer; Important signal transduction pathways in cancer (G-protein coupled receptors, phosphoinositide-3-kinase pathway, mTOR, tyrosine kinase, protein phosphatases, JAK-STAT pathway, oestrogen receptor pathway, hypoxia-inducible factor, TNF receptor signalling, TGF beta signalling, HSP-mediated events); Tumour angiogenesis factors and inhibitors; Cancer stem cells and their therapeutic implications.

UNIT III Hereditary, environmental and molecular aspects of cancer

Hereditary cancers; radiation-induced cancers; cancers induced by hormones (oestrogen, oral contraceptive steroids, diethylstilbesterol); chemical carcinogenesis – classes of chemical carcinogens and their mechanism of action, role of oxidative stress in carcinogenesis; Oncogenic viruses; Proto-oncogenes and Oncogenes – definition, discovery, functional classes of oncogenes, oncogene activation; Cellular oncogene (*c-onc*) expression during normal embryonic development.

UNIT IV Molecular mechanisms in cancer development

Role of tumour suppressor genes in cancer; Defective DNA repair in cancer induction (xeroderma pigmentosum, breast cancer); DNA methylation and cancer – DNA hypermethylation and hypomethylation in oncogenesis, inhibitors of DNA methylation; Significance of telomeres and telomerase in cancer; Metastasis control by microRNA; Tumour markers – cell surface and nucleic acid markers.

UNIT V Cancer diagnosis and treatment

Cancer diagnostic methods – serum and urine analysis, cytogenetic analysis, cytologic and histologic diagnosis, frozen section analysis, immunohistochemistry, molecular diagnostics (southern blotting and PCR-based diagnostics); Chemotherapy – types of drugs; modes of action of anticancer drugs, dosage and modes of administration, side effects; Hormonal therapy; Stem cell therapy; Radiotherapy; Gene therapy; Cancer prevention.

Textbook:

1. Pelangaris S. and Khan M. (2006), *The Molecular Biology of Cancer*, Blackwell Publishers

References

1. Ruddon R. W. (2006), *Cancer Biology*, Fourth edition, Oxford University Press.
2. Weinberg R. (2000), *The Biology of Cancer*, Garland Science, Taylor & Francis Group, New York
3. Kleinsmith L. J. (2004), *Principles of Cancer Biology*, Pearson Benjamin Cummings.
4. Morris D. and Kearsley. J. 1998. *Cancer: A Comprehensive Clinical Guide*, Taylor & Francis Group, New York.
5. Spillane J. B. and Henderson M.A (2007), *Cancer Stem cells: a review*, *ANZ J. Surg.* 77: 464–468.
6. Ehrlich M. (2002), *DNA Methylation in Cancer*, *Oncogene* 21: 5400-5413.

Journals

1. *Nature Cancer*
2. *British Journal of Cancer*
3. *Cancer Gene Therapy*
4. *Oncogene*

Websites

1. www.cancer.org
2. www.cancer.gov
3. www.icbp.nci.nih.gov

BT 3822 - ANIMAL BIOTECHNOLOGY

SEMESTER : III
CATEGORY : MC

CREDITS : 3
NO.OF HOURS /WEEK: 4

Objectives:

1. To enable the learners to know how to maintain animal cells in culture and genetically engineer them for the betterment of human life.
2. To focus on the different ways in which molecular biotechnology could be applied for the improvement, use and conservation of animals.

UNIT I Basics requirements for cell culture

Types of cultures – primary, secondary; Cell line – definition, types (finite, continuous/established, transformed), examples; Cell strains-Characteristics of finite, continuous and transformed cells in culture-Tumorigenesis assays – histological examination, transplantation, CAM assay, organoid confrontation, filter well invasion, angiogenesis, testing for plasminogen activator levels -Cell culture media – defined media, serum supplementation, serum-free media-Types of culture vessels for laboratory-scale and large-scale cultures - Applications of cell culture

UNIT II Routine maintenance of cell cultures

Phases of cell growth -Feeding and subculture of cells - Characterization of cell lines-Microbial contamination of cell culture – tests for bacterial, fungal, viral and mycoplasma contamination - Cell viability and cytotoxicity tests for cells in culture - Cryopreservation of cell lines – principle, methodology and applications - Induction of differentiation – physiological and non-physiological inducers

UNIT III Stem cell culture, 3D culture and tissue engineering techniques

Culturing of stem cells – basic principles and methodology - Induction of stem cell differentiation - Induced pluripotency of adult stem cells and its applications - Three-dimensional cultures - histotypic and organ culture methods and applications - Tissue engineering – Design stages; types of substrate/support materials; cell sources; orientation; tissue-engineered skin, peripheral nerve implant, cartilage, uterus, trachea, urinary bladder; genetically engineered tissues

UNIT IV Genetic manipulation of animals

Genetic engineering of animal cells – types of origins of replication, promoters, markers and vectors used; methods of transfection; use of baculovirus vectors for production of

recombinant proteins - Transgenic animals – methodology used for the production of transgenic insects, mice, cattle, sheep, pigs, birds, fish; Applications of transgenic animals - Pharming – definition, pharming products and their applications - Animals as disease models for cancer and alzheimer’s disease - Cloning of animals – methods and applications

UNIT V Tools for assisted reproduction, genetic improvement and conservation of animals

Assisted reproduction in farm animals: artificial insemination, In vitro fertilization in humans and farm animals, embryo sexing - Molecular diagnostics for animal diseases – infectious diseases and genetic disorders - Marker-assisted selection for genetic improvement of livestock - Molecular techniques for species conservation - DNA barcoding of animals --Applications of RNA interference-based gene silencing in animal agriculture - Ethics in animal biotechnology

Text books:

1. R. Ian Freshney (2010) *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications*, John Wiley & Sons, USA.
2. Portner R. (2007) *Animal Cell Biotechnology*, Humana Press, USA.

References:

1. Gordon I (2005) *Reproductive Techniques in Farm Animals*, CABI.
2. Glyn N. Stacey, John Davis (2007) *Medicines from Animal Cell Culture*, John Wiley & Sons, USA.
3. Twyman RM (2003) *Advanced Molecular Biology*, Bios Scientific, Oxford, UK.
4. R. Renaville, A. Burny (2001) *Biotechnology in Animal Husbandry*, Springer, UK.
5. Manjula Shenoy, (2007) *Animal Biotechnology*, Firewall Media, India.

Journals

1. *Nature*
2. *Nature Biotechnology*
3. *Nature Genetics*
4. *Science*
5. *Scientific American*

Websites

1. www.animalscience.ucdavis.edu
2. www.gslc.genetics.utah.edu
3. www.biotechnology.gov.au
4. www.nature.com
5. www.scientificamerican.com

BT- 3823 PLANT BIOTECHNOLOGY

SEMESTER : III
CATEGORY : MC

CREDITS : 3
NO.OF HOURS /WEEK: 4

Objectives:

1. To provide detailed information about the tissue culture practices for micro-propagation and other applied aspects.
2. To cover information about the biotechnology to agriculture, in raising transgenic plants and provide scope to use algae and fungi for novel products of utilitarian value.

Unit I – Molecular Organization and Tools in Plant Tissue Culture

Plant Genome Organization – structural features of a representative plant gene - Targeting of proteins to chloroplast; cytoplasmic male sterility; Maize transposable elements - Composition of various tissue culture media and their preparation - Callus and suspension cultures; organogenesis and embryogenesis; Meristem tip culture; hardening of plants; anther, embryo and ovule culture - Protoplast isolation, culture and fusion - Artificial seeds; production of secondary metabolites.

Unit II – Molecular Plant Pathology

Socio-economic aspects of plant pathology in sustained agriculture - Molecular biology of plant pathogen interaction - Agricultural entomology – molecular tools to tackle plant pests - Plant disease management for sustained agriculture – novel trends – genetic engineering for biotic stress tolerance (fungi, bacteria, viruses).

Unit III – Molecular Plant Physiology

Seed storage proteins - Molecular aspects of seed development - Role of abscissic acid in seed maturation - Plant hormones – biosynthesis and molecular basis of action – IAA, ethylene, ABA, GA; peptide hormones - Phytohaemagglutinins – distribution, properties, role of lectins - Photomorphogenetic effect.

Unit IV – Agricultural Biotechnology

Conventional breeding methods and plant biotechnology tools for crop improvement - Somaclonal variation - Genetic engineering for increasing crop productivity by manipulation of nitrogen fixation – early events in symbiotic nitrogen fixation in legumes by *Rhizobia*; *nod* factors; nodulins in nodule developments - Molecular biology of crown galls – *Agrobacterium tumefaciens* - Transgenic plants and applications; plants as bioreactors – edible vaccines

Unit V – Algal and Fungal Biotechnology

Occurrence and distribution of micro and macro algae of economic importance - Cyanobacterial biotechnology – mass cultivation of blue green algae in field - Micro algae as biofertilizers; carrier materials; immobilization techniques - Commercially important fungal enzyme – industrial uses - Mushroom cultivation – food value of edible mushrooms - Product end – fungal antibiotics, mycobactericides, importance of VAM fungi, fungal secondary metabolites

Text Books

1. Satyanarayanan U. 2007. Biotechnology. Books and Allied (P) Ltd., Kolkata.
2. Hammound J., McGarvey P. and Yusibov V. (eds.) 2000 Plant Biotechnology, Springer Verlag

References:

1. Trivedi P.C. 2000 Plant Biotechnology – Recent Advances. Panima Publication Corporation, New Delhi
2. Ignacimuthu S. 1998 Plant Biotechnology. Oxford and IBH
3. Reynolds P.H.S 1999. Inducible Gene Expression in Plants. CABI Publishing, U.K.
4. Ramavat K.G. 2006 Plant Biotechnology S. Chand and Co. Ltd., New Delhi
5. Rao K.N. Sudhakara Rao G. and Bharathan S. 1997 Plant Physiology – The Functioning Plant. S. Viswanathan Pvt. Ltd.
6. Purohit S.S., Kothari P.R., and Mathur S.K. 1993. Basic and Agricultural Biotechnonology (4th ed.) New Age International Publishers
7. Mahesh S. 2008 Plant Molecular Biotechnology. New Age International Publishers.

Journals

1. Acta Physiologiae Plantarum
2. *In Vitro* Cellular & Developmental Biology – Plant

BT 3824 NANOTECHNOLOGY & MEDICAL BIOTECHNOLOGY

SEMESTER : III

CATEGORY : MC

CREDITS : 3

NO.OF HOURS /WEEK: 3

Objectives:

1. To introduces the learners to the basic concepts and applications of nanotechnology.
2. To cover the most recent molecular diagnostic and therapeutic tools used for various diseases.
3. To provide information related to neonatal diagnosis and oncology and provide practical solutions to pertaining medical problems, bordering on medical ethics.

UNIT I Basic concepts in Nanotechnology

Definition and Timeline of nanotechnology - Properties of nanostructures - Tools for characterization of nanostructures - Methods for fabrication of nanostructures - Carbon nanostructures (Fullerenes, carbon clusters, carbon chain polymers) - Nanostructured crystals - Quantum dots

UNIT II Nanobiotechnology

Biological nanostructures and their properties - Peptide nanowires and nanotubes - DNA nanowires - Protein nanoparticles - Biologically inspired nanomaterials - Nanodevices and nanomachines based on biological nanostructures - Protein and DNA nanoarrays - Medical applications of nanotechnology - Use of nanotechnology in reducing energy consumption and environmental pollution - Safety, ethical and economic issues in nanotechnology

Unit III Molecular Medicine

Molecular Technology for medical applications - Medical Genetics – Thalassaemias as model study - Autosomal recessive disorders – Cystic Fibrosis/any other disease as model study; Autosomal Dominant Disorders – FHC / any other disease as model study - X-linked disorders – Haemophilia / any other disease; Multifactorial Disorders – Schizophrenia and Diabetes / any other disease - Genetic Counselling; Gene Therapy

Unit IV Fetal / Neonatal Medicine and Forensic Medicine

Prenatal Diagnosis – Fetal blood sampling, Amniocentesis, CVS - DNA testing in the fetus - Fetal therapy and future directions - Embryonic stem cells as therapeutic agents - Repetitive DNA as forensic tools

Unit V Medical Oncology

Concepts in Medical Oncology – proto-oncogenes and oncogenes - Retinoblastoma and other familial cancer syndromes - Tumour suppressor genes – p53 - Diagnostic Applications in Cancer – *In situ* Hybridization, Flow Cytometry, etc.- Biomedical Ethics

Textbooks:

1. Christof M. Niemeyer and Chad A. Mirkin (2004) *Nanobiotechnology: Concepts, Applications, and Perspectives*, Wiley-VCH, Weinheim, Germany.
2. Mark A. Ratner, Daniel Ratner (2003) *Nanotechnology: A Gentle Introduction to the Next Big Idea*, Prentice Hall Professional, New York.
3. Thomas D. Gelehrter, Francis S. Collins and David Ginsburg, 1998. Principles of Medical Genetics (2nd ed.) Williams and Wilkins.

4. Trent, R.J. *Molecular Medicine* (2nd ed.) Churchill Livingstone
5. Dorian J. Pritchard and Bruce R. Korf 2004. *Medical Genetics at a glance*. Blackwell Science

References:

1. Claudio Nicolini (2008) *Nanobiotechnology and Nanobiosciences*, Pan Stanford Publishing, Singapore
2. Patrick Boisseau, Marcel Lahmani (2009) *Nanoscience: Nanobiotechnology and Nanobiology*, Springer, UK
3. Geoffrey M. Cooper (1990) *Oncogenes*, Jone and Barlett Publishers
4. Ramachandran A and Chandran M.R. (2006) *Forensic Medicine and Technology*, All India Publishers and Distributors.
5. Gavin Brooks (ed.) (2005) *Gene Therapy – The use of DNA as a drug*, Viva Books Private Limited.

Journals:

1. Journal of Nanobiotechnology
2. Journal of Biomaterials and Nanobiotechnology
3. Nature Nanotechnology

Websites:

1. www.understandingnano.com
2. www.nanowerk.com

BT 3825 BIOPROCESS AND PHARMACEUTICAL TECHNOLOGY

SEMESTER : III
CATEGORY : MC

CREDITS : 2
NO.OF HOURS /WEEK: 3

Objectives:

1. To make the learners understand the principles of fermentation technology and their specific applications.
2. To provide details about how this technology is applied for a wide range of product development.

Unit I – Introduction to Fermentation Technology

History of fermentation industry – Components of fermentation process - Types of fermentors - Sterilization – medium, fermenter, feeds, liquid wastes; filter sterilization - Environmental factors for microbial growth.

Unit II – Microbial Growth Kinetics

Models – Batch, continuous and fed-batch - Isolation of industrially important microbes - Preservation - reduced temperature, dehydrated form - Strain improvement strategies - Media – Formulation and components - Inoculum development for industrial purposes.

Unit III – Applications

Scale-up process – down stream processing - Fermented food products – Milk and milk products - Alcohol Beverages; Organic acids and amino acids - Single cell proteins (bacteria, algae and fungi).

Unit IV Protein and Natural Products as Pharma Drugs

History and Scope of Pharmaceutical and Biotechnology Industries - Characterization and bioanalytical aspects of recombinant proteins as pharmaceutical drugs - Pharmaceutical properties of steroids, prostaglandins and antibacterial compounds - Rituximab- clinical development of 1st therapeutic antibody - Phytopharmaceuticals- terpenoids, alkaloids, flavanoids, coumarins, phenolics acids and nitrogen compounds.

Unit V Therapeutic proteins

Pharmaceutical products from mammalian culture - Methods of delivering drug to target tissues - Steps involved in clinical trials - ICMR guidelines - ELSI in pharmaceutical trials, role of FDA.

References:

1. Peter.F.Stanbury, Allan Whitaker and Stephen.J.Hall. 1997. Principles of Fermentation Technology (2nd ed.) Aditya Books (P) Ltd.
2. Rastogi, S.C. 2007. Biotechnology – Principles and Applications. Narosa Publishing House.
3. Crueger.F. and Anneliese Crueger. 2000. Biotechnology: Industrial Microbiology. Panima Publications.
4. Dubey.R.C. 2002. A Textbook of Biotechnology. S. Chand & Company Ltd., New Delhi.
5. Nagori.B.P. and Roshan Issarani. 2007. Foundations in Pharmaceutical Biotechnology. Pharma Book Syndicate.
6. Gavin Brooks (ed.). 2005. Gene Therapy – The use of DNA as a drug. Viva Books Private Limited.
7. Bhat.S.V., Nagasampagi.B.A. and Sivakumar.M. 2006. Chemistry of Natural Products. Narosa Publishing House.
8. Lilia Alberghina (ed.) 2000. Protein Engineering in Industrial Biotechnology. Harwood Academic Publishers.
9. Julio Collado-Vides, Boris Magasanik and Temple.F.Smith. 2004. Integrative Approaches to Molecular Biology. Ane Books.
10. Satyanarayan.U. 2007. Biotechnology. Books and Allied (P) Ltd., Kolkata.

Journals:

1. Journal of Bioprocessing and Biotechniques
2. Bioprocessing Journal

3. Indian journal of pharmaceutical sciences
4. Advanced drug delivery reviews

Websites:

1. <http://www.ingentaconnect.com/content/ben/cpb>
2. <http://onlinelibrary.wiley.com/book/10.1002/0471250589>

**BT 3826 Practical V
(ANIMAL BIOTECHNOLOGY)**

SEMESTER : III
CATEGORY : MC

CREDITS : 2
NO.OF HOURS /WEEK: 3

Objectives:

1. To provide the practical background and training in animal cell culture and molecular techniques related to animal biotechnology
2. To equip students with the essential skills to apply and explore theoretical concepts of animal biotechnology in the laboratory.

1. Preparation and sterilization of reagents and media for cell culture.
2. Primary culture of chick embryo fibroblasts.
3. Cell counting using haemocytometer.
4. Viability test - Dye exclusion assay.
5. Subculture and Cryopreservation of cell lines.
6. Exposure of cells to carcinogens and transformation assay (focus assay or soft agar assay).
7. Isolation of DNA from mammalian blood or spleen.
8. WSSV detection by PCR.
9. VNTR Genotyping.
10. Comet assay for assessing genotoxicity.

BT- 3827 PRACTICAL – VI (Plant Biotechnology)

SEMESTER : III
CATEGORY : MC

CREDITS : 2
NO.OF HOURS /WEEK: 3

Objectives:

1. To enable the students to acquire skills in in vitro regeneration of plants and also expose

them to molecular techniques using plants.

2. To utilize the plant and plant products technologically by mushroom cultivation and artificial seed production.

1. Preparation of Plant Tissue Culture Media
2. Surface sterilization of explants
3. Callus induction
4. Meristem culture and regeneration of plantlets
5. *Agrobacterium* culture for transformation
6. Hairy root culture
7. GUS assay
8. Isolation of *Rhizobium* from legumes
9. Protoplast isolation
10. Protoplast fusion
11. Production of artificial seeds
12. Seed storage proteins- extraction and characterization

Demo: Biolistic Gun Transformation;

FP 3875 - FOOD PROCESSING TECHNOLOGY

SEMESTER : III
CATEGORY : ID

CREDITS : 5
NO.OF HOURS /WEEK: 6

OBJECTIVES:

- To gain knowledge on the basic principles of food processing and the various methods used to process foods*
- To be aware of the processed food products available in the market.*
- To understand the basic principles of processing and the unit operations employed in a food processing plant.*

UNIT I – Introduction to Processing - Unit Operations

- 1.1 Introduction – Types of biodeterioration – Chemical, Physical and microbial deterioration
- 1.2 Food biodeterioration – Autolysis, Microbial spoilage, Contamination and Food spoilage, Mechanism of food deterioration – Factors affecting microbial growth – fermentation – fermentation biochemistry – putrefaction- lypolysis.
- 1.3 Operations in Food Processing – An overview – Handling, Cleaning, Separation Techniques, size reduction, pumping, mixing, heat exchange, concentration, drying, , forming and packaging

UNIT -2 Storage of food in Low Temperatures

- 2.1 Effect of cold storage and quality- storage of grains; Principles of refrigerated gas storage of

food- Gas packed refrigerated foods; Sub atmospheric storage; gas atmospheric storage of foods.

2.2 Principles of freezing of food product, processes and equipment for freezing of fresh and processed foods. IQF of marine products. Frozen and cold storage. Changes during freezing and storage. Microbial aspects of frozen foods, Freeze drying and freeze concentration.

UNIT -3 Storage of foods in high temperatures

3.1 Principles of thermal processing of food. Pasteurization, sterilization and canning. Spoilage of canned foods, storage of canned foods; Influence of canning on the quality of food; improvement in canning technology. Calculation of process time temperature-schedules.

3.2 Retort processing of Ready to eat (RTE) products. Drying Water activity, microbial spoilage due to moisture. Dehydration of fruits, vegetables, milk, animal products etc. Types of dryers. Osmotic dehydration.

3.3 Newer methods of thermal processing- batch and continuous; application of infra-red microwaves; ohmic heating. Intermediate moisture foods.

UNIT -4 Other Methods and Hurdle technology

4.1 Preservation by Concentration of liquid foods :Control of water activity; preservation by concentration; reverse osmosis and membrane filtration with reference to fruit juice and milk.

4.2 Non-thermal methods, chemical preservatives, irradiation, high hydrostatic pressure, smoking. Application of Hurdle technology and minimal processing. GRAS and permissible limits for chemical preservatives and legal aspects for gamma irradiation.

4.3 Use of enzymes and microorganisms in processing and preservation of foods. Lactic acid fermentation, alcoholic fermentation, pickling, smoking.

UNIT 5 Processing Technology of the Basic five food groups – An overview of the various processed food products

5.1 Cereals and Pulses -Milling of wheat, Milling of rice – parboiled rice, rice based instant food Processing of corn, barley and millets – pearling, flaking and puffing, corn starch products, Malting , Pulses – Decortication and dhal milling, elimination of toxic factors, fermentation and germination , Soy based products

5. 2. Milk and Milk products-Collection, Standardization, pasteurization, homogenization, UHT processing, manufacture of some of the common Indian dairy products-Paneer, khoa, curd, etc

5.3. Fruits and vegetables-Harvesting, physiological and bio chemical changes during ripening, handling and storage, general methods of processing - extraction and pulping, raw material and product specifications and standards.

5. 4. Meat, poultry, fish and egg - Ageing and tenderizing, curing, smoking and freezing of meat, fresh storage of meat. Meat based products: sausages, salaami, bacon. Fish processing and storage, pickling. Egg: storage, frozen egg, dehydrated egg powder.

5.5.Nuts and Oil seeds – Pressing, solvent extraction, purification – degumming, refining, bleaching, deodourizing. Hydrogenation – margarines, shortenings

5.6 Beverages – Alcoholic (Beer and Wine) , Non – Alcoholic (Tea, coffee and cocoa) – Processing and storage.

TEXT BOOKS:

1. Arsdel WB, Copley MJ & Morgan AI. 1973. *Food Dehydration*. 2nd Ed. Vols. I, II. AVI Publ.
2. Desrosier NW & James N. 1977. *Technology of Food Preservation*. 4th Ed. AVI. Publ.
3. Fellows PJ. 2005. *Food Processing Technology: Principle and Practice*. 2nd Ed. CRC.
4. Khetarpaul Neelam, 2005. 'Food Processing and Preservation', Daya Publications, New Delhi.
5. Salunke D K and Kadam S S., 1995. 'Hand book of Food Science and Technology: production, composition, storage and processing' Marcel Dekker INC, New York.
6. Sivasankar B., 2002. 'Food Processing & Preservation' Prentice Hall, India.
7. Meyar, LH., 2000. Food chemistry, CBS publishers and distributors, NewDelhi.
8. Srilakshmi, B. Food Science, 3rd edition, New Age International Pvt. Ltd. Publishers,

REFERENCES:

1. Ashurst, PR. 2004. Food Flavorings, Blackie, Glasgow and London.
2. Potter, NN. and JH. Hotchkiss, 1997. Food Science, CBS Publishers and Distributors 5th edition.
3. Murano, PS., 2003. Understanding food science and technology, Thomson Wordsworth.
4. Parker, R. 2003. Introduction to food science.

BT 3955- MOLECULAR PATHOLOGY

SEMESTER : III
CATEGORY : ES

CREDITS : 3
NO.OF HOURS /WEEK: 4

Objectives:

1. To introduce the learners to the molecular basis for many cellular processes and diseases and will therefore enable them to develop a thorough understanding of the underlying

causes of disease.

2. To help the students to appreciate the role of pathology in applied or experimental medical research.

Unit I Molecular mechanisms in cell aging and death

Genes involved in aging - Role of telomeres and telomerase in cell aging - Mitochondrial genes and aging - Role of oxidative DNA damage in aging and disease development - Mechanisms of repair of oxidative DNA damage - Cellular and molecular mechanisms of necrotic cell death.

Unit II Role of genes in disease development and manifestation

Pattern recognition receptors and inflammatory responses - Molecular mechanisms in wound healing and regeneration - Role of nuclear and mitochondrial DNA mutations in the development of disease - Genetic imprinting in the development of diseases - Epigenetic regulation of the genome - Biomarkers of disease – DNA biomarkers, RNA biomarkers, Protein biomarkers; Use of biomarkers in diagnosis, treatment and prediction of therapeutic responses.

Unit III Developmental genetics and molecular aspects of infectious diseases

Role of genes in development; Pattern formation; Effect of teratogens; Molecular basis of developmental disorders - Cellular and pathological functions of PrP in prion diseases - Molecular basis of infectious diseases – bacterial and viral diseases - Genomics of infectious disease susceptibility.

Unit IV Molecular pathology of some major disorders

Molecular basis of cardiovascular diseases – atherosclerosis and ischaemic heart disease - Molecular mechanisms of liver development, liver regeneration, and hepatocyte death; Adult liver stem cells in health and disease; genetic basis of alcoholic liver disease - Molecular basis of diabetes; genetic defects of the beta cell and mutations in the insulin receptor - Molecular neuropathology of neurodevelopmental disorders and neurological injury (stroke and neurodegeneration).

Unit V Applied molecular pathology

Toxicogenomics – molecular mechanisms involved in biological responses of organisms exposed to environmental toxicants and stressors - Use of molecular pathology in the development of drugs - Pharmacogenetics and pharmacogenomics in the treatment of human diseases

Textbooks:

1. William B. Coleman, Gregory J. Tsongalis (2009) *Molecular Pathology: The Molecular Basis of Human Disease*, Academic Press, New York, USA.
2. Philip T. Cagle, Timothy Craig Allen (2009) *Basic Concepts of Molecular Pathology*, Springer, UK

References:

1. Jonathan Salisbury (1997) *Molecular Pathology*, Taylor & Francis, UK.

2. Ruth A. Heim, Lawrence M. Silverman (1994) *Molecular Pathology: approaches to Diagnosing Human Disease in the Clinical Laboratory*, Carolina Academic Press, USA.
3. Anthony A. Killeen (2003) *Principles of Molecular Pathology*, Humana Press, USA.
4. Charles J. Epstein, Robert Erickson, Anthony Wynshaw- Boris (2003) *Inborn Errors of Development: The Molecular Basis of Clinical Disorders of Morphogenesis*, Oxford University Press, UK.

Journals:

1. Journal of Clinical Pathology
2. Experimental and Molecular Pathology
3. Journal of Infectious Diseases
4. The Lancet

Websites:

1. www.mp.bmj.com
2. www.amp.org/jmd
3. www.humpath.com

BT 3956 - FUNCTIONAL GENOMICS

SEMESTER : III

CREDITS : 3

CATEGORY : MC

NO.OF HOURS /WEEK: 4

Objective:

1. To depict large-scale techniques to study gene expression and to understand the inside-outs of genome wide polymorphisms and their significances.

Unit -I Introduction to genome

General features of eukaryotic genome - Analysis of chromosomes using genome browsers - Process of genome sequencing - Sequencing and assembling genomes – Model organisms for functional genomics

Unit-II Approaches to explore gene expression

Genomics, gene expression - Gene expression analysis using quantitative PCR methods - Gene expression analysis- Microarrays - Microarray applications

Unit-III Approaches to study RNA

Bioinformatics approaches to study RNA- Transcriptomics-Introduction - Transcriptional Profiling - Serial analysis of gene expression (SAGE) and massively parallel signature sequencing (MPSS)

Unit-IV Approaches to investigate proteins

Introduction to Proteomics – Protein modifications in proteomics - Protein –protein interactions –types - Experimental techniques to study protein -protein interactions - Web based resources to study protein -protein interactions

Unit-V Applications in functional genomics

Modifying Gene Expression and Cellular Function, Gene silencing - Forward genetics & reverse genetics - Applications in Metagenomics, Metabolomics & Pharmacogenomics - Functional genomics & society

References:

1. Jonathan Pevsner.2009. Bioinformatics and Functional Genomics. *John Wiley & sons*.
2. Michael J. Brownstein, Arkady B. Khodursky.2010. Functional genomics: methods and protocols. *Humana Press.Inc*.
3. Dario Leister .2005.Plant functional genomics.*Food Products Press*

Journals :

1. Briefings in Functional Genomics.
2. Comparative and *Functional Genomics*.

Websites:

1. <http://www.sciencegenomics.org/>
2. <http://www.genome.wisc.edu/functional.htm>

BT 4804- Project (Dissertation & Viva voce)

SEMESTER : IV
CATEGORY : MC

CREDITS : 24
NO.OF HOURS /WEEK: 30

Objectives:

1. To understand the purpose and the importance of research in any biotechnology related topic.
2. To Plan and carry out research work through literature review, materials and methods, results and discussion.
3. To get exposed to various reputed research institutes.
4. To present the findings periodically subjected to both external and internal evaluation.