Syllabus

Department of Biochemistry and Molecular Biology

Sr. No.	Course Code	Course Title	Credits
1.	BIO-111	Basic Bio-chemistry	2+1=3
2.	BIO-122	Enzymology	2+1=3
3.	BIO-123	Microbial Genetics	2+1=3
4.	BIO-234	Molecular Biology	2+1=3
5.	BIO-235	Plant Metabolic Pathways	2+1=3
6.	BIO-236	Elements of Immunology	1+1=2
7.	BIO-247	Techniques in Biochemistry and Molecular Biology	2+2=4
8.	BIO-358	Recombinant DNA Technology	2+1=3
9.	BIO-369	Molecular Plant Virology	2+1=3
		Total	**17+10=27**

Course contents (Syllabus)

BIO – 111 : BASIC BIOCHEMISTRY 2+1

Theory :

Biochemistry: Definition, scope and importance in Agril. Biotechnology Concept of life and living processes : Introduction, nature of biological material, properties, the identifying characteristics of a living matter, molecular logic of life, The Cell - A Brief Introduction : Structure of prokaryotic and eukaryotic cells, Cell Membrane System and Cell wall: Cell membrane and its organization; elementary idea of cellular constituents: nucleus, mitochondria, golgi bodies, endoplasmic reticulum, lysosomes and microbodies; bacterial and plant cell walls. Biomolecules : Carbon and its brief chemistry, general properties of biomolecules, water: structure and unique properties, acid, base, buffers, polyprotic acids. Carbohydrates : Monosaccharides: classification, structure, configuration, properties and derivatives, common disaccharides, structure and function, occurrence of storage and structural polysaccharides, glucosaminoglycans, glycoproteins: structure and function. Lipids : Fatty acids, triacylglycerol, phospholipids, sphingolipids: sphingomyelins, cerebrosides gangliosides, cholesterol, micelles, bilayers, liposomes, lipoproteins: structure and function. Amino acids and proteins: Amino acids: structure, nomenclature and general properties. Peptide bond, primary structure of proteins, end group analysis, amino acid composition, specific peptide cleavage and sequence determination. Secondary structure: peptide group, Ramachandran diagram, helical structures: alpha-helix and other polypeptide helices, □- pleated sheets. Protein stability:

electrostatic interactions, hydrogen bond and hydrophobic forces, disulphide bond. Tertiary and quaternary structures of proteins. Vitamins and enzymes : Water soluble vitamins, their coenzyme forms, sources and biochemical functions. Fat soluble vitamins: sources and functions. Enzymes: historical perspective, naming and classification, factors affecting enzyme activity, mechanism of enzyme action, enzyme units. Nucleic acids and chromosomes: Nucleic acid structure and function, physical and chemical properties, spectroscopic and thermal properties, *in vitro* denaturation and renaturation of DNA, DNA as genetic material. Bioenergetics : Principles of thermodynamics and their applications in biochemistry -introduction and thermodynamic state functions, first and second law of thermodynamics, concept of free energy, standard free energy change, biological oxidation-reduction reactions, redox potential. High energy phosphate compounds, free energy of hydrolysis of ATP and sugar phosphates.

Practicals :

1) Preparation of standard solutions
2) Methods for measurement of pH
3) Preparation of buffer solutions
4) Qualitative tests for sugars.
5) Quantitative estimation of reducing and non reducing sugars by Nelson Somyogi method.
6) Qualitative tests of amino acids and proteins.
7) Quantitative estimation of protein by Folin Lowry's method.
8) Estimation of free amino acids by ninhydrin reagent.
9) Separation and identification of amino acids by paper chromatography/TLC.
10) Estimation of lipid/crude fat by soxhlet apparatus
11) Estimation of saponification, iodine and acid values of oil/fat.
12) Determination of ascorbic acid fromthe aonla
13) Determination of phosphorus froma given sample
14) Estimation of nitrate reductase activity from leaves of crop plants.

Reference Books :

1. Voet & Voet, 2000, Fundamentals of Biochemistry, JohnWiley, New York
2. Zubay, 1995, Biochemistry, Brown Publishers.
3. Nelson & Cox 2000, Lehningers Principles of Biochemistry.W.H. Freeman.

4. L. Stryer, 2002, Biochemistry,W.H. Freeman.

5. Harper, 2003, Biochemistry,McGraw-Hill.

6. David Metzler,2006 Biochemistry Vol.I,II, Panima N.Delhi

7. D.T. Plumer. An Introduction to Practical Biochemistry. Tata McGraw Hill Co.

BIO – 122 : ENZYMOLOGY 2+1

Theory:

Introduction : Review of brief history, enzymes as biological catalysts, classification, nomenclature, proximity and orientation, covalent catalysis, acid-base catalysis. Isolation and purification of enzymes : Objectives, strategy, choice of source, methods of homogenization and separation. Enzyme assays, specific activity, enzyme activity units. Factors affecting the rate of enzymatic reactions : substrate concentration, enzyme concentration, pH, temperature, coenzymes and cofactors. Specificity of enzymes : absolute specificity, broad specificity, intermediate specificity, stereospecificity. Active site of enzymes : common features, enzymesubstrate complex formation, evidences. Enzyme kinetics: Monosubstrate reactions, Michaelis-Menten equation and its linear transformations, Km and Vmax: definition, determination and significance. Enzyme inhibition: Reversible inhibition, competitive, noncompetitive and uncompetitive inhibitions. irreversible inhibition, specific examples. Identification of functional groups essential for catalysis, ribonuclease and chymotrypsin as specific examples. Bisubstrate enzyme reactions : Single and double displacement reactions, random and ordered mechanisms. Enzyme regulation : allosteric enzymes, cooperativity, special characteristics, Monod and Koshland models, covalent modification of enzymes, specific examples to be studied: ATCase, phosphorylase, lactate dehydrogenase. Mechanism of enzyme action : specific examples; chymotrypsin, lysozyme, ribonuclease A, carboxypeptidases. Isoenzymes : Characteristics and importance. Enzyme as tools in biotechnology : Methods of enzyme immobilization and its industrial applications.

Practical:

1. Extraction of crude enzyme, purification of enzymes: General principles.

2. Assay of the á- and â- amylases

3. Effect of substrate concentration, pH, enzyme concentration, assay media, and temperature on enzyme activity

4. Determination of Km value
5. Effect of different inhibitors on the enzyme activity
6. Effect of coenzyme and metal ions on enzyme activity.
7. Extraction and assay of peroxidase, polyphenol oxidase, catalase and invertase.
8. *In vivo* and *in vitro* nitrate reductase activity fromtissue samples
9. Isolation and sequential purification of enzymes by different analytical techniques.
   a. Purification of enzyme by dialysis membrane
   b. Purification of enzyme by ammonium sulfate precipitation
   c. Purification of enzyme by gel filtration
   d. Purification of enzyme by ion exchange chromatography.

Reference Books:

1. Nelson & Cox 2000, Lehninger's Principles of Biochemistry.W.H. Freeman.
2. Voet & Voet, 1991. Biochemistry.
3. Dixon, M.,Webb, E.C. Thorne, C.J.R. and Tipton, K.F. 1979. Enzymes, 3rd edn.
4. Price , Fundamentals of Enzymology.
5. Palmer, T. 2001. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, England.
6. Price, N.C. and Stevens, L. 1999. Fundamentals of Enzymology, 3rd edn.
7. Marwaha, 2000 Food Processing Biotechnological Applications. Asiatech publishers, New Delhi.

BIO – 123 : MICROBIAL GENETICS 2+1

Theory:

Introduction to microbial genetics. Prokaryotes: bacteria, cyanobacteria, mycoplasma etc. The evolution of prokaryotic genetics; early concept of bacterial variation; adaptation, mutation and selection. Prokaryotic chromosome structure: bacterial chromosome, supercoiling of the genome, circular and super helical DNA, Plasmids: Types, properties and roles, Conjugal transfer of plasmid DNA – stage in transfer process, effective contact and pilli, mobilization and transfer *tra* genes of F plasmids, host restriction in transfer; plasmid replication. Transposable elements, insertion sequences, types of bacterial transposons, transposition, transposase, excision of transposons, transposons and evolution. Mutations: Biochemical basis of mutations, spontaneous mutation, isolation of mutants,

mutagenesis, reversion, suppression, genetic analysis of mutants. Genetic recombination, transformation, conjugation and transduction. Transformation: Discovery of transformation, competence and DNA uptake. Conjugation. Insertion of F plasmid into the *E. coli* chromosome, *Hfr* transfer, Transduction : generalized and specialized, sexduction, Viruses: different genomes; bacteriophages with lytic (T4 phage) and lysogenic (lambda phage) in detail.

Practicals:

1. Culture techniques for isolation of single colonies of bacteria Escherichia coli streaking, serial dilutions etc.
2. Induction of mutation in bacteria through physical, chemical and biological agents; studying the mutation rate.
3. Replica plating technique
4. Bacterial Genomic DNA isolation
5. Plasmid DNA isolation techniques: Alkali lysis; Heat lysis etc.
6. Bacterial competent cell preparation and transformation
7. Triparental mating experiments for studying conjugation (Donar x Recipient x Helper), conjugation frequency calculation
8. Bacteriophage Lambda infection and plaque study.

Reference books:

1. Microbial Genetics, 2006, Second Edition, by S. R. Maloy, J. E. Cronan, Jr. and David Freifelder; Narosa Publishing House, New Delhi.
2. Molecular Biology, 2005, Second Edition, by David Freifelder; Narosa Publishing House, New Delhi.
3. Genetics, 2005, Third Edition, by M.W. Srtickberger, Prentice Hall of India Private Ltd. New Delhi.
4. Genetics, 2006, First Edition, by B. D. Singh, Kalyani Publishers, New Delhi.
5. Genes IX, 2006, by Benjamin Lewin, Pearson Prentice Hall, Pearson Education Inc., New Jersey.

BIO – 234: MOLECULAR BIOLOGY 2+1

Theory:

Chromosome structure: basic chemical aspects – DNA, histones and non-histones; basic structural aspects – the nucleosomes, euchromatin and heterochromatin. Organization of the genome in eukaryotes: Gene and gene number; C-value paradox; organization of replication; gene amplification, chromosomal redundancy, repetitive DNA and its relevance to plants and animals, inverted and tandem repeats. DNA replication: DNA replication and its overview: semi conservative mechanism of DNA replication, replicons, origins and termini, semi-discontinuous replication, RNA priming, replication in prokaryotes and eukaryotes. DNA damage and repair: Biological indications of damage to DNA, evidence for repair systems, repair of thymine dimmers. Regulation of gene expression: Basic principles of transcription, transcription in prokaryotes. Transcription in eukaryotes, its regulation , RNA processing and RNPs.– multiple RNA polymerases, sigma like factors in eukaryotes; heterogeneous nuclear RNA; messenger RNA - structure and complexity; interrupted genes and RNA splicing; expression of specific genes; genes for ribosomal RNA; histone genes; globin genes; heat-shock genes; The dynamic genome: Mobile genetic elements in eukaryotes (jumping genes) – relevance to plants; studies in maize. Brief introduction to the complexity of eukaryotic genome. Molecular biology of organelles: Genomes of mitochondria and plastids - interaction with nucleus.

Practicals:

1. Preparation of buffer solutions for isolation and purification of DNA and RNA.
2. Isolation and purification of genomic DNA from plants, fungi, bacteria and animal tissues.
3. Quantification of DNA by different methods.
4. Fractionation and isolation plant organelles.
5. Isolation and purification of organelle DNA.
6. Isolation of total RNA and mRNA from plant sample
7. Isolation of ribosomes, rRNA and PR proteins

Reference Books:

1. Lewin B, Genes IX, Oxford University Press, Sixth Edition
2. Darnell, J., Lodish, H. and Baltimore, D. 1986. Molecular Cell Biology.,W.H.

Freeman andCompany, NewYork.

3. Alberts, B. Bray, D. Lewis, J., 1989.Molecular Biology of the Cell. Garland Publishing, Inc. New York.

4. Wolfe, S.L.,Molecular and Cellular Biology,Wordsworth, Belmont, CA.

5. Fundamentals of Molecular Biology by Allison, 2007, Panima, N.Delhi.

6. PlantMolecular Biology by Shaw, Panima, N.Delhi.

7. Biochemistry and Molecular Biology of Plants by Buchanan et al.

8. Molecular Biology by Friefedler.

BIO – 235 : PLANT METABOLIC PATHWAYS 2+1

Theory:

Introduction to metabolism: anabolism and catabolism, metabolic compartments, thermodynamics, transport systems, translocators, Carbohydrate metabolism: Photosynthesis : photosynthetic pigments in relation to their functions, photosynthetic electron transport and generation of NADPH and ATP, cyclic, non-cyclic and pseudocyclic photophosphorylation. Carbon reduction in C3 plants – reactions of Calvin cycle (reductive pentose phosphate pathway), oxidative pentose phosphate pathway, regulation of reductive and oxidative pentose phosphate pathway, photorespiration. Carbon reduction in C4 plants - leaf anatomy of C4 plants, biochemical pathway of CO2 assimilation and CAM plants, Sucrose metabolism : Transport of sugar from source to sink, phloem loading and unloading of sucrose, sucrose metabolizing enzymes, sucrose synthesis, sucrose storage and utilization, sucrose-starch inter-conversion, Starch metabolism : Starch biosynthesis, regulation and degradation Metabolism of nitrogen-amino acids and nucleotides : Pathway of nitrate assimilation, incorporation of NH3 into amino acids and proteins, biosynthesis of amino acids, sulfate assimilation, biosynthesis of nucleotides – *de novo* and salvage pathway, biological nitrogen fixation – a scheme for nitrogenase action, protection of nitrogenase against damage by oxygen in non-symbionts, role of leghemoglobin, regulation of nitrogenase activity, hydrogen evolution and uptake, energetics of N2 fixtation vis-à-vis nitrate assimilation, molecular biology of nitrogen fixation – genes involved in *Rhizobium*-legume symbioses; Protein synthesis : Major components of protein synthesizing machinery, steps in polypeptide synthesis; Lipid metabolism : Saturated and unsaturated fatty acid biosynthesis, biosynthesis of triacylglycerols and phospholipids, catabolism of lipids – lipid degrading enzymes, fatty

acid oxidation (â, á, ù); Catabolism : Glycolysis, gluconeogenesis, citric acid cycle, electron transport chain and oxidative phosphorylation, interrelationships of metabolic pathways; Biochemistry of seed germination and development; biochemistry of fruit ripening.

Practicals:

1. Isolation of cell organelles-mitochondria and chloroplasts.
2. Estimation of chlorophyll
3. Measurement of Hill reaction
4. Assay of mitochondrial enzyme, succinate dehydrogenase
5. Determination of activities of enzymes of nitrate assimilatory pathway: nitrate reductase, nitrite reductase
6. Assay of ammonia incorporating enzymes GS and GOGAT.
7. Assay of lipooxygenase / phospholipase C activity.
8. Assay of sucrose synthase/ invertase activity.
9. Assays of a-amylase and polygalacturonase.

Reference books:

1. Buchanan, B.B., Gruissem, W. and Jones, R.L. (Eds.). 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Rockville, Maryland, USA.
2. Metzler, D.E. 2001. Biochemistry, Vol. II : The Chemical Reactions of Living Cells, 2nd edn. Harcourt Academic Press, London and New York.
3. Stryer, L. 1995. Biochemistry, 4th edn.W.H. Freeman and Company, New York.
4. Stumpf, P.K. and Conn, E.E. (Eds.). The Biochemistry of Plants : A Comprehensive Treatise, Vol. I, II, III, IV & V. Academic Press, London.
5. Voet, D., Voet, J.G. and Pratt, C.W. 1999. Fundamentals of Biochemistry, John Wiley and Sons Inc., New York and Toranto.
6. Mehta, S.L., Lodha, M.L. and Sane, P.V. (Eds.) 1993. Recent Advances in Plant Biochemistry, Publication and Information Division, ICAR, Krishi Anusandhan Bhavan, Pusa, New Delhi.

BIO – 236 : ELEMENTS OF IMMUNOLOGY 1+1

Theory:

Introduction to immunology. Immune systems-overview, immunity with historical perspective. Molecular and cellular basis of immune system, self verses non-self recognition; antigen – antibody and their structure, and function. Concepts of Ag-Ab reactions. Immunoglobulins - structure, biological characters and functions, isotypes, structure and function. Theories of antibody synthesis, complement system and their reactions. Organisms and cells involved in immunity. The humoral immune response; antibodies-structure, diversity of function and mechanism of action. The cell mediated immune response; recognition of antigen by T cells; antigen precipitation; the major histocompatibility proteins; the role of cytokinins and the regulation of immune responses, hypersensitivity reactions. Lymphocytes. Differentiation of stem cells and generation of lymphocytes, mechanisms. Lymphocyte traffic, effector mechanisms in immune response, immunity to infectious diseases, vaccines. generation of monospecific antibodies : hybridoma technology.

Practicals :

1. Detection of albumins by double immunodifusion (DID) method
2. Detection and quantification of antigen using indirect ELISA
3. Detection of antigens by dot immunoblot binding assay (DIBA)
4. Immuno detection of antigens by immunofluroscent assay
5. Protein blotting (Western blotting) or immunoblots.

Reference Books :

1. Text Book of Biochemistry and Human Biology by Talwar, G.P.1980. Prentice Hall of India, New Delhi.
2. Elements of Biotechnology by Gupta, P.K. 2000. Rastogi Publications, Meerut, India.
3. Cell Biology : Fundamentals and Applications by Gupta, M.L. and M.L. Jangir, 2002 Agribios ,Jodhapur, India..
4. Pelczer & Krieg, 1986, Microbiolgoy, McGrawHill.
5. Stanier, 1986, GeneralMicrobiology, McMillan Publishing Co.
6. William, E. Paul (1989) Fundamental Immunology, 2nd Edition Raven Press,

New York.

7. Molecular cloning by Sambrook

8. Kubey- Fundamentals of Immunology

9. Roit- Elements of Immunology.

BIO – 247 : TECHNIQUES IN BIOCHEMISTRY AND MOLECULAR BIOLOGY

2+2

Theory :

General principles of biochemical investigations. Units in biochemistry and molecular biology. Principle methods of separation of biomolecules. Centrifugation techniques – Basic principles, analytical and preparative centrifugation, their applications. Spectrophotometry : UV-visible spectrophotometer, fluorimetry. Chromatographic techniques – Basic principles, types, adsorption, partition, ion exchange, molecular sieve, affinity, GLC and HPLC and mass spectrometry, flow cytometry and its application in DNA estimation. Electrophoresis : theory and different types – PAGE, SDS-PAGE, capillary electrophoresis, and IEF. Radioisotope techniques : Nature, detection and measurement of radioactivity. Molecular biology techniques – Southern hybridization, northern hybridization, western blotting, microarray technology, complementation techniques; Polymerase chain reaction (PCR); radioactive / non radioactive lableling, RFLP, AFLP, RAPD; RT-PCR and DNA sequencing.

Practicals :

1. Extraction of proteins from seeds of cereal, legume, oilseed plantmaterial and calli.
2. Concentration of the proteins using ammonium sulfate precipitation, dry sephadex, dialysis, ultra filtration, and organic polymers.
3. Separation of the proteins by native – and SDS - PAGE
4. Separation and identification of amino acids by paper chromatography.
5. Isolation of messenger RNA by affinity chromatography.
6. Restriction digestion of DNA.
7. Agarose gel electrophoresis of DNA.
8. Non-radioactive randomlabeling of probe with DIG-dUTP system
9. Detection of restricted DNA fragment by Southern hybridization.
10. Amplification of plant/bacterial DNA by polymerase chain reaction.

11. Separation of sugars by TLC.

Reference Books:

1. Techniques in Molecular Biology by Walker J..M. and W. Gaastra. 1983. Croom Helm, London.
2. A biologist's Guide to Principles and Techniques of Practical Biochemistry by Wilson K. and K.H. Goulding. 1992. 3rd edition, Cambridge University Press, Cambridge.
3. Standard methods of biochemical analysis. 1999. By Thimmaiah, S. R. Kalyani Publishers, Ludhiana
4. Methods in plant biochemistry and molecular biology. 1997. By Dashek,W. V.CRC Press, Boca Raton, New York
5. Practical biochemistry – Principles and Techniques 2005. By Wilson, K. and Walker, J. Cambridge University Press, UK.
6. Rob Reed, David Holmes, Jonthan., Practical Skills in Bimolecular Sciences., Weyers and Allan Jones. AddisonWesley Longman Ltd. 1998.
7. Williams and Fleming, 1980. Spectroscopic Methods in Organic Chemistry.
8. Walker, 1987. Techniques in Molecular Biology.
9. Hamilton and Sewell, 1982. Introduction to HPLC.
10. Ausubel, 1995. Short protocols in molecular biology.
11. Shlein, B. (ed.) (1987). Radiation safety manual for users of radioisotope in Research and Academic Institutions. Nucleon Lactern Associates. Olney,Md.
12. Palumbi, S.R., The Polymerase Chain Reaction Nuclear Acids II : In Molecular Systematics (Iind Edn.) 1996. Edtd by D. Hillis, C.Moritz and B.Mable. Sinauer Assoc., Inc., USA.

BIO – 358 : RECOMBINANT DNA TECHNOLOGY 2+1

Theory:

Recombinant DNA : Definition, recombinant DNA and evolution, Host controlled restriction modification system; The range of manipulative enzymes – nucleases, ligases, polymerases, modifying enzymes, topoisomerases, restriction endonucleases - Types of restriction enzymes, characteristics of RE II, nomenclature, restriction sites, unit of restriction enzymes, cleavage pattern, restriction mapping, linkers, adaptors, homopolymer tailing, Vectors : Definition , properties of the good vectors, plasmid – pBR322 and pUC

vector properties and physical maps. Bacteriophage vectors – lambda phage vector, M13 vectors, insertion vectors, replacement vectors, cosmids, phasmid, YAC, BAC, and MAC; Introduction of the vector into suitable host : Properties of good host, preparation of competent cells, transformation, transfection and *in vitro* packaging; Selection of recombinant clones : Selection of clones containing recombinant vectors. Reporter genes, elimination of non-transformed cells,

identification of clones having recombinant vectors; selection of clones having specific DNA insert – colony hybridization, hybrid arrested translation, nucleic acid hybridization, complementation, unique gene products, immunochemical methods – antibodies specific to the protein product, colony/plaque screening with antibodies; Gene library : Construction cDNA library and genomic library, screening of gene libraries – screening by DNA hybridization, immunological assay and protein activity, methods of labeling nucleic acids and probes- nick translation, primer extension method, methods based on RNA polymerases;Important genome sequencing projects of plants. Applications of recombinant DNA technology in crop improvement.

Practicals:

1. Isolation, propagation and storage of bacterial (*E. coli*) strain.
2. Methods for long and short term storage (conservation) of microorganisms.
3. Isolation of plasmid DNA from*Escherichia coli*
4. Digestion of plasmid DNA with restriction endonucleases and separation of products in agarose gel.
5. Preparation of restriction maps.
6. Ligation of plasmid DNA with ë DNA restriction fragments
7. Electrophoresis of the ligated samples
8. Preparation of competent cells of *Escherichia coli* by CaCl2 method
9. Transformation of plasmid and recombinant DNA into *Escherichia coli*
10. Selection of recombinants and calculation of transformation rate.

Reference books:

1. Recombinant DNA by Watson, J. D., Gilman, M., Witkowski, J. and Zoller, M. 1992, Second Edition,W. H. Freeman and Company, New York.
2. Biotechnology by Singh, B. D. Kalyani Publishing Co., New Delhi.
3. Gene cloning and DNA analysis : an introduction by Brown, T. A. 2001, 4th

edition, Blackwell Sci. Ltd., Blackwell Pub. Co., USA.

4. Methods in biotechnology by Schmauder, H. P., Schweizer, M. and Schweizer, L. M. 2005. Replica Press Pvt. Ltd. Kundl

5. Principles of gene manipulation : An introduction to genetic engineering by Old, R. W. and Primose, S. B. 1989. Blackwell Scientific Publication, London

6. Molecular Biotechnology. Glick, B.R. and Pasternak, J.J. 2003. ASM Press, USA.

7. DNA cloning 1 and 2. Glover, D.M. and Hames, B.D. 1995. IRL Press (Oxford University Press, USA).

8. Molecular Cloning, A laboratory Manual. Sambrook, J., Fritsch, E.F., Mariatis.3rd edition. 2001. Cold Spring Harbor Laboratory, USA.

9. Molecular Biology of the Cell (4th edition). Alberts, Johnson, Lewis, Raff, Roberts and Walter.

10. Molecular Cell Biology (5th edition). Lodish, Berk, Matsudaira, Kaiser, Krieger, Scott, Zipersky and Darnell.

11. Lehninger Principles of Biochemistry (4th edition). Nelson and Cox.

BIO – 369: MOLECULAR PLANT VIROLOGY 2+1

Theory :

Historical developments of virology. General classification, purification, structure and replication of plant viruses. Transmission of virus, virus-vector relationship and virus assaying. Translocation of viruses in plants, physiology of virus-infected plants, chemical composition and nature of viruses, methods of virus detection and identification. methods of virus disease management. Virus resistance:- coat protein genes , movement protein genes, replicase, RNA polymerase genes. Antisense and hairpin loop based on small interfering RNA.

Practicals:

Symptom studies, virus transmission – mechanical, grafting and insect transmission. Microscopy. Purification of plant viruses, serology, ELISA and molecular detection. Viral DNA isolation and detection by electrophoresis.

Reference books:

1. The Molecular Biology of Viruses by Coher, J.S. and W. Paranchych. 1967.

Academic press, NewYork.

2. The Biology of Large RNA Viruses by Barry, R. D. and B.W.J Mahy. 1970. Academic Press, London.

3. Virology: Principles and Applications by Carter & Saunders,2007, J .Willey.

A. Cafeteria courses for Department of Biochemistry & Molecular Biology

BIO – 4710 ADVANCES IN RECOMBINANT TECHNOLOGY 1+3

Theory :

Introduction to genetic engineering and cloning, Restriction enzymes in cloning. Restriction endonucleases, types, properties and nomenclature, DNA ligase and cofactors. Techniques in recombinant DNA technology, shot gun methods, Instrumentation ,PCR, UV transilluminator. Gel electrophoresis (PAGE,SDS-PAGE) Southern, Nothern and Western blotting. Dot and slot blots. Cloning vectors- plasmid: pBR322, Ti and cosmid, viruses: CMV. Bacteriophages.

Isolation, sequencing and synthesis of gene. Isolation of gene of interest, fragmentation, reverse transcription method. Sequencing-sequencing of gene, (Maxam Gilbert & Sanger's Dideoxy method) synthesis of gene. Oregano-chemical synthesis of RNA, precursor of RNA and interferon gene selection, screening and analysis of recombinants, Use of selectable and scorable reporter gene, expression of cloned gene. Application of recombinant DNA technology. Transgenic cops – resistance to herbicides, insecticides, viruses and pathogens, nif gene

Practicals:

1. Isolation of genomic DNA/ RNA (plant)
2. Isolation of DNA from plasmid/bacteria/yeast/ blood
3. Restriction enzyme digestion
4. Ligation of DNA fragmentAgarose gel electrophoresis of DNA
5. Quantification of DNA and RNA
6. Conjugation & Transformation
7. Maintenance of culturesPreparation of competent cells

References :

1. An introduction to genetic engineering (II Edition) by Desmond S.T.Nicholl (studies in Biology series) I South Asian Edition 2002, Cambridge University Press.
2. DNA technology, the Awesome skill II edition by Alcamo, I.E.(2000) Harcourt/ Academic Press.
3. Genomes, Brown, T.A. (1999), Bios Scientific Publishers, Oxford.
4. Cell and Molecular Biology, II Edition by Gupta. P.K. , Rastogi Publication.

BIO – 4711 : SECONDARY METABOLITES OF COMMERCIAL IMPORTANCE

1+3

Theory :

Introduction to secondary metabolites like phenols, tannins, quinolic compounds flavonides and all these are including pathways involve in plant metabolism.

Pigments : Like carotenoids, terpenoids, lycopene, chlorophyll, Curccumine, anthocynine their importance, uses, their role in plant metabolism. Plant acids : Details of oxalic acid, their role in metabolism use and function. Alkaloids : Details of alkaloids their role, uses in relation to plant metabolism.

Practicals :

1. Estimation of total phenols
2. Separation and detection of phenol by paper chromatography
3. Estimation of tannins, flavonoids, lignins, terpenoids.
4. Estimation of chlorophyll
5. Separation of different pigments by paper or thin layer chromatography
6. Estimation of oxalic acid

References :

1. A. Mahadvan and R. Sirdhar (1986) Methods in physiological plant pathology 3rd Ediction.
2. S. Sadasivam and A. Manikam (1992), Biochemical methods for Agricultural Sciences. Wiley Eastern Ltd. New Delhi.
3. Hand book of phytological methods, Cambridge Uni. Press, London.

4. BIO- 4712 Immunological Techniques and Its Applications 1+3

Theory :

Introduction to immunology, innate immunity, acquired immunity, immune response, Antigen and antibodies ; structural organization and their properties, receptors for antigen. Immunological methods and applications, detection and quantification of antigen by antibody. Immunodetection of antigen in cell and tissues. The primary interaction with antigen. Identifying B-cells epitopes on a protein . Specificity and cross reactivity of antibodies. The major Histocompatibility complex (MHC) , and their classes I and II (MHC), control mechanism. T-cell regulation, Activation induced cell death, apoptosis. Effect of diet, exercise, trauma and age on immunity.Vaccines: Passive acquired immunity, Vaccination, vaccines against parasitic disease, bioterrorism, immunization against cancer. Immunodeficiency: Primary and secondary immunodeficiency syndrome (AIDS) ELISA :The scope of autoimmune diseases, T-helper cells, diagnostic value of autoantibody tests, Treatment of autoimmune disorders.

Practicals:

1. To study the structure and function of the immunoglobulin classes.
2. Immunodiffussion
3. To study the major histocompatibility complex
4. ELISA
5. To study the antigen-antibody reactions
6. Purification of antigen and antibodies by affinity chromatography
7. Immunofluorecence microscopy
8. Radioimmunoassay (RIA)
9. Immunocytochemical Techniques
10. Agglutination reacton, precipitation reaction, CFT, Serum-blood separation
11. Molecular basis of immune responses.

References :

1. Roitts Essential of immunology, XIth Edition, Peter J.Delves, Seamus J.Martin, Dennis R. Burton and Iran M.Roitt.
2. Kubys Essential of immunology, Ist Edition. Kuby.

BIO – 4713 PROTEINS AND PROTEOMICS 1+3

Theory:

Introduction. Proteomics and functional genomics; Protein structure, functions and properties; protein synthesis; Protein separation techniques; Protein interactions. Protein Identification and Analysis, Protein preparation and separation; Two-dimensional gel electrophoresis, Limitations of two-dimensional gel electrophoresis, Protein fractionation prior to electrophoresis, Protein Digestion Techniques, Mass Spectrometers for Protein and Peptide Analysis, Protein Identification by Peptide Mass Fingerprinting, Protein identification by mass spectrometry; Basics of mass spectrometry analysis, Ionization of biological macromolecules Tandem mass spectrometry, Peptide Sequence Analysis by Tandem Mass Spectrometry, Protein Identification with Tandem Mass Spectrometry Data, Multidimensional liquid chromatography and tandem mass spectrometry Identification of post-translational modifications; Identification of phosphorylated Proteins, Protein chips, arrays and functional proteomics : Different types of protein chips; Antibody arrays, Antigen arrays, Broad-specificity capture chips, Functional protein chips, Manufacture of protein chips, Detecting and quantifying proteins bound to protein chips, Emerging protein chip technologies; Bead and particle arrays in solution, Cell and tissue arrays Applications of proteomics : Proteomics and plant biotechnology; Proteomics in plant breeding and genetics, Proteomics for the analysis of genetically modified plants, Proteomics and the analysis of secondary metabolism.

Practical:

1. Protein isolation & purification by different techniques
2. SDS-PAGE analysis two dimensional gel electrophoresis.
3. Western Blotting. Capillary blotting and electrophoretic blotting.
4. Protein identification by mass spectrometry.
5. Protein analysis by liquid chromatography.
6. Protein analysis by gas chromatography.
7. Protein motif sequence analysis.

References:

1. Introduction to Proteomics: Tools for the New Biology, By Daniel C. Liebler, Humana Press Inc. Totowa, New Jersey, 2002.

2. PROTEOMICS by Timothy Palzkill, Kluwer Academic Publisher, New York, 2002.
3. Principles of Proteomics: Advanced Text, by Twyman, Richard M**.,** Garland. Science/BIOS Scientific Publishers, 2004.
4. Protein Arrays, Biochips, and Proteomics: The Next Phase of Genomic Discovery by Joanna S. Albala and Ian Humpheiy-Smith, by Marcel Dekker, Inc., New York, 2003.

BIO – 4714 : ENZYME TECHNOLOGY 1+3

Theory:

Large scale production and purification of enzymes Production of enzymes on an industrial scale, Large scale purification of enzymes, Synthesis of artificial enzymes, Immobilized enzymes: Preparation of immobilized enzymes, properties, application, enzyme utilization in industry, application in food drink and other industries, use of microorganisms in brewing and cheese making, use of microorganisms in organic chemicals, use of isolated enzymes in industrial processes, clinical aspects of Enzymology, introduction to enzyme inhibitors and drug design, enzyme therapy, Indigenous enzymes of Bovine Milk: lipases, proteinases and phosphatases, exogenous enzymes used in dairy industry.

Practicals:

1. Enzyme assays, measurement of catalytic activity of enzymes.
2. Purification of enzyme by different methods like Dialysis, Ammo. sulphate precipitation, Gel filtration, and ion exchange chromatography etc.
3. Preparation of Immobilized enzyme.
4. Use of immobilized enzyme for production of HFCS.
5. Use of immobilized yeast for production of alcohol.
6. Production of enzymes using various microorganisms.
7. Production of taq. Polymerase using microorganism on laboratory scale.

Reference Books:

1. Advances in Enzymology, Vol. 1-10 Nord, F.F. (ed.) 1941-50. Interscience Publisher, New York.
2. Principles of Enzymology for the Food Sciences by Whitaker, J.R. 1972. Marcel Dekker, New York.

3. Enzymes in Food Processing by G. Reed 1975. Academic Press, London.

4. Industrial Enzymology by Godfry, T. and J.R. Relchelt, (2nd edn.) 1997. MacMillan Publishing Co., London.

5. Fundamentals of Enzymology by Price N.L. and L. Stevens. 1993. Oxford Scientific, Oxford.

6. Biochemistry by Stryer, L. 1994. Fourth Edition W.H. Freeman and Company New York.

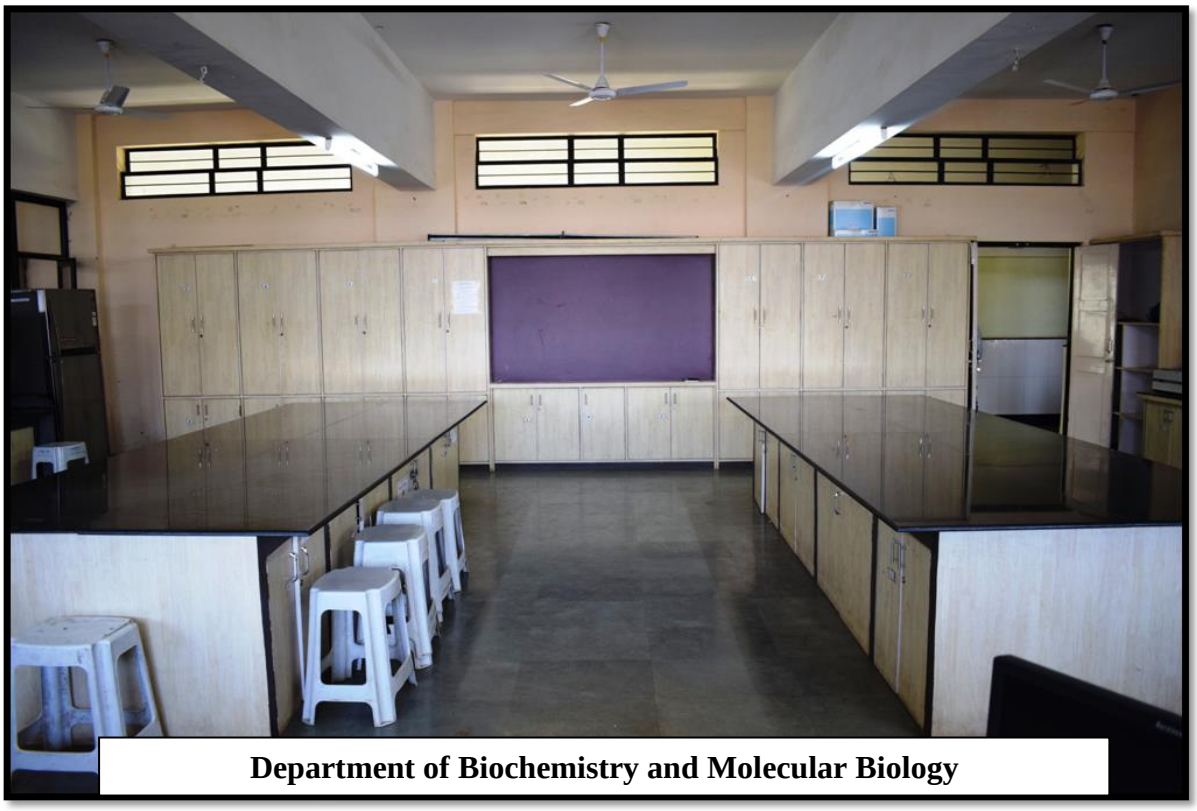
7. Food Biotechnology by K. Shetty CRC publication.

5. Events/ Activities

- Workshop conducted on Techniques in Production of Secondary Metabolites (BIO-4711) dated 12 / 09 / 2017

- Workshop conducted on Elements of Immunology (BIO-236) dated 09 / 10 / 2017 to 10 / 10 / 2017

6. Photo Gallery



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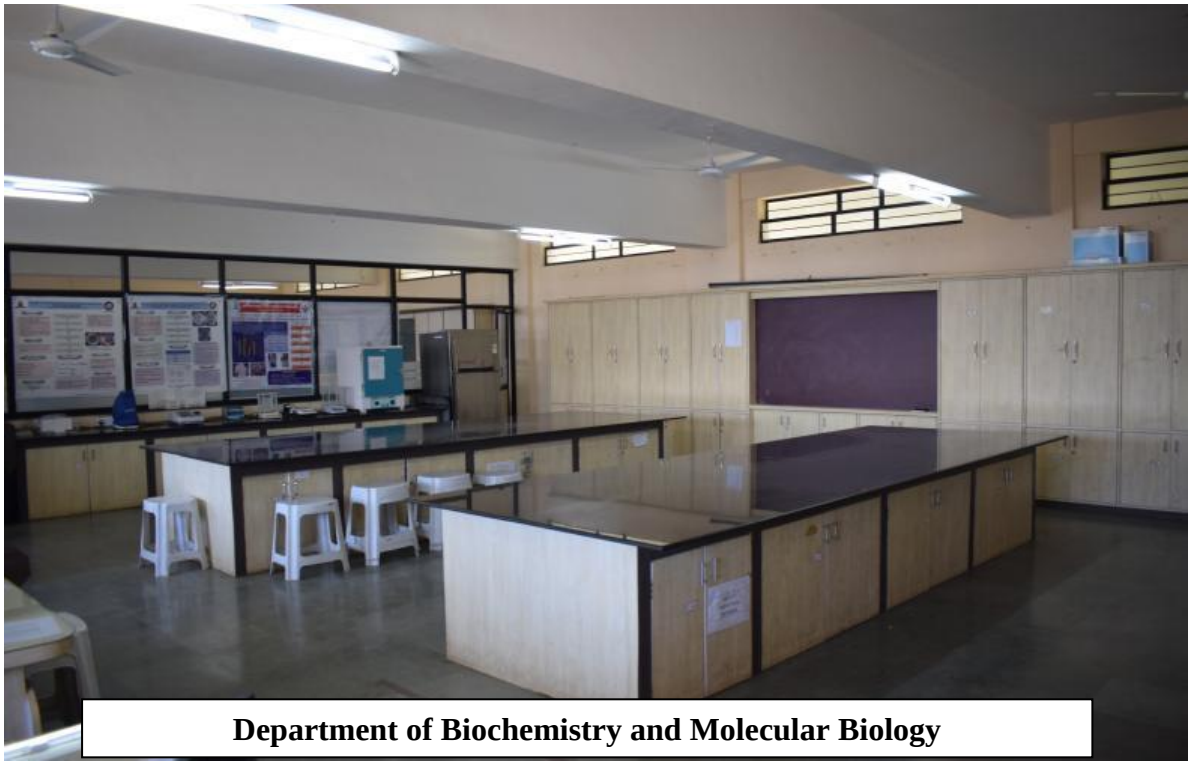

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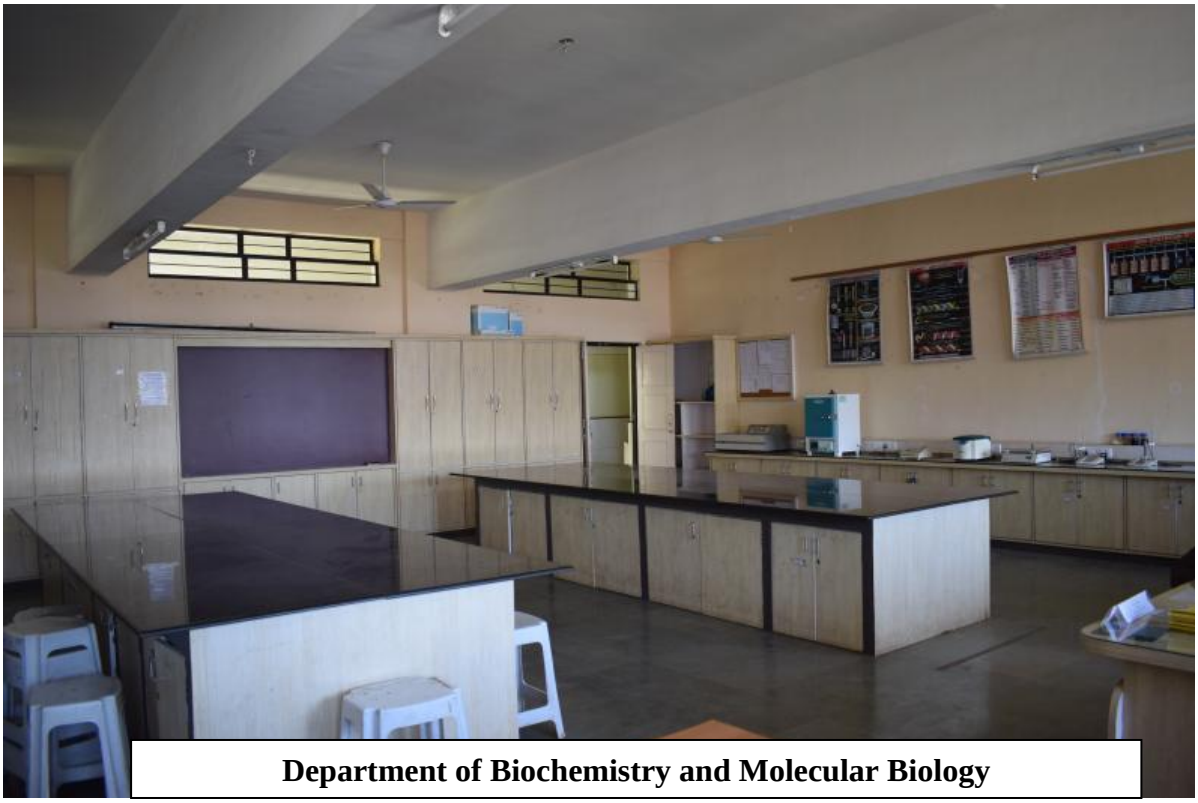

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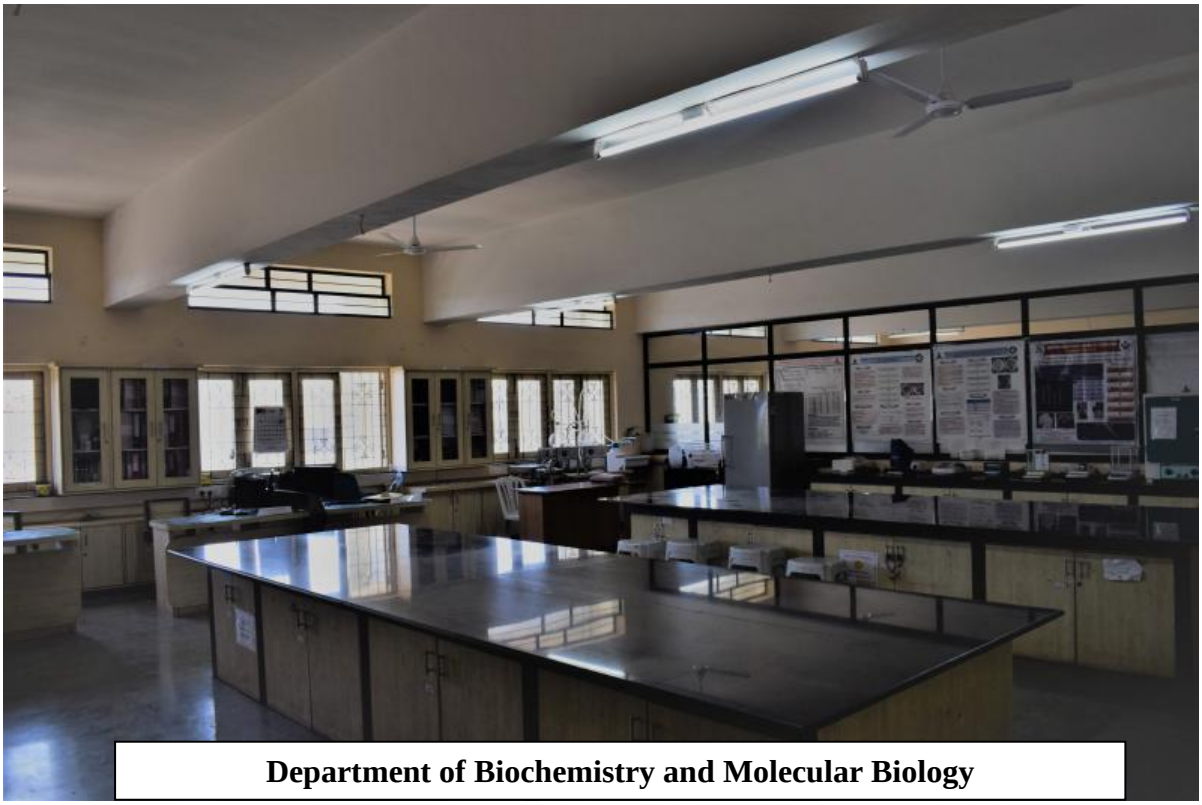

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