

**Paper Code: PB-101 (Compulsory)**

**Paper Title: Techniques in Biochemistry and Biotechnology**

**(All faculty members)**

**Unit I**

Nucleic acid isolation and fractionation. DNA fingerprinting. Separation techniques for nucleic acids (agarose electrophoresis, Polyacrylamide gel electrophoresis, pulse field gel electrophoresis), Nucleic acid blotting methods

Gene cloning and its applications, Polymerase chain reaction(PCR) and real time polymerase chain reaction(RT-PCR), comet assay, DNA microarray

**Unit II**

Separation techniques for proteins (2D gel electrophoresis, isoelectric focusing), chromatography (ion exchange, gel filtration, High pressure liquid chromatography (HPLC), gas liquid chromatography (GLC)

Matrix assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF MS), Flow cytometry

Immunological techniques, Enzyme linked immunosorbent assay (ELISA), Radioimmunoassay (RIA), Immunoblotting

**Unit III**

Centrifugation techniques, Density gradient centrifugation

Absorption and fluorescence spectrophotometry, circular dichroism (CD) and optical rotatory dispersion (ORD) and their applications

**Unit IV**

Designing and methodology of experiment, sample and sampling, collection of data, presentation of data, interpretation and analysis of data (ANOVA, chi-square test, t-test etc.)

Introduction to Bioinformatics, Different types of databases, Mining tools (BLAST, ProSite), PubMed, Medline, Introduction to MS Office, Internet

Introduction to intellectual property rights (IPR), types of IPR, Filing and processing of patent applications



**Paper Code: PB-102A (Optional)**

**Paper Title: Gene Technology**

**(Prof. U.N. Dwivedi)**

**Unit I**

Transgenic technology with special reference to the lignin biosynthesis pathway engineering

**Unit II**

Gene cloning, expression and purification of recombinant proteins. Gene expressional analyses.

**Unit III**

In-silico sequence analyses. Comparative genomics and proteomics approaches for unique drug target identification. Rational drug designing using molecular modeling, QSAR approaches etc with special reference to plant derived secondary metabolites.

**Unit IV**

Purification, characterization and immobilization of industrially important enzymes such as peroxidases, laccases etc.



Paper Code: PB-102B (Optional)

Paper Title: Protein Chemistry & Enzymology

(Prof. S.K. Agarwal)

#### Unit I

Research Methodology: Identifying research problems, literature search, objective and experimental design, presentation of scientific data/findings.

#### Unit II

Isolation and purification of enzymes/proteins: Fractional precipitation by change of pH/heating/organic solvents/salts and fractional adsorption by polar and non-polar adsorbents; separation of proteins/enzymes on the basis of size, charge, affinity and pH gradient; crystallization, concentration and homogeneity of enzymes/proteins. Intracellular localization of enzymes – histochemical methods and differential centrifugation

#### Unit III

Strategies of sequence determination: Amino acid composition, determination of N- and C-terminal residues, chemical and enzymatic degradation of polypeptide, chemical synthesis of peptide, peptide mapping, forces stabilizing the structure of proteins/enzymes, denaturation and renaturation of proteins, domain structure, protein folding and protein-protein interaction.

#### Unit IV

Characterization of enzymes/proteins: Determination of molecular weight, number of free-SH groups, subunit structure, carbohydrate content, spectral and hydrodynamic properties, dependence and stability on physiological parameters, chemical modifications, specificity and kinetic properties.



**Paper Code: PB-102C (Optional)**

**Paper Title: Higher plant photosynthesis under abiotic stress**

**(Prof. R.K. Mishra)**

**Unit I**

Introduction to photosynthesis in higher plants. Current understanding of organization of the photosynthetic apparatus. Light reactions, dark reactions, water oxidation and photophosphorylation

**Unit II**

Structure and functions of the photosynthetic apparatus of higher plants with special reference to the photosystem II complex. Measurement of photosynthetic activity

**Unit III**

Higher plant photosynthesis under abiotic stress including high temperature, strong light, draught, salinity. Stress tolerance, Plant defense mechanisms. Assessment and characterization of damage to the photosynthetic apparatus

**Unit IV**

Strategies for improvement of photosynthetic performance under abiotic stress



**Paper Code: PB-102D (Optional)**

**Paper Title: Diseases and Drug Development**

**(Prof. Deepak Chandra)**

**Unit I**

Introduction to infectious/ parasitic diseases and metabolic disorders with special reference to diabetes. Cellular and animal models to study diabetes and other diseases.

**Unit II**

Primary complications of diabetes: effect on carbohydrate, protein, lipid and other metabolic pathways. Cellular and molecular mechanisms of insulin action.

**Unit III**

Secondary complications of diabetes: retinopathy, neuropathy, nephropathy and cardiovascular disorders.

**Unit IV**

Treatment/management of diabetes, existing drugs and their mode of action. Strategies to develop newer compounds/drugs for management of diabetes. Recent development in the area of translational medicine and development of synthetic drug molecules against diabetes.



Paper Code: PB-102E (Optional)

Paper Title: Harmful Effects of Pollutants and Toxicants on the Environment

(Prof. Sudhir Mehrotra)

**Unit I**

**Air Pollution:** Particulate and non-particulate air pollutants, smog, outdoor and indoor air pollution, acid rain, harmful effects of air pollution on humans, plants and animals, Remedial measures.

**Unit II**

**Water Pollution:** Sources of water Pollution, BOD, COD, types of water pollution, waste water treatment.

**Unit III**

**Xenobiotic biotransformation:** Phase I and Phase II reactions, Cytochrome P-450.

**Unit IV**

Acute, subacute and chronic toxicity. Toxic effects of heavy metals such as lead, including its neurotoxicity, epigenetics, stress and memory modulation.



**Paper Code: PB-102F (Optional)**

**Paper Title: Plant Biochemistry-Redox Biology**

**(Dr. Samir Sharma)**

**Unit I**

**Respiratory pathways in plants**

Respiratory pathways exclusive to plants. Alternative respiratory pathways. Interaction of light regimes with plant respiration. Organization of plant respiratory OXPHOS complexes and their interaction with TCA cycle enzymes. Plant NADH dehydrogenases and their role in energy dissipation.

**Unit II**

**Reactive oxygen and reactive nitrogen in plants**

Introduction to reactive oxygen and reactive nitrogen species. Basis of reactivity and nature of oxidative and nitrosative stress. Sites of generation conditions promoting ROS/RNS production. Methods of detection and markers of oxidative and nitrosative stress.

**Unit III**

**Maintenance of cellular redox status**

ROS and RNS scavenging mechanisms. Enzymatic and non-enzymatic systems of dealing with oxidative stress. Redox poise and its regulation. Cellular redox buffers, with main accent on Glutathione redox couple and interacting systems.

**Unit IV**

**Redox sensing and coordination of plant metabolism**

ROS and RNS as signaling systems. Interaction of  $\text{Ca}^{2+}$  signaling with ROS and RNS. Protein modifications as sensors of redox/RNS based signaling. Alteration of transcriptional state by redox and nitrosative stress.



**Paper Code: PB-102G (Optional)**

**Paper Title: Understanding Cancer: From basic science to clinical practice  
(Dr. Minal Garg)**

**Unit I**

Introduction to cancer.

Causes of cancer: Age distribution; Environment; Initiators and Promoters

**Unit II**

Genetic basis of cancer: Oncogenes and tumor suppressor genes

Molecular mechanisms of cancer pathogenesis

**Unit III**

Tumor classification

Tumor behavior: Preneoplastic conditions; Preinvasive states; Benign tumors; Malignant tumors; tumor heterogeneity

**Unit IV**

Tumor assessment: Grading and staging

Cancer treatment: Chemotherapy; Radiotherapy; new approaches to treatment





**Paper Code: PB-102H (Optional)**

**Paper Title: Plant tissue culture and DNA marker techniques**

**(Dr Kusum Yadav)**

**Unit I**

Introduction of plant tissue culture. Surface sterilization, culture media, different types of plant growth regulators. Explants used in plant tissue culture, shoot multiplication, rooting of shoots, hardening of plantlets.

**Unit II**

Genetic markers: morphological, biochemical and DNA markers. Types of DNA markers; hybridization based markers like RFLP, and PCR based markers like, RAPD, ISSR, AFLP, SSR, SNP etc. Methodology of these markers along with their merits and demerits.

**Unit III**

Analysis of RAPD, ISSR, SSR and SNP markers. Interpretation of markers on gels and its conversion to binary data. Tools and techniques used for mining of EST based markers. Designing of primers for application of markers in plant biotechnology.

**Unit IV**

Application of DNA markers in genetic diversity analysis of plants. Introduction and application of statistical tools used for diversity analysis. Identification of markers linked to important traits.

