

Course Contents

ABC 501 BASIC BIOCHEMISTRY 3+1

Theory

Scope and importance of biochemistry in agriculture; Fundamental principles governing life; structure of water; acid base concept and buffers; pH; hydrogen bonding; hydrophobic, electrostatic and Van der Waals forces.

Classification, structure and function of carbohydrates, lipids and biomembranes, amino acids, proteins, and nucleic acids.

Structure and biological functions of vitamins & Plant Hormones, Bioenergetics.

Practical

Preparation of standard and buffer solutions, Extraction and estimation of sugars, Amino acids, Estimation of Proteins by Lowry's method, Estimation of DNA and RNA by diphenylamine and orcinol methods, Estimation of Ascorbic acid, Separation of biomolecules by TLC and Paper chromatography.

ABC 502 ENZYMOLOGY 3+1

Theory

Introduction and historic perspective, Enzyme nomenclature and classification, measurement of enzyme activity. Ribozymes isozymes & zymogens.

Enzyme structure, enzyme specificity, active site, mechanism of enzyme catalysis. cofactors, coenzymes - their structure and role.

Enzyme kinetics, enzyme inhibition and activation, multienzyme complexes, allosteric enzymes and their kinetics, regulation of enzyme activity.

Isolation and purification of enzymes, enzyme immobilization.

Practical

Enzyme assay by taking any model enzyme like alpha-amylase or acid phosphatase, study of the effect of enzyme and substrate concentrations and determination of K_m and V_{max} , determination of pH and temperature optima and effect of various inhibitors, determination of the pH and temperature stability of enzyme.

ABC 503 FOOD AND NUTRITIONAL BIOCHEMISTRY 3+1

Theory

Fundamentals of human nutrition, concept of balanced diet, biochemical composition, energy and food value of various food grains (including cereals, pulses, oilseeds), fruits and vegetables. Physico-chemical, functional and nutritional characteristics of carbohydrates, proteins and fats and their interactions (emulsions, gelation, browning etc.).

Biochemical and nutritional aspects of vitamins, minerals, Nutraceuticals, antinutritional factors.

Effect of cooking, processing and preservation of different food products on nutrients, biochemical aspects of food spoilage, role of lipase and lipoxygenase, oxidative rancidity and antioxidants.

Enzymes in food industry, food additives (coloring agents, preservatives etc.), nutritional quality of plant, dairy, poultry and marine products.

Practical

Estimation of starch, lipid/oil, phenols in plant tissue/sample, Estimation of carotenoids, Estimation of Trypsin and chymotrypsin inhibitor activities in seeds, Estimation of Vitamin C in fruits, Reducing & non reducing sugar in fruits, Estimation of protein contents, Determination of limiting amino acids, Estimation of Phytate/Oxalate.

ABC 551 MOLECULAR BIOLOGY 3+1

Theory

Historical development of molecular biology, nucleic acids as genetic material, chemistry and structure of DNA and RNA, Genome organization in prokaryotes and eukaryotes, chromatin structure and function.

DNA replication, DNA polymerases, topoisomerases, DNA ligase, reverse transcriptase, repetitive and non-repetitive DNA, satellite DNA; transcription process, RNA editing, RNA processing.

Ribosomes structure and function, organization of ribosomal proteins and RNA genes, genetic code, aminoacyl tRNA synthetases, inhibitors of replication, transcription and translation; translation and Post translational modification; nucleases and restriction enzymes, regulation of gene expression in prokaryotes and eukaryotes, molecular mechanism of mutation.

Practical

Isolation and purification of DNA and RNA from different sources, check of purity of isolated DNA and RNA, restriction fragmentation and separation of oligos by agarose electrophoresis, RAPD analysis of DNA, cDNA synthesis using PCR, Southern and Northern blotting experiments

ABC 552 TECHNIQUES IN BIOCHEMISTRY I (THEORETICAL ASPECTS) 2+0

Theory

Chromatographic and electrophoretic methods of separation, Principles and applications of Paper, Thin layer & HPTLC, Gas-liquid & Liquid chromatography, HPLC; gel electrophoresis, Different variants of polyacrylamide gel electrophoresis (PAGE) like native and SDS-PAGE, 2D-PAGE, capillary electrophoresis.

Spectrophotometry: Principles and applications UV-Visible, Fluorescence, IR, NMR and FTNMR, ESR and X-Ray spectroscopy.

Tracer techniques in biology: Concept of radioactivity, concept of α , β and γ emitters, scintillation counters, γ -ray spectrometers, autoradiography, applications of radioactive tracers in biology.

ABC 553 PLANT BIOCHEMISTRY I 3+0

Theory

Scope and importance of biochemistry in Agriculture, Plant cell organelles and their separation, structure and function of cell organelle. Photosynthetic pigments in relation to their functions, photosynthesis, C_3 , C_4 and CAM pathways, photorespiration.

Sucrose-starch interconversion..

Biochemistry of seed germination and development, Biochemistry of fruit ripening, phytohormones and their mode of action.

ABC 601 INTERMEDIARY METABOLISM 3+0

Theory

The living cell: a unique chemical system, Introduction to metabolism, transport mechanism, bioenergetics, biological oxidation.

Catabolic and anabolic pathways of carbohydrates, lipids, and regulation. Energy transduction and oxidative phosphorylation.

General reactions of amino acid metabolism, Degradative and biosynthetic pathways of amino acids and their metabolic disorders.

Compartmentation of metabolic pathways, metabolic profiles of major organs and regulation of metabolic pathways.

ABC 602 CARBON, NITROGEN AND SULPHUR METABOLISM 3+1

Theory

Carbon metabolism: Synthesis of sucrose, Regulation of sucrose phosphate synthesis, Transport of sucrose, phloem loading and unloading, synthesis of starch in leaves and seeds, concept of transitory starch.

Synthesis of fructose, galactomannans raffinose series oligosaccharides and trehalose.

Nitrogen cycle- Biochemistry of nitrate assimilation and its regulation, GS/GOGAT and GDH pathway, ureides and amides as nitrogen transport compounds, chemoautotrophy in denitrifying bacteria.

Biological nitrogen fixation; structure function and regulation of nitrogenase; *nif* genes and their regulation; biochemical basis of legume-Rhizobium symbiosis, genes involved in synthesis. Sulphur metabolism.

Practical

Estimation of nitrite content, Estimation of protein by Lowry's method, Estimation of starch, Estimation of nitrate content by hydrazine sulphate reduction method, *in vivo* assay of nitrate reductase activity, *in vitro* assay of nitrate reductase activity, *in vitro* assay of nitrite reductase activity, *in vitro* assay of glutamine synthetase activity, *in vitro* assay of glutamate synthase and glutamate dehydrogenase activity, Estimation of ureids and amides.

ABC 701 BIOCHEMISTRY OF ABIOTIC STRESSES 2+1

Theory

Biochemical basis of abiotic stresses namely osmotic (drought, salinity), temperature, heavy metals, air and water pollutants, synthesis and functions of proline and glycine betaine in stress tolerance interaction between biotic and abiotic stresses; stress adaptation.

Reactive oxygen species and abiotic stress, antioxidants, enzymes defense system.

Practical

Measurement of lipid peroxidation and antioxidant potential under different systems of assay, assay of some antioxidative enzymes

ABC 702 PLANT BIOCHEMISTRY II 2+1

Theory

Biochemistry and significance of secondary metabolites- plant sulphur compounds including glucosinolates, cyanogenic glycosides, phenolic compounds, terpenoids, alkaloids, role of these compounds in relation to plant defense.

Practical

Estimation of Plant phenolics, alkaloids, carotenes, glucosinolates

ABC 751 BIOCHEMISTRY OF BIOTIC STRESSES 3+0

Theory

Plant-pathogen interaction and disease development; molecular mechanisms of fungal and bacterial infection in plants; changes in metabolism, cell wall composition and vascular transport in diseased plants.

Plant defence response, antimicrobial molecules; genes for resistance, hypersensitive response and cell death; systemic and acquired resistance.

Plant viruses, host-virus interactions, disease induction, virus movement, and host range determination; viroids, pathogen-derived resistance.

ABC 752 BIOMEMBRANES 2+0

Theory

Concept of biomembranes and their classification based on cellular organelles; physico-chemical properties of different biological and artificial membranes, cell surface receptors and antigen.

Membrane biogenesis and differentiation; membrane components-lipids, their distribution and organization; proteins, intrinsic and extrinsic, their arrangement; carbohydrates in membranes and their function.

Various membrane movements; transport across membrane and energy transduction.

Role of membrane in cellular metabolism, cell recognition and cell –to –cell interaction; signal transduction, recent trends and tools in membrane research.

List of Journals

- Annual Review of Biochemistry
- Annual Review of Genetics
- Annual Review of Plant Physiology and Plant Molecular Biology
- Biochemical and Biophysical Research Communication
- Biochemical Journal
- Biochim. Biophysic Acta
- Cell
- Current Science
- Federation of European Biochemical Society
- Indian Journal of Experimental Biology
- Journal of Biological Chemistry
- Journal of Immunology
- Journal of Molecular Modeling
- Journal of Plant Biochemistry and Biotechnology
- Nature
- Physiologia Plantarum
- Plant Physiology
- Plant Science
- Planta
- Proceedings of National Academy of Sciences, USA

- Protein Science
- RNA
- Science
- Scientific American
- Trends in Biochemical Sciences
- Trends in Biotechnology
- Trends in Plant Sciences

e-Resources

- www.unixl.com/dir/molecular_sciences/biochemistry/biochemistry_jobs/
- www.unixl.com/dir/medical_sciences/
- <http://www.ncbi.nlm.nih.gov/>
- <http://us.expasy.org>
- <http://us.expasy.org/spdbv/>
- <http://www.brenda.uni-koeln.de/>
- <http://www.worthington-biochem.com>
- <http://www.cefotaxime.net>
- <http://home.123india.com/nbsc/>
- <http://www.biochemist.org>
- <http://www.gwu.edu/~mpb>

Suggested Broad Topics for Master's and Doctoral Research

- Immobilization of industrially important enzymes
- Manipulation of metabolic pathways for reserve biosynthesis and utilization.
- Biochemistry and molecular biology of biotic and abiotic stresses in plants.
- Biochemistry of fruits and vegetables during ripening and post ripening.
- Manipulation of metabolic pathways at molecular level to increase shelf life of fruits and to increase contents of alkaloids, flavones and isoflavones, PUFA etc.
- Use of molecular markers for identification and improvement of crop plants.
- Enzyme engineering and functional genomics/proteomics.
- Biochemical and molecular evaluation of varieties for quality improvement.
- Use of biomolecules as biosensors.
- Study of metabolome and elucidation of metabolic pathway of secondary metabolites.