

**SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR**



**Programme: MSc (CBCS)
Syllabus with effective from: JUNE-2017**

BIOCHEMISTRY

M. Sc. Biochemistry				
Semester	I	II	III	IV
Core I (4 Credits)	Cell Biology and Genetics (PS01CBIC21)	Molecular Biology (PS02CBIC21)	Human Physiology (PS03CBIC21)	Animal Biotechnology (PS04CBIC21)
Core II (4 Credits)	Bioinstrumentation (PS01CBIC22)	Toxicology (PS02CBIC22)	Genetic Engineering (PS03CBIC22)	Nutritional and Clinical Biochemistry (PS04CBIC22)
Core III (4 Credits)	Cellular Metabolism (PS01CBIC23)	Fundamentals of Immunology (PS02CBIC23)	Enzymology (PS03CBIC23)	Lab I (PS04CBIC23) Practicals based on PS04CBIC21 and PS04CBIC22
Core IV (4 Credits)	Lab I (PS01CBIC24) Practicals based on PS01CBIC21 and PS01CBIC22	Lab I (PS02CBIC24) Practicals based on PS02CBIC21 and PS02CBIC22	Lab I (PS03CBIC24) Practicals based on PS03CBIC21 and PS03CBIC22	
Core V (Credits)	Lab II (PS01CBIC25) Practicals based on PS01CBIC23 and PS01EBIC2X	Lab II (PS02CBIC25) Practicals based on PS02CBIC23 and PS02EBIC2X	Lab II (PS03CBIC25) Practicals based on PS03CBIC23 and PS03EBIC2X	
Elective I (4 Credits)	Biochemistry of Horticultural commodities (PS01EBIC21)	Biostatistics (PS02EBIC21)	Advanced Immunology (PS03EBIC21)	Lab II (PS04EBIC21) Practicals based on PS04EBIC2X and PS04EBIC2X
Elective II (4credits)	Biomolecules and Bioenergetics (PS01EBIC22)	Medical Biochemistry (PS02EBIC22)	Bioinformatics (PS03EBIC22)	Dissertation (PS04EBIC22) (12 Credits)
Elective III (4 Credits)	Phytoresource Utilization and Conservation (PS01EBIC23)	Microtechniques (PS02EBIC23)	Omics and Computational Biology (PS03EBIC23)	Microbial Physiology (PS04EBIC23)
Elective IV (4 Credits)			Plant Biochemistry (PS03EBIC24)	Plant Biotechnology (PS04EBIC24)
Elective V (4 Credits)				IPR and Biosafety (PS04EBIC25)

Elective VI (4 Credits)				Pharmacognosy (PS04EBIC26)
Elective VII (4 Credits)				Endocrinology (PS04EBIC27)

PS01CBIC21: Cell Biology and Genetics

Unit I

An overview of Cells and Cell Research; Structure and Organization of pro-and eukaryotic cells. Cell membranes: molecular organization, Cell permeability - transport across membranes: facilitated diffusion, active transport and receptor mediated endocytosis.

Nucleus – Structure of the nuclear envelope, organization and regulation of nuclear pore complex. Transport across nuclear membrane, internal organization of the nucleus and nucleolus, the nucleus during mitosis.

Unit II

Chloroplast and Mitochondria: structural organization in relation to function, genome, transport of metabolites across the membranes, import and export of proteins through membrane compartments and biogenesis – Envelope, stroma and thylakoids; Molecular organization of thylakoids. Endomembrane system: endomembrane concept, membrane flow, Structural organization of ER and Golgi, targeting of proteins to ER, , insertion of proteins into ER membrane, Protein folding and exporting of proteins and lipids from ER to golgi protein sorting and export from golgi to different cellular compartments, mechanism of vesicle transport and vesicle fusion.

Unit III

Cytoskeletal elements– composition and organization of microtubules, microfilaments and intermediate filaments. Role in cell division, wall formation and transport. Cell Cycle – Phases of Cell Cycle, functional importance of each phase, Molecular events during cell cycle, Check points, Cyclins and protein kinases, MPF (maturation promoting factor), Regulation of cell cycle. Apoptotic pathway and cell death

Unit IV

Fundamentals of genetics: Mendelian analysis- Mendels laws of inheritance; Quantitative inheritance. Multiple alleles and physical basis of heredity.

Linkage and tetrad analysis: Linkage and crossing over in higher organisms; tetrad analysis; mitotic recombination and gene conversion in haploid organisms. Molecular mechanisms of recombination.

Reference Books:

1. Cell and Molecular Biology: Concepts and Experiments (1996) Gerald Karp, John Wiley & Sons, Inc.,USA.
2. Cell and Molecular Biology (1987), 8th Edn. De Robertis, E. D. P. and De Robertis, E.
3. The Cell – A Molecular Approach (Third Edition) (2004) Geoffrey M. Cooper and Robert
4. Molecular Cell Biology 3rd edn, (1995) Lodish, Baltimore, Berk, Lawrence, et al, Scientific American Books, N.Y.
5. Cell Biology: A Laboratory Handbook- Third Edition. Volumes 1 – 4 (2006), Edited by Julio E. Celis, Elsevier Academic Press, U. K. David. E. Sadava. 1993.
6. Cell Biology. Jones and Bartlett Publishers, Boston.
Genetics: P K Gupta
7. Genetics: Suzuki et al

PS01CBIC22: Bioinstrumentation

Unit I

Visualization techniques:

Principle of working and applications of bright field microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, scanning and transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy. Principle and applications of cytophotometry and flow cytometry.

Unit II

Separation techniques:

Basic principle and application of Differential, density and ultracentrifugation
Principle and applications of Native-PAGE, SDS-PAGE, Agarose and 2D gel electrophoresis. Capillary electrophoresis and its applications.
Principle, methodology and applications of gel – filtration, ion –exchange and affinity chromatography; Thin layer and High Performance Thin Layer Chromatography. Gas chromatography, High performance liquid chromatography and FPLC.

Unit III

Spectroscopy

Principle, instrumentation and applications of UV, Visible, IR (including FTIR and ATR), AAS, NMR, fluorescence and CD spectroscopy.

Unit IV

Principle and applications of tracer technique in biology:

Radioactive Isotopes and half-life of isotopes; Effect of radiation on biological system; autoradiography; cerenkov radiation; radiation dosimetry; ionization and scintillation based detection and quantification of radioactivity.

Biosensors: Principle, types and applications.

Principle of biophysical methods used for analysis of biopolymer structure: X ray diffraction and mass spectrometry.

Reference Books:

1. Instrumental method of chemical analysis: Sharma B K
2. Instrumental methods of analysis: D A Skoog
3. An introduction to practical Biochemistry: Plummer
4. Instrumentation: Chatwal and Anand
5. Modern experimental Biology: Boyer

PS01CBIC23: Cellular Metabolism

Unit I

Basic concept of metabolism, Concepts of energy transformation in metabolic reactions, Biological oxidations, free energy changes and redox potentials. The mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron Sulphur proteins, cytochromes and their characterization. The Q cycle and the stoichiometry of proton extrusion. Respiratory controls and oxidative phosphorylation. Un-couplers and inhibitors of energy transfer. ATP-synthetase complex.

Glycolysis, citric acid cycle its function in energy generation and biosynthesis of energy rich bonds, coordinated regulation of glycolysis and citric acid cycle, pentose phosphate pathway and its regulation, Gluconeogenesis, interconversions of sugars, Biosynthesis of glycogen, starch and oligosaccharides. Regulation of blood glucose homeostasis. Hormonal regulation of carbohydrate metabolism.

Unit II

Metabolism of circulating lipids: Chylomicrons, LDL, VLDL and HDL. Free fatty acids.

Fatty acid oxidation: α , β , ω oxidation and lipid peroxidation. Fatty acid biosynthesis: Acetyl CoA carboxylase, Fatty acid synthase, desaturase and elongase. Lipid biosynthesis: Biosynthesis of triacylglycerol, phosphoglycerides, sphingolipids. Biosynthesis pathways for terpenes, steroids and prostaglandins. Ketone bodies –formation and degradation.

Unit III

Degradation of amino acid and their regulation, oxidative deamination, Urea cycle and its regulation. Linkage between urea cycle and citric acid cycle

Biosynthesis of amino acids and regulation.

Unit IV

Biosynthesis of purines and pyrimidines and regulation, Degradation of purines and pyrimidines, and regulation

Biosynthesis, Structure and regulation of ribonucleotide reductase, biosynthesis of ribonucleotides, deoxyribonucleotides and polynucleotides

Integration of metabolism

Reference Books:

1. Lehninger's Principles of Biochemistry : D. L. Nelson and M. M. Cox, Macmillan, Worth Pub.Inc., NY.
2. Biochemistry : Lubert Stryer WH Freeman & Co., NY.
3. Harper's Biochemistry : R. K. Murray and others. Appleton and Lange, Stanford.
4. Text book of Biochemistry with clinical correlations by Delvin

PS01EBIC21: Biochemistry of Horticultural Commodities

Unit I

Introduction: common fruits, vegetables, flowers and their quality characteristics
Fundamental Nature of Perishable Products - Aspects of Deterioration
Biochemistry of development, maturation, ripening and senescence of fruits and vegetables;
Biochemistry of flower development and senescence

Unit II

Maturity indices and harvesting of fruits, vegetables and flowers
Metabolism of Harvested Products/Metabolic Control Mechanisms of Ripening and Senescence Processes
Programmed cell death during plant senescence

Unit III

Phytochemistry of fruits and vegetables
Carotenoids and colour in fruit and vegetables
Phenolic compounds and oxidative mechanisms in fruit and vegetables
Aroma biochemistry of fruits and vegetables
Gibberellins and fruit development
Phytochemistry of fruit and vegetables: an ecological overview

Unit IV

Biochemical analysis of major nutrient constituents
Postharvest Biology and Technology of fruits, vegetables and flowers
Postharvest handling and Physiology of fruits, vegetables, cut flowers and spices
Edible films and coatings for fruits and vegetables
Processing of horticultural commodities

References:

- Gopinadhan, P., Dennis, P. M., Avtar, K. H. and Susan, L. (2008) Postharvest Biology and Technology of fruits, vegetables and flowers.
- Tomas-Barberan, F. A. and Robins, R. J. (1997) Phytochemistry of fruits and vegetables.
- Salunkhe, D. K. and Kadam, S. S. (2005) Handbook of Fruit Science and Technology: Production, composition, Storage and Processing.
- Thompson, A. K. (1996) Postharvest Technology of Fruit and Vegetables
- Milda, E. E., Kerry, C. H. (2009) Edible films and coatings for food applications.
- Kenneth, V. T. (1980) Senescence in plants
- Heldt, H. 2005. Plant Biochemistry (3rd Edn.) Indian Reprint, Elsevier, New Delhi.
- Dey, P. M. & Harborne, J. B. (Eds.) 1997. Plant Biochemistry, Academic Press, London
- Doby, G.: Plant Biochemistry. Inter Science Publishers, New York
- Buchanan et al. 2004. Biochemistry & Molecular Biology of Plants.
- Taiz, L. and Zeiger, E. Plant Physiology, 4th Edition. Sinauer Associates, Inc.
- Hopkins, W. G., Introduction to Plant Physiology. 3rd Edition. John Wiley & Sons, New York.
- Salisbury, F. B. and Ross, C. W., Plant Physiology, 4th Edition. Wadsworth Publishing Company, California

- Lehninger, A. L., D. L. Nelson and M. M. Cox 2000: Principles of Biochemistry. CBS Publishers and Distributors, New Delhi.
- Briggs, W. R. (ed.) Plant hormones. Klywer Academic Publishers, Dordrecht.

PS01EBIC22: Biomolecules and Bioenergetics

Unit I

Carbohydrates and glycobiology : Monosaccharide - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and nonreducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules, working with carbohydrates, Industrial importance of carbohydrate.

Unit II

Amino acids: Structure and classification, physical, chemical and optical properties of amino acids, Classification of amino acids, Protein sequencing and alignment

Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes, Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Lipids as signals, cofactors and pigments

Nucleic acids: Structure of major species of RNA - mRNA, tRNA and rRNA.

Nucleic acid chemistry – UV absorption, effect of acid and alkali on DNA.

Unit III

Acid-Base Equilibrium & Henderson and Hassebach equation, Buffers and their importance, pKa of amino acid and their relevance, Importance of discontinuous buffer system used in SDS PAGE.

Common reaction mechanism in biological reaction: Peptide bond formation, oligonucleotide and oligosaccharide synthesis, disulphide bond, group-specific chemical modification for amino acid

Unit IV

Bioenergetics: The laws of thermodynamics, concept of entropy and free energy; ATP synthesis and hydrolysis, Biological oxidations—oxygenases ,hydrolases ,dehydrogenases, free energy changes and redox potentials, Gibbs energy,

The mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron sulphur proteins, cytochromes and their characterization (Animals, Plants, and Bacteria), ATP- synthetase complex, Chemiosmotic theory of Energy Coupling, Inhibitors of ETC, Regulation of body temperature

References:

- Chemistry of Biomolecules by S. P. Bhutani, Ane Books Pvt. Ltd. CRC Press
- Lehninger's Principles of Biochemistry: D. L. Nelson and M. M. Cox, Macmillan, Worth Pub. Inc., NY.
- Biochemistry: Lubert Stryer WH Freeman & Co., NY.
- Harper's Biochemistry: R. K. Murray and others. Appleton and Lange, Stanford.
- Text book of Biochemistry with clinical correlations by Delvin.

PS01EBIC23: Phytoresource Utilization and Conservation

Unit - I

Plant Biodiversity : Concept, status in India, utilization and concerns.

Origin, evolution, botany, cultivation and uses of (i) Food, forage and fodder crops, (ii) fibre crops (iii) medicinal and aromatic plants, and (iv) vegetable oil – yielding crops

Plants as sources of drugs, pharmaceuticals and pharmaceutical aids.

Unit -II

Ethnomedicobotany: Basic approaches to study traditional knowledge on herbal medicine; Scope and potential applications.

Collection methods of ethnomedicobotanical data: Field methods and scrutiny of Herbarium specimens and folklore; verification of data; collection of materials for voucher specimen and for phytochemical screening; application of ethnomedicobotany.

Creating indigenous knowledge base of traditional medicines of plant origin.

Unit -III

Forest products:

Important timber yielding planting.

Timber types, identification diagnostic features, structure & quality

Important fire wood plants

Non Timber forest products bamboos, rattans, fibers pulp; gums, resins, tanins, lotex, fruits & tubers.

Innovations for meeting world food demands.

Plants used as avenue trees for shade, pollution control and aesthetics.

Unit -IV

Principles of conservation; extincitons; environmental status of plants based on International Union for Conservation of Nature.

Strategies for conservation – *in situ* conservation : International efforts and Indian initiatives; protected areas in India – sanctuaries, national parks, biosphere reserves, wetlands, mangroves and coral reefs for conservation of wild biodiversity.

Ex situ conservation : Principles and practices; botanical gardens, fields gene banks, seed banks, *in vitro* repositories, cryobanks; general account of the activities of Botanical Survey of India (BSI), National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific & Industrial Research (CSIR), and the Department of Biotechnology (DBT) for conservation, non-formal conservation efforts.

Reference Books :

- Anonymous. National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New Delhi.
- Arora, R. K. and Nayar, E. R. Wild Relatives of Crop Plants in India. NBPGR Science Monograph.
- Baker, H. G. Plants and Civilization. C. A. Wadsworth, Belmont.
- Bole, P. V. and Vaghani, Y. Field Guide to Common Indian Trees. Oxford University Press, Mumbai.
- Chandel, K. P. S., Shukla, G. and Sharma, N. Biodiversity in Medicinal and Aromatic Plants in India : Conservation and Utilization. National Bureau of Plant Genetic Resources, New Delhi.

- Cristi, B. R. CRC Handbook of Plant Sciences and Agriculture. Vol. I. In-situ conservation. CRC Press, Boca Raton, Florida, USA
- Council of Scientific & Industrial Research. The Useful Plants of India. Publications and Information Directorate, CSIR, New Delhi.
- Plant Wealth of India. Special Issue of Proceedings India National Science Academy B – 63
- Rodgers, N. A. and Panwar, H. S. Planning a Wildlife Protected Area Network in India. Vol. 1. The Report Wildlife Institute of India, Dehradun.
- Sahni, K. C. The Book of India Trees, Oxford University Press, Mumbai.
- Sharma, O. P. Hill's Economic Botany. Tata McGraw Hill Co. Ltd., New Delhi.
- Swaminathan, M. S. and Kocchar, S. L. Plants and Society. Macmillan Publication Ltd., London.
- Thakur, R. S., Puri, H. S. and Husain, A Major Medicinal Plants of India. Central Institute of Medicinal and Aromatic Plants, CSIR, Lucknow. S.K. Jain: A Manual of Ethnobotany
- S.K. Jain: Glimpses of Indian Ethnobotany
- S.K.Jain, B.K. Sinha and R.C.Gupta: Notable plants in Ethnomedicine of India
- J.K. Maheswari: Dictionary of Indian Folk medicine and Ethnobotany
- S.K. Jain: Useful plants of India
- Wiley Chichester, CIBA Foundation Symposium 185: Ethnobotany and the search for new drugs

PS01CBIC24: Lab I (Practicals based on PS01CBIC21 and PS01CBIC22)

PS01CBIC25: Lab II (Practicals based on PS01CBIC23 and PS01EBIC2X)