Department of Botany, Govt. Degree College Baramulla (Autonomous)

(NAAC Re-accredited Grade A and CPE status)

Syllabus 8th Semester (4 years Honours with Research Degree Course)

Subject: Botany

Title: Plant Biomolecules and Secondary Metabolites (Credits: 4 theory)

Paper 1. (Paper Code_ BOTR2822M) **No. of Contact hours: 64)**

Course Learning Objectives (CLOs)

By the end of the course, students will be able to:

1. **Describe and classify** carbohydrates, lipids, proteins, and nucleic acids, explaining their structures, physicochemical properties, biological roles, and biosynthetic pathways in plants.
2. **Apply and interpret** analytical techniques for the isolation, purification, sequencing, and structural characterization of biomolecules, including stereochemistry and conformational analysis.
3. **Explain and evaluate** the structure, function, biosynthesis, and ecological roles of plant secondary metabolites, and **analyze** their pathways using metabolomic and molecular approaches.
4. **Assess** the applications of biomolecules and secondary metabolites in plant physiology, biotechnology, medicine, and crop protection, including metabolic engineering strategies.

Unit I: **Carbohydrates and Lipids**

Carbohydrates: Classification, Physicochemical properties and biological roles (brief idea). Derivatives and stereochemistry of monosaccharaides. Glycoconjugates - Glycoproteins and Glycolipids, Peptidoglycans and Glycosaminoglycans.

Lipids: classification, and biological role compound lipids (Phospholipids, Glycolipids) and derived lipids (Steroids, Terpenoids and Carotenoids). Lipid biosynthesis and breakdown (in plants). Triglycerides.

Unit II: Proteins

Proteins: classification and organization levels, Sequence determination of peptides – classical degradation and modern proteomic approaches. Isolation, Purification and characterization of proteins (brief idea); Criteria of homogeneity; conformation of Proteins – domains, motifs and folds, Ramachandran plots and their applications; Stability of proteins, protein folding and dynamics- molecular chaperones, Heat shock proteins, Denaturation of proteins (pH, temperature, chaotropic agents) and refolding.

Unit III Nucleic acids

Nucleic acids: Primary, secondary and tertiary structure of DNA; stabilizing forces; types and forms (A, B, C and Z) of DNA, triplet helix and quadruplex DNA, Concept of DNA supercoiling, DNA Fingerprinting, DNA sequencing – classical methods versus next generation sequencing, C- value paradox. Mitochondria and chloroplast DNA, Denaturation and Renaturation kinetics of nucleic acids - Melting temperature, Cot curve,

Structure and functions of RNA, Different types of RNAs. A brief idea of transcriptomics and proteomics.

Unit IV Plant Secondary Metabolites

Secondary metabolism in plants - compartmentalization, biological and ecological role.

Major classes. (phenolics, polyphenols, phenylpropanoids, alkaloids, terpenoids, glycosides), Biosynthesis pathways (Shikimic acid and alkaloid)

Concept, methods and applications of metabolic engineering in plants, Toxic secondary metabolites, Role of phytoelaxins in plant resistance.

Suggested Readings0

1. Nelson D.L., and, M.M. Cox (2021). *Lehninger's Principles of Biochemistry* 8th Edition. W. H. Freeman and Co, 2021.
2. Satyanarayan U., and U Chakrapani, (2013) *Biochemistry*. 4th Edition. Elsevier India,.
3. Voet D.H., and Voet J. G *Biochemistry*.. 4th Edition. John Wiley and Sons Inc, 2021.
4. Bender, D. A., Botham, K.M., Murray, R.K., Kenelly, P.J., Rodwell V.W and Weil PA *Harpers Illustrated Biochemistry*.. 30th edition, Mc-Graw Hill Michael, Canada, 2015.
5. Jain, J.L., Jain, S. and Jain N. *Fundamentals of Biochemistry*..5th Edition. S. Chand and co Ltd, India.2013.
6. Heldt, H. and Piechulla, B. *Plant Biochemistry*. 5th Edition, Academic Press, UK. 2021