Course Title: Taxonomy and Systematics

Learning Objectives:

Upon completion of this course, students should be able to:

1. Understand the historical development of Angiosperms classification.
2. Demonstrate practical skills in field inventory, Herbarium Techniques, and use of Virtual Herbarium and E-flora.
3. Explore significant herbaria and botanical gardens globally and in India.
4. Gain knowledge of Biosystematics, Chemotaxonomy, Numerical taxonomy, and cytotaxonomy.
5. Apply the International Code of Botanical Nomenclature (I.C.B.N) and understand principles of priority.
6. Discuss Effective and valid publication, Citation norms, and Rejection/retention of names.
7. Evaluate the significance of computers and databases in plant identification.
8. Analyze Molecular Systematics, including proteins, nucleic acids, and sequencing.
9. Understand taxonomic hierarchy, species concept, and Cladistics methodology.
10. Examine major contributions in plant classification history and familiarize with key classification systems, including the APG IV Classification.

Learning Outcomes:

Upon successfully completing the course, students will be able:

1. Demonstrate a deep understanding of the historical narrative of Angiosperms classification, including key developments and influential figures.
2. Acquire practical skills in field inventory, Herbarium Techniques, and the utilization of Virtual Herbarium and E-flora for plant identification.
3. Explore and evaluate significant herbaria and botanical gardens globally and in India, gaining insights into their functions and importance.
4. Develop expertise in Biosystematics, Chemotaxonomy, Numerical taxonomy, and cytotaxonomy for systematic plant classification.
5. Apply the International Code of Botanical Nomenclature (I.C.B.N), understand principles of priority, and effectively publish and cite botanical names.
6. Evaluate the significance of computers and databases in plant identification, demonstrating proficiency in utilizing digital resources for taxonomy.
7. Gain expertise in Molecular Systematics, including the analysis of proteins, nucleic acids, and sequencing techniques for molecular data compilation.
8. Define taxa (family, genus, species) and comprehend the taxonomic hierarchy, including the species concept and Cladistics methodology.
9. Critically examine major contributions in plant classification history, understanding key classification systems such as Bentham and Hooker, Engler and Prantl, and the APG IV Classification.
10. Apply their acquired knowledge to assess and classify plants systematically, demonstrating competence in practical plant identification and classification.

Theory

Unit 1: History of Plant Classification and Identification

Exploration into the historical narrative of Angiosperms classification; Examination of the major contributions of prominent figures in plant classification history, including Parasara, Charaka, Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan, Cronquist, Bremer, and MW Chase. Comprehensive coverage of the classification systems of Benthan and Hooker (up to series) and Engler and Prantl (up to series). Inclusion of the Angiosperm Phylogeny Group (APG IV) Classification, highlighting major clades.

Practical aspects of field inventory, Herbarium Techniques, Functions of Herbarium, and exploration of significant herbaria and botanical gardens globally and in India. Emphasis on Virtual Herbarium, E-flora, including Flora, Monographs, Journals. Comprehensive study of Biosystematics, Chemotaxonomy, Numerical taxonomy, and cytotaxonomy.

Unit 2: Nomenclature and Documentation

Examination of I.C.B.N, Typification, Principles of priority, and their limitations. Detailed discussions on Effective and valid publication, Citation norms, Rejection, and retention of names. Special focus on Names of hybrids and cultivars, Concepts of biocode, and the application of Keys for plant identification, both single access and multi-access. Evaluation of the significance of computers and databases in plant identification.

Unit 3: Molecular Systematics

Exploration of Molecular Systematics, delving into context and controversies. Analysis of Proteins, Amino acid sequence, Storage Protein, Serology, and isozyme. Examination of Nucleic acids, Base ratio, Polymerase chain reaction, Fragment analysis, restriction sites, and the application of sequencing in molecular systematics. Evidence compilation from cytology, phytochemistry (Alkaloids, Phenolics, Glycosides in brief), and molecular data (cp DNA, mt DNA, nuclear DNA, PCR amplification, sequence data analysis).

Unit 4: Taxonomic Hierarchy and Basic Terms and Concepts of Phylogeny

Conceptualization of taxa (family, genus, species) and exploration of Categories and taxonomic hierarchy. In-depth exploration of Species concept (taxonomic, biological & evolutionary). Introduction to Cladistics, encompassing terms and concepts such as primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly, clades, and grades. Methodology of Cladistics and various methods of illustrating evolutionary relationships, such as phylogenetic tree and cladogram.

Practicals

1. Conduct an in-depth examination of the families outlined in the theoretical framework and categorize them based on Bentham and Hooker's classification, utilizing representative species indigenous to the local region. Please focus on a minimum of twelve families from the provided list, ensuring the study includes at least two specimens (or one, if constraints exist). The suggested families include *Apiaceae,

*Asteraceae, *Brassicaceae, *Euphorbiaceae, *Fabaceae, *Lamiaceae, *Malvaceae, *Poaceae, *Ranunculaceae, *Solanaceae, Acanthaceae, Rubiaceae, Apocynaceae, and Moraceae and Orchidaceae.

2. Acquire proficiency in the binomial nomenclature of the indigenous plant species using the Gamble flora as a reference.
3. Identify the family, genus, species, and morphological characteristics of plant parts deemed valuable according to the theoretical framework.
4. Create a minimum of two herbarium specimens, employing available resources such as literature, herbaria, e-resources, and taxonomic keys for identification. Classify the specimens up to the family level, adhering to Bentham and Hooker's classification.

Suggestive Readings:

1. Simpson, M. G. (2019). Plant systematics. 3rd Edition, Academic press.

2. Singh, G. (2019). Plant Systematics- An Integrated Approach. 4th edition. CRC Press, Taylor and Francis Group.

3. Pandey, A. K., Kasana, S. (2021). Plant Systematics. 2nd Edition. CRC Press Taylor and Francis Group 4. http://www.mobot.org/MOBOT/research/APweb/

5. Maheshwari, J. K. (1963). The flora of Delhi. Council of Scientific & Industrial Research.

6. Maheshwari, J. K. (1966). Illustrations to the Flora of Delhi. Council of Scientific & Industrial Research.

7. Harris, J. G., Harris, M. W. (2001). Plant Identification Terminology: An Illustrated Glossary. Spring Lake, Utah: Spring Lake Pub. Spring Lake, Utah.

Additional Resources:

1. The Angiosperm Phylogeny Group, Chase, M.W., Christenhusz, M.J.M, Fay M.F., Byng, J.W., Judd, W.S., Soltis, D.E., Mabberley, D.J., Sennikov, A.N., Soltis, P.S., Stevens, P.F. (2016). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. Botanical journal of the Linnean Society 181 (1): 1-20.

2. https://www.mobot.org/MOBOT/research/APweb/treeapweb2s.gif

3. https://www.digitalatlasofancientlife.org

4. http://apps.kew.org/herbcat/navigator.do

5. https://efloraofindia.com/

6. https://powo.science.kew.org/

7. Page, R.D.M., Holmes, E.C. (1998). Molecular Evolution: A Phylogenetic Approach. Blackwell Publishing Ltd. Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time