

Government Degree College, Baramulla (Autonomous)

Semester 6th

Course: Major/Minor

Department of Botany

Subject: Botany

Course Title: Biodiversity and Conservation Biology
Credits: Theory: 04; Practicals: 02

Course Code: BOTC1622M
Contact Hours: 964T+ 64 P)

Course Objectives:

- *To impart students with the theoretical and practical knowledge about concept, uses and threats of biodiversity.*
- *To make the students aware about the strategies for the conservation of biodiversity.*
- *To acquaint the students with methods for measuring and monitoring of biodiversity.*

Learning Outcomes:

After completion of the course, the students will:

- *Understand the concept of biodiversity, its uses, and threats.*
- *Be familiar with conservation strategies for sustainable utilization and management of biodiversity.*
- *Get trained in quantitative metrics of biodiversity measurement.*

Unit I: Biodiversity

Concept of biodiversity; components of biodiversity (species richness and evenness); levels of biodiversity; values of biodiversity (intrinsic, consumptive, productive, social, ethical, aesthetic); threats to biodiversity (habitat loss, pollution, invasive alien species introduction, global climate change, over-exploitation, poaching); Global Biodiversity Hotspots (concept, criteria and overview), Biodiversity Hotspots in India.

Unit II: Conservation Biology

Principles and characteristics; genetic variation (magnitude, loss and its consequences); species endemism (concept and types); causes of species extinction – ultimate and proximate; the IUCN scheme of threatened species and ecosystems: an overview; ecosystems at risk (tropical rain forests, coral reefs, wetlands); global conservation efforts (organizations, conventions and treaties); Indian conservation efforts (organisations, & legislations).

Unit III: Conservation Strategies and Policies

Government Degree College, Baramulla (Autonomous)

Conservation strategies – *in-situ* (Protected Area Network, Biosphere Reserves, National Parks, Wildlife Sanctuaries), *ex-situ* (Botanical Gardens, Field Gene Banks, Seed Banks, *In vitro* Repositories, Cryobanks, DNA banks); top-down and bottom-up approaches for conservation.

Unit IV: Monitoring and Management of Biodiversity

Methods of biodiversity measurement (qualitative and quantitative) sampling unit (concept, form, size and number); phylogenetic and functional diversity (concept and estimation); biodiversity surrogates (types and use); role of Geographic Information Systems (GIS), remote sensing, and distributional modelling in biodiversity management; Role of global (e.g., Global Biodiversity Information Facility) and national (e.g., India Biodiversity Portal) databases in biodiversity studies. Citizen science - concept and application in biodiversity monitoring.

Laboratory Course

1. Estimation of species diversity of grassland and forest communities using Shannon Wiener diversity index.
2. Measurement of alpha, beta and gamma diversity of grassland and forest communities.
3. Estimation of species similarity and dissimilarity between different plant communities.
4. Two field visits to the national parks, sanctuaries, botanical garden and herbaria to acquaint students with different *in situ* and *ex situ* conservation strategies.
5. Field demonstration of Global Positioning System (GPS) and its role in biodiversity studies.
6. Demonstration of the Global Biodiversity Information Facility (GBIF) database and its utility in biodiversity studies.

References

1. Hunter Jr, M. L., & Gibbs, J. P. (2006). *Fundamentals of Conservation Biology*. John Wiley & Sons.
2. Negi, S. S. (1993). *Biodiversity and its Conservation in India*. Indus Publishing.

Government Degree College, Baramulla (Autonomous)

3. Krishnamurthy, K. V. (2018). *An Advanced Textbook on Biodiversity: Principles and Practice*. Oxford and IBH Publishing.
4. Richard B. P. (2014). *Essentials of Conservation Biology*. 6th Ed., Sinauer Associates Incorporated.
5. Magurran, A. E. (2003). *Ecological Diversity and its Measurements*. Blackwell Publications.
6. Mahanty, S., & Srivastava, A. (2016). *Biodiversity and its Conservation*. Disha International Publishing House, India.
7. Rajak, A. (2020). *Textbook of Biodiversity*. 1st edition, Notion Press, India.
8. Dar, G. H., & Khuroo, A. A. (Eds.). (2020). *Biodiversity of the Himalaya: Jammu and Kashmir State* (Vol. 18). Springer, Singapore.

Government Degree College, Baramulla (Autonomous)

Semester 6th

Course: Major

Department of Botany

Subject: Botany

Course Title: Plant Metabolism

Course Code: BOTC2622M

Credit: Theory: 04; Practical: 02

Contact Hours: (64 T + 64 P)

Course Objectives:

The course has been meticulously designed to offer a comprehensive study of the metabolic processes that occur in plants. The topics which have been covered are photosynthesis, respiration, nitrogen metabolism and synthesis of organic compounds. With a focus on understanding the biochemical pathways and regulatory mechanisms involved in plant metabolism, this course also provides students with a deep understanding of how plants utilize energy and nutrients.

Learning Outcomes:

At the end of the course, the students should have the ability to explain the metabolic processes of plants, carbon assimilation, oxidation of food and synthesis of ATP.

Part 1: Theory:

UNIT 1: CONCEPT OF METABOLISM AND CARBON ASSIMILATION (16 Hours)

Metabolism: Anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric, covalent modulation and isozymes).

Photosynthesis: Photosynthetic pigments, antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, Z-Scheme, Photo system I, Photo system II, Photorespiration (C2), Calvin Cycle (C3); Hatch and Slack Pathway (C4) and Crassulacean Acid Metabolism (CAM) Plants; Factors affecting CO₂ reduction.

UNIT II: PLANT BIOMOLECULES (16 Hours)

Carbohydrates: Classification and occurrence of monosaccharide, oligosaccharides, and Polysaccharides (starch, cellulose and pectin).

Proteins: Amino acids, structure and characteristics of peptides and proteins, functions of proteins.

Lipids: Classification, occurrence and functions of lipids.

UNIT III: CARBON OXIDATION AND ATP SYNTHESIS (16 Hours)

Government Degree College, Baramulla (Autonomous)

Respiration: Glycolysis (Embden Mayerhof Parnas Pathway); Anaerobic respiration (Alcoholic and Lactic Acid Fermentation); Pentose phosphate pathway (PPP); Krebs Cycle, Electron Transport System (ETS) and Oxidative phosphorylation, Cyanide-resistant respiration, factors affecting respiration.

ATP Synthesis: Mechanism of ATP synthesis (Chemiosmotic Hypothesis); Synthesis and catabolism of sucrose and starch.

UNIT IV: ENZYMES AND NITROGEN METABOLISM

(16 Hours)

Enzymes: Structure, Nomenclature and Classification of enzymes; Michaelis-Menten Constant; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced fit theory); enzyme inhibition and factors affecting enzyme activity.

Nitrogen metabolism: Concept of symbiotic and asymbiotic associations; Biological nitrogen fixation (BNF); Nitrate and ammonia assimilation.

Part II: Practicals:

1. Extraction of starch from available plant material through micro-chemical tests
2. Estimation of starch from Cereals/potato tubers
3. Determination of reducing sugars in fruits.
4. Identification of different kinds of sugars (spot tests).
5. Estimation of amino acids by ninhydrin.
6. Determination of Chlorophyll pigments by Solvent Extraction Method
7. Determination of chlorophyll-a chlorophyll-b, total chlorophyll by spectrophotometric method.
8. Determination of chlorophyll-a: chlorophyll-b ratio in C₃ plants
9. Determination of chlorophyll-a: chlorophyll-b ratio in C₄ plants

Suggested Readings:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th Edition.

Government Degree College, Baramulla (Autonomous)

2. Gatto Jr, G. J., Stryer, L., Tymoczko, J. L., & Berg, J. M. (2019). *Biochemistry*. WH Freeman. 9th Edition
3. Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2022). *Lehninger Principles of Biochemistry*. Macmillan. 8th Edition
4. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). *Plant Physiology and Development*. Sinauer Associates Inc. USA. 6th Edition.
5. Bajracharya D. (1999). *Experiments in Plant Physiology-A Laboratory Manual*. Narosa Publishing House, New Delhi.
6. Harborne, J.B. (1973). *Phytochemical Methods*. John Wiley & Sons. New York
7. David, L.N, & Michael, C. (2017). *Lehninger Principles of Biochemistry*, WH Freeman; 7th Edition.
8. Arora, B.B. (2018). *Plant Physiology and Metabolism by Modern Publishers*. 2nd Edition
9. Shrivastava, H.S. and Shankar, N. (2019). *Plant Physiology and Biochemistry and Biotechnology*, by Rastogi Publications, Shivaji Road, Meerut India. 7th Reprint 1st Edition

Government Degree College, Baramulla (Autonomous)

Semester 6th

Course: Major

Department of Botany Subject: Botany

Title: Plant Reproductive Biology
Credits (4+2): Theory: 04, Practicals: 02)

Course Code: BOTC3622M
Contact Hours: 64(T) + 64(P)

Course Objectives:

The objective of this course is to provide students with an in-depth understanding of the reproductive biology of angiosperms, focusing on the mechanisms and processes involved in sexual reproduction, as well as the evolutionary and ecological significance of reproductive strategies in flowering plants.

Learning Outcomes:

After completion of the course, the student would have a comprehensive understanding of:

- 1. The process of reproduction of flowering plants including its biochemical, genetic, and molecular basis.*
- 2. The role of pollinators in pollination and importance of conservation of pollinators for sustainable pollination and perpetuation of flowering plants.*

UNIT 1: Introduction

Plant reproductive biology (history and scope); Flower as a modified determinate shoot; Flower development; ABCD model of flower development; Induction of flowering; Plant Phenology (Vegetative and Reproductive Phenophases)

UNIT II: Anther and Pollen Biology

Anther wall: Structure and functions; Microsporogenesis; Microgametogenesis; Pollen wall structure, male germ unit (MGU) structure, Number, position and Characteristics (NPC) system. Palynology and its scope (a brief account). Pollen wall proteins; Pollen viability, storage and germination.

Abnormal features: pseudomonads, polyads, massulae, pollinia.

UNIT III: Ovule, Pollination and Fertilization

Structure and types of ovules; Special structures: endothelium, obturator, aril, caruncle and hypostase.

Female gametophyte: - megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of *Polygonum* type). Organization and ultrastructure of mature embryo sac. Pollination types and significance. Structure of stigma and style; path of pollen tube in pistil; double fertilization, triple fusion.

UNIT IV: Self Incompatibility

Basic concepts of self-incompatibility (interspecific, intraspecific, homomorphic, heteromorphic, Gametophytic Self-Incompatibility (GSI) and Sporophytic Self-Incompatibility (SSI); Methods to overcome self-incompatibility: mixed pollination, bud pollination, stub pollination; Intra-ovarian and *in vitro* pollination; Polyembryony, Apomixis, Parthenocarpy

Government Degree College, Baramulla (Autonomous)

PRACTICALS

1. Anther wall and its ontogeny. Tapetum (amoeboid and glandular). MMC, spore tetrads, uninucleate, bicelled and dehiscent anther stages through slides/micrographs. Male germ unit (MGU) through photographs and schematic representation.
2. Pollen grains: Fresh and acetolyzed pollen grains showing ornamentation and apertures. Types of pollen through temporary slides.
3. Ovule types: anatropous, orthotropous, amphitropous, hemi-anatropous, campylotropous, circinotropous; Unitegmic, bitegmic; Tenuinucellate and crassinucellate;
4. Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs).
5. Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus.
6. Intra-ovarian pollination; Test tube pollination through photographs.
7. Endosperm: Dissections of developing seeds for studying endosperm with free-nuclear haustoria.
8. Embryogenesis: Study of development of dicot and monocot embryo through permanent slides.
9. Dissection of developing seeds for embryos at various developmental stages.

Suggested Reading

1. Bhojwani, S.S., Bhatnagar, S.P. (2011). The Embryology of Angiosperms, 5th edition. New Delhi, Delhi: Vikas Publishing House.
2. Johri, B.M. (1984). Embryology of Angiosperms. Netherlands: Springer-Verlag.
3. Raghavan, V. (2000). Developmental Biology of Flowering Plants. Netherlands: Springer
4. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. New Delhi, Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
5. Maheshwari, P. (2000). An Introduction to the Embryology of Angiosperms. Surjeet Publications. Delhi.
6. Panday, A.K. (2022). Reproductive Biology of Angiosperms. CRC Press, Boca Raton, Florida, USA.