COOCH BEHAR PANCHANAN BARMA UNIVERSITY

SYLLABUS

Department of Botany

M.Sc. Botany Semester – I

UNDER NATIONAL EDUCATION POLICY 2020 (NEP 2020)

Paper Code	Topic	Credit	Total Marks	Marks Division
CC-1	Foundations of Plant Biology: Origin, Evolution, Phytodiversity and Ecology	5	100	Theory: 75 Presentation: 20 Attendance: 05
CC-2	Functional Plant Biochemistry and Metabolism	5	100	Theory: 75 Presentation: 20 Attendance: 05
CC-3	Practical	5	100	Practical: 75 Visits*: 20 Attendance: 05
DCE	Plant Systematics, Indian Knowledge System and Plant Resource Utilization	5	100	Theory: 75 Presentation#: 20 Attendance: 05
	Total	**20**	**400**	

Syllabus structure

*Field visit/Lab visit/Industrial visit to be conducted as part of curriculum.

#Seminar presentation on any topics relevant to theory syllabus. A brief PPT presentation to be given by the student on any topic within the syllabi of particular paper. An abstract within 300 words duly signed by concerned teachers to be submitted by the students during evaluation (to be evaluated by internal teachers only).

Paper Code

Core Course 1 (CC-1)

Paper Name

Foundations of Plant Biology: Origin, Evolution, Phytodiversity and Ecology

Credit and Marks

Credit: 5, Full Marks: 100 (75+20+5)

Course Objectives

The main objectives of this course are:

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1. To explain the origin of life and major events in the evolutionary history of Earth and living organisms.
2. To understand the mechanisms of evolution, speciation, and phylogenetic analysis.
3. To examine the diversity, evolution, adaptation, and ecological significance of major plant groups.
4. To apply the knowledge of ecological principles to populations, communities, ecosystems, biomes, and environmental sustainability.
5. To develop scientific presentation and literature review skills.

Syllabus (Theory): 75 Marks

Unit I: Origin of Life

Concept of geological time scale and origin of earth; prerequisite role of water for the origin of life; carbon and the foundation of biomolecular diversity; physicochemical conditions for the origin of life (protocells); synthesis of organic compounds on early earth; abiotic synthesis of macromolecules, Stanley Miller's experiment – materials & methods, results and conclusion; concept of RNA world; the fossil evidences as the history of life; radiometric dating; first single celled organisms – stromatolites; photosynthesis and oxygen revolution; the first eukaryotes – endosymbiotic theory, early multicellular eukaryotes; cambrian explosion; the colonization of land; plate tectonics, continental drift and mass extinction.

Unit II: Evolution

Basic concepts of evolution and evolutionary biology; microevolution and macroevolution; concept of species (origin of species & biological species concept); significance of learning evolutionary biology; how to learn evolutionary biology; evolution *vs* human health; major evolutionary forces – mutation, natural selection, random genetic drift, inbreeding (a type of non-random mating), migration (gene flow); analytical comparison on Lamarck's and Darwin's hypotheses of evolution; reproductive isolation; concepts of phylogeny – shared ancestral character & shared derived character, divergent & convergent evolution, coevolution, adaptive radiation, types of phylogenetic tree, tree construction methods, statistical validation methods, open-source molecular phylogeny software and molecular clocks.

Unit III: Phytodiversity

Concept of Phytodiversity in comparison to Biodiversity; major plant groups – the chlorophyll bearer; concept of dominance and dependence between sporophyte and gametophyte among major plant groups; alternation of generations; concepts of embryophytes, archegoniate, vascular & non-vascular plants, extinct & extant plants; unique and general features of algae, bryophytes, pteridophytes, gymnosperms and angiosperms; lichen – characteristics and major types; major adaptations for land habit; heterospory – a defining feature among seed plants; concepts of reproduction of major plant groups;

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ecological and economic importance of major plant groups including lichen; products from seed plants for human welfare; major threats to plant diversity.

Unit IV: Ecology

Basic concepts of ecology; biotic and abiotic factors; conceptualization of the terms of ecological hierarchy – individual, population, community, ecosystem, landscape, biome and biosphere; scientific method to study ecology; major terrestrial biomes – tropical rain forest, tropical deciduous forest, temperate rain forest, temperate deciduous forest, temperate coniferous forest (taiga or boreal forest), tropical grassland (savanna), temperate grassland; hot desert, cold desert, tundra and mountain ranges; major aquatic biomes – zonation, thermocline, ponds, lakes, wetlands, streams & rivers, estuaries, intertidal zones, ocean pelazic zone, coral reefs and marine benthic zones including human impact; role of average precipitation and temperature on different biomes; community interactions – competition, predation, herbivory, symbiosis (parasitism, mutualism, commensalism; amensalism and facilitation); concepts of – competitive exclusion, ecological niche, resource partitioning, speciation (allopatric and sympatric); character displacement; mimicry (Batesian and Müllerian); concepts of population ecology – The Hardy-Weinberg principle, density & dispersion; mark recapture method, population dynamics (immigration, emigration), demographics, life tables, survivorship curves (type I, II and III) and change in population size; major environmental pollutants and pollution; sustainable bioremediation strategies; dynamics of ecosystems (biogeochemical cycles, energy flow, trophic-level interactions etc.); plant-microbe interactions in context of microbial ecology; conservation biology (biodiversity crisis, value of biodiversity, factors responsible for extinction, approaches for preserving endangered species and ecosystems); modern concept of carbon credit.

Suggested References

1. Reece, Urry, Cain, Wasserman, Minorsky, Jackson (2014). **Campbell Biology** (10th Edition), Pearson.
2. Raven, P., Johnson, G., Mason, K., Losos, J., & Singer, S. (2017). **Biology** (11th Edition). McGraw Hill.
3. Mauseth, J. D. (2022). **Botany: An Introduction to Plant Biology (7th ed.).** Jones & Bartlett Learning.
4. Taylor, E. L., Taylor, T. N., & Krings, M. (2009). **Paleobotany: The Biology and Evolution of Fossil Plants**. Academic press.
5. Stewart, W. N., & Rothwell, G. W. (1993). **Paleobotany and the Evolution of Plants**. Cambride University Press.
6. Darwin, C. (2009). **The Origin of Species by Means of Natural Selection.** Cambridge University Press.
7. Douglas J. Futuyma & Mark Kirkpatrick (2017). **Evolution** (4th Ed.) Sinauer Associates, Inc. Publishers.

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8. Knoll, A.H. (2003). **Life on a Young Planet: The First Three Billion Years of Evolution on Earth.** Princeton University Press.
9. Ghosh, Z., & Mallick, B. M. (2018). **Bioinformatics Principles and Applications.** Oxford University Press.
10. Stiling, P. (2014). **Ecology: Global Insights and Investigations** (2nd ed.). McGraw-Hill Education.
11. Smith, T. M. & Smith, R. L., (2012). **Elements of Ecology** (8th Edition). Pearson Benjamin Cummings.

Presentation: 20 Marks

Seminar presentation on any topics relevant to CC-1 theory syllabus. A brief PPT presentation to be given by the student on any topic within the syllabi of particular paper. An abstract within 300 words duly signed by concerned teachers to be submitted by the students during evaluation (to be evaluated by internal teachers only).

Attendance: 5 Marks

As per University regulations.

Course Outcome

After successful completion of the course, students will be able to explain the origin and early evolution of life and interpret major events in Earth's biological history; understand and analyze fundamental principles and mechanisms of evolution, including natural selection, genetic drift, gene flow, mutation, speciation, reproductive isolation, adaptation, phylogeny and molecular clocks; characterize major plant groups with respect to diversity, evolutionary relationships, life cycles, reproduction, adaptations, ecological and economic significance; explain ecological organization and functioning from individuals to the biosphere, including population dynamics, community interactions, terrestrial and aquatic biomes, ecosystem processes, energy flow and biogeochemical cycles; analyze plant–microbe interactions within the framework of microbial ecology; evaluate environmental pollution, biodiversity loss, extinction and conservation challenges and identify sustainable approaches such as bioremediation and ecosystem conservation; and apply ecological and evolutionary principles to contemporary issues including climate change, biodiversity conservation, sustainable resource management and carbon credits. The course will also develop students' scientific reasoning, critical thinking and analytical skills for interpreting biological patterns and addressing current environmental and sustainability challenges.

COOCH BEHAR PANCHANAN BARMA UNIVERSITY

SYLLABUS

Department of Botany

M.Sc. Botany Semester – I

UNDER NATIONAL EDUCATION POLICY 2020 (NEP 2020)

Paper Code

Core Course 2 (CC-2)

Paper Name

Functional Plant Biochemistry and Metabolism

Credit and Marks

Credit: 5, Full Marks: 100 (75+20+5)

Course Objectives

The main objectives of this course are:
This course aims to provide students with a comprehensive understanding of the molecular and biochemical basis of plant life, including the structure and function of biomolecules, protein architecture, and enzyme catalysis. It introduces the principles of primary and secondary metabolism, carbon and respiratory metabolism, and their roles in plant growth, development, stress adaptation, and climate-smart agriculture. The course further familiarizes students with emerging applications of plant biochemistry, including metabolic engineering, biofortification, functional foods, nutraceuticals, and genome editing for sustainable crop improvement.

Syllabus (Theory): 75 Marks

Unit I. Biomolecular Foundations of Plant Life
History of Biochemistry, Stabilizing Forces in Biomolecular Interactions.
Protein architecture: Primary to quaternary structure, Ramachandran plot, α-helices, β-sheets, motifs, domains, molecular chaperones and protein folding, Protein Stability.
Protein DNA interaction: DNA binding motifs, zinc fingers basic leucine zipper (bZIP), basic helix-loop-helix (bHLH) motif.
Enzymology: Principles of Catalysis, Enzyme Kinetics (Michaelis–Menten kinetics and inhibition), Catalytic Mechanisms, Enzyme Regulation and Isozymes, industrial enzymology: principles of immobilized enzyme technology; applications of immobilized enzymes.

Unit II. Functional Plant Metabolism
Concepts of Plant Metabolism: Anabolic and catabolic metabolism (Elementary concepts). Idea of Primary and secondary metabolism.

Carbon metabolism: Photosynthetic Machinery and Energy Conversion, Carbon Fixation and Metabolic Integration, Regulation of Photosynthesis, Concepts of Translational Photosynthesis for climate-smart agriculture.
Respiratory metabolism: Mitochondrial bioenergetics, coupled reactions, group transfer, biological energy transducers.
Secondary metabolism: Basic concept, Diversity of Secondary metabolites and biological significance, Phytochemicals and bioactive compounds, metabolic responses to abiotic stresses and xenobiotics; role in plant defense, herbicide tolerance and crop resilience.

Unit III. Applied biochemistry and metabolic engineering
Elementary Concepts: Metabolic Engineering for Crop Improvement; Biofortification; Idea of functional foods, nutraceuticals and medicinal plant products.
Case Studies: Golden Rice (biofortification), high-starch potato (carbon metabolism), high-oleic soybean/canola (lipid engineering), C_4 rice (photosynthetic engineering) and CRISPR-mediated crop improvement.

Suggested References

1. Plumer, D. T. (1993). An Introduction to Practicals in Biochemistry. Tata McGraw Hill.
2. Conn, E.E. and Stumpf, P.K. (1994). Outlines of Biochemistry. Wiley Eastern.
3. Dey, P.M. and Harborne, J.B. (1997). Plant Biochemistry. Acad. Press.
4. Boyer, R. (1999). Concept in Biochemistry. Brooks/Cole Publ.
5. Boyer, R.F. (2012). Biochemistry Laboratory: Modern Theory and Techniques, Pearson Prentice Hall, New Jersey
6. Buchanan, B.B., Gruissem, W. and Jones, R.L. (2015). Biochemistry and Molecular Biology of Plants. Wiley Blackwell, Sussex, UK.
7. Lea, P.J. and Leagood, R.C. (1999). Plant Biochemistry and Molecular Biology. Wiley.
8. Nelson, D.L. and Cox, M.M. (2013). Lehninger Principles of Biochemistry. 6th Edition, Freeman and Company, New York.
9. Stryer, L. (1993). Biochemistry. W.H. Freeman.
10. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A. (2014). Plant Physiology and Development. Sinauer Associates.

Presentation: 20 Marks

Seminar presentation on any topics relevant to CC-2 theory syllabus. A brief PPT presentation to be given by the student on any topic within the syllabi of particular paper. An abstract within 300 words duly signed by concerned teachers to be submitted by the students during evaluation (to be evaluated by internal teachers only).

COOCH BEHAR PANCHANAN BARMA UNIVERSITY

SYLLABUS

Department of Botany

M.Sc. Botany Semester – I

UNDER NATIONAL EDUCATION POLICY 2020 (NEP 2020)

Attendance: 5 Marks

As per University regulations.

Course Outcome

Upon successful completion of this course, students will be able to:

1. Demonstrate an understanding of the structure, function, and organization of plant biomolecules, proteins, nucleic acids, and enzymes.
2. Analyze the organization, regulation, and integration of primary and secondary metabolic pathways in plants.
3. Interpret the biochemical principles underlying carbon metabolism, respiratory bioenergetics, and metabolic regulation in plants.
4. Evaluate the biological significance and applications of secondary metabolites, phytochemicals, and bioactive compounds in plant systems.
5. Integrate and access biochemical principles to metabolic engineering, biofortification, and functional plant products for sustainable crop improvement.

Paper Code

Discipline Centric Elective (DCE)

Paper Name

Plant Systematics, Indian Knowledge System and Plant Resource Utilization

Credit and Marks

Credit: 5, Full Marks: 100 (75+20+5)

Course Objectives

The DCE offers essential knowledge and technical skills to the students to study the Plant Systematics, Indian Knowledge System and Plant Resource Utilization at advance level and it also offers essential knowledge and technical skills to the students to identify plant specimens in field. They also study the theoretical portion of plant systematics, Indian Knowledge System and Plant Resource Utilization.

Syllabus (Theory): 75 Marks

Unit I:

History of Botanical nomenclature, Biological Species Concept. Evolution of angiosperm, Evolution of xylem stamens and carpel.

System of Classification – Rolf M.T. Dahlgren (1975) and Robert F. Thorne (1976). Detail understanding of Angiosperm Phylogeny Group (APG IV, 2016).

Taxonomic Data Sources: (a) Anatomy, (b) Cytology, (c) Embryology, (d) Palynology, (e) Phytochemistry, (f) Genome Analysis, (g) Nucleic acid hybridization, (h) Seedling morphology.

Unit II:

Developing Classification: Phenetic method, Principles of Taxometrics, Cladistic methods, Different phylogenetic terms and their significance and uses. Phylogenetic data analysis. Operational Taxonomic unit (OTU), Binary and multistate characters, ordering of character state, Assigning polarity, Character Weighting and coding - measure of similarity, Simple matching coefficient and Jaccard Coefficient, Construction of tree – general idea.

Numerical Taxonomy: Aims and objectives, characters and attributes, OTUs. Coding cluster analyses, merits and demerits.

DNA bar-coding, DNA meta-barcoding and DNA mega-barcoding for identification of plants – concept and outline.

Unit III:

Biodiversity and Conservation Biology: Importance and preservation of Biodiversity; Conservation Hotspots, IUCN guidelines; invasions & introductions, endemism. Sacred groves, Ramsar sites, National Biodiversity Authority (NBA), West Bengal Biodiversity Board, The biological diversity Act 2002, Biological diversity Rules, 2004. Earth summits, mega diversity countries, Bioprospecting and Biopiracy, IUCN Red data book, Carbon Stock, Biodiversity Hotspots and Conservation.

Unit IV:

Indian Traditional Knowledge System: Traditional knowledge on the use of Bio resources: - Utilization, need, survey, evaluation and conservation. Basic concepts on Forest Ecology, Non-Timber Forest Producers.

Ethnobotany: Definition and concept, importance, Meaning, Branches, History, Use of plant materials by Totos, Ravas and Rajbanshis other ethnic groups in North Bengal.

Paleoethnobotany or archaeobotany – A general account. Importance of Ethnobotany in Indian Knowledge System. Botany and Environmental concepts of ancient India – a brief account.

Suggested References

1. Lawrence, George H. M. (1951) Taxonomy of Vascular Plants. New York: The Macmillan Company.

2. Dahlgren, R.M.T., Clifford, H.T. and Yeo, P.F. (1985) The Families of the Monocotyledons: Structure, Evolution, and Taxonomy. Springer-Verlay.

3. Datta SC (2018), Systematic Botany. New Age International Private Limited. New Delhi, India.

4. Kumar U and Asija M.J. (2011) Biodiversity: Principles and Conservation (2nd Eds), Agrobios.

5. Das A.P. &. Pandey A.K (2007) Advances in Ethnobotany Bishen Singh Mahendra Pal Singh, Dehradun, India.

6. Singh Gurcharan (2004) Plant Systematics: An Integrated Approach, Science Pub Inc

7. Naik V.N. (1984) Taxonomy of Angiosperms. Tata McGraw-Hill, India.

8. Paria N.D. (2022) Plant Taxonomy and Biodiversity, Santra Publication, Kolkata, India.

Presentation: 20 Marks

Seminar presentation on any topics relevant to DCE theory syllabus. A brief PPT presentation to be given by the student on any topic within the syllabi of particular paper. An abstract within 300 words duly signed by concerned teachers to be submitted by the students during evaluation (to be evaluated by internal teachers only).

Attendance: 5 Marks

As per University regulations.

Course Outcome

Gather botanical knowledge of Plant Systematics, Indian Knowledge System and Plant Resource Utilization at advanced level.

Paper Code

Core Course 3 (CC-3)

Paper Name

Practical

Credit and Marks

COOCH BEHAR PANCHANAN BARMA UNIVERSITY

SYLLABUS

Department of Botany

M.Sc. Botany Semester – I

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Credit: 5, Full Marks: 100 (75+20+5)

Course Objectives

The main objectives of this course are:

1. To develop an understanding of plant evolution and diversification through geological time, fossil evidence, phylogenetics, and evolutionary traits such as homospory and heterospory.
2. To develop proficiency in plant identification, taxonomic characterization, microscopic examination, photographic documentation, and field-based study of regional flora.
3. To apply quantitative methods for vegetation analysis, species diversity assessment, ecological investigation, and ethnobotanical documentation.
4. To acquire practical skills in plant biochemical techniques for the extraction, separation, and quantitative estimation of proteins, sugars, phenolics, pigments, lipids, and amino acids.
5. To develop competency in modern molecular and computational techniques, including phylogenetic analysis, DNA sequence analysis, DNA barcoding, chloroplast activity assays, and enzyme screening.

Syllabus (Practical): 75 Marks

1. Preparation of a comprehensive chart/innovative model on geological time scale showing major geological eras and biological events to understand Earth's history and evolution of life.
2. Construction and analysis of phylogenetic tree using open-source tools and database to familiarize with modern concept of phylogenetics.
3. Study of various parts of fossil plant from permanent slides and their identification to observe, identify and interpret fossil plant specimens and correlate their structural characteristics with plant evolution and the fossil record.
4. Microscopic examination and photographic documentation of selected microflora from the North Bengal region, with emphasis on their morphological characteristics and taxonomic identification.
5. Preparation of a photographic album of selected extant macroscopic flora from the North Bengal region representing any one major plant group (except angiosperms), along with taxonomic identification, diagnostic characters, and ecological significance.
6. Comparative study and identification of heterospory and homospory using representative specimens or permanent slides of pteridophytes and seed plants.

7. Quantitative assessment of vegetation in selected habitats of the North Bengal region using the quadrat method for estimation of frequency, density, abundance, and species diversity.
8. Preparation of buffers, solutions and serial dilutions.
9. Extraction and quantitative estimation of proteins from plant tissues by the Lowry method using a BSA standard curve.
10. Extraction and estimation of reducing sugars from plant tissues by the Somogyi–Nelson method.
11. Determination of acid value of plant oils/fats.
12. Separation and identification of amino acids/plant pigments by thin-layer chromatography (TLC).
13. Estimation of photosynthetic pigments (chlorophyll and carotenoids) by spectrophotometry.
14. Isolation of chloroplast and assay of chloroplast activity by Hill Reaction
15. In vitro screening of plant proteases in phytochemical extracts.
16. Identification of plant material: from locally available plant specimen.
17. Local field study / out station research Laboratory or University visit/ Ethnobotanical survey in any village in North Bengal.
18. Work out of plant materials: From locally available plant specimen. The plant material will be identified up to genus following "Bengal plants, Vol -1 & 2; David Prain, 1903".
19. Study of Seedling morphology from seedlings germinated in Laboratory condition/ field condition.
20. Development of *in silico* DNA barcode from matK/ and other related sequence downloaded from repository.

Field visit/Lab visit/Industrial visit: 20 Marks

*Field visit/Lab visit/Industrial visit to be conducted as part of curriculum. Students have to submit a brief report (within 800-1000 words) on any visits conducted by the department.

Attendance: 5 Marks

As per University regulations.

Course Outcome

On successful completion of the practical course, students will be able to demonstrate proficiency in the observation, identification, documentation, quantitative analysis, and interpretation of plant materials using classical as well as modern approaches. They will be

able to relate fossil evidence and geological events to major evolutionary trends in plants and distinguish important evolutionary features such as homospory and heterospory. Students will acquire practical competence in plant taxonomy, microscopy, field sampling, quadrat analysis, biodiversity assessment, ethnobotanical documentation, and seedling studies, particularly with reference to the flora of North Bengal. They will be able to prepare and analyses biochemical samples, quantify proteins, reducing sugars, phenolics, pigments and lipids, separate amino acids by TLC, and assess chloroplast and protease activities using appropriate laboratory techniques. Students will also develop skills in phylogenetic analysis, DNA sequence retrieval, DNA barcoding and computational interpretation using open-source databases and tools. Overall, the course will enable students to integrate morphological, anatomical, biochemical, ecological, molecular and computational evidence for systematic study, evolutionary interpretation, and research-oriented investigation of plants.

Date: 14.10. 2026

Dr. Debadin Bose
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(Dr. Debadin Bose)
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