NATIONAL UNIVERSITY BANGLADEH



Syllabus
Bachelor of Science (Honours) Second Year
Department of Botany

Effective from the Academic Year: 2024–2025 and onward

Vision of the University

We expect that the hundredth anniversary of the National University, our commitment to "Progress for Everyone" will be evident in all areas of our operations and stakeholder engagements.

We leverage our core strength in education, research, and community engagement to address pressing global issues and foster sustainable development.

By 2042, National University aims to strengthen its positions as Bangladesh's top academic institution and rank among the world's leading universities. Our focus will be on expanding expertise building strategic partnerships, and increasing our global influence. Our services will be measured by the achievements of the individuals and communities we serve.

Mission of the University

To promote "Progress for Everyone" by fostering transformative education, conducting pioneering research, and encouraging meaningful collaboration with individuals, communities, and partners both in Bangladesh and around the world.

Name of the Program: B.Sc. (Honours) in Botany

Vision of the Department

To develop scientifically competent, research-oriented, innovative, ethical, and environmentally responsible graduates in Botany who possess strong knowledge, critical thinking, leadership, communication, and lifelong learning skills, and who are capable of contributing to biodiversity conservation, environmental sustainability, scientific advancement, and societal development at national and global levels.

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Mission of the Department

To provide quality education and practical training in botanical sciences through integrated theoretical, laboratory, field, and research-based learning; develop students' scientific knowledge, analytical and problem-solving abilities, technological competence, communication, teamwork, leadership, and entrepreneurial skills; promote ethical research, innovation, biodiversity conservation, environmental sustainability, and lifelong learning; and prepare graduates for professional careers, higher education, research, entrepreneurship, and meaningful contributions to society and the Sustainable Development Goals (SDGs).

Programme Educational Objectives (PEOs)

PEO-1: To equip graduates in botany with the appropriate abilities to navigate a wide range of circumstances in an integrative and multimodal context, including analytical skills, creativeness, self-drive, and the pursuit of outstanding performance.

PEO-2: To prepare graduates with entrepreneurial competence across various domains and the professional skills required to be globally employable in government, private, and research institutions for achieving Sustainable Development Goals (SDGs) of Bangladesh.

PEO-3: To generate graduates with advanced expertise in Botany, equipped to solve complex scientific and environmental.

PEO-4: To foster graduates with strong moral leadership and teamwork abilities, dedicated to achieving individual excellence and organizational success.

PEO–University Mission Mapping Matrix

PEO	**M1**	**M2**	**M3**
	(Transformative Education)	**(**Pioneering Research)	**(**Meaningful Collaboration)
PEO-1	2	1	0
PEO-2	2	2	2
PEO-3	2	2	1
PEO-4	2	1	2

Scale: 2 = Strongly aligned; 1 = Aligned; 0 = Not aligned.

Programme Learning Outcomes (PLOs)
Botany Graduates will be able to:

PLO-1 (Knowledge): Acquire fundamental and specialized knowledge of plant sciences to understand biological system and related challenges.

PLO-2 (Scientific Analysis & Critical Thinking): Understand, identify and analyze complex biological problems by applying botanical principles and scientific reasoning.

PLO-3 (Proficiency in Modern Tools & Technologies): Utilize contemporary tools, digital platforms, and laboratory instruments in plant research, adapting to technological advancements while understanding their scope and limitations.

PLO-4 (Conduct investigations of problems): Conduct research-based investigations, including data collection, data analysis, and interpretation to draw logical conclusions.

PLO-5: (Innovative Solution Design): Design scientific strategies and develop effective solutions to botanical problems, considering SDG goal.

PLO-6 (Social Awareness & Health Perspective): Apply scientific understanding to evaluate societal and health-related issues, fostering a sense of responsibility toward community well-being.

PLO-7 (Environment and sustainability): Assess the effects of expert technological remedies on the environment and society, and exhibit an awareness of and commitment to ecofriendly friendly development.

PLO-8 (Individual and teamwork): Work effectively both independently and as part of multidisciplinary teams, adaptability, and interpersonal skills in collaborative environments.

PLO-9 (Communication): Professionally communicate scientific operations to the scientific field and the general population by understanding and producing quality reports and design

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documentation, giving and receiving precise instructions, and making effective presentations.

PLO-10 (Leadership & Project Management): Exhibit project management skills and leadership qualities by planning, organizing, and executing research or community-based initiatives in diverse professional settings.

PLO-11 (Professional Ethics): Adhere to professional ethics, obligations, and scientific practice standards by putting ethical concepts into practice.

PLO-12 (Life-long Learning): Demonstrate the motivation and capability to pursue continuous learning, staying updated with scientific advancements and adapting to emerging challenges in the field.

Mapping PEOs with PLOs

PLOs \ PEOs	PEO-1 (Skills, creativity, excellence)	PEO-2 (Entrepreneurship, global employability, SDG)	PEO-3 (Scientific & environmental expertise)	PEO-4 (Leadership, ethics, teamwork)
PLO-1 (Knowledge)	√	√	√	
PLO-2 (Scientific Analysis & Critical Thinking)	√	√	√	
PLO-3 (Proficiency in Modern Tools & Technologies)	√	√	√	√
PLO-4 (Conduct investigations of problems)	√	√	√	√
PLO-5 (Innovative Solution Design)	√	√	√	√
PLO-6 (Social Awareness & Health Perspective)		√	√	√
PLO-7 (Environment and sustainability)		√	√	
PLO-8 (Individual and teamwork)	√	√		√
PLO-9 (Communication)	√	√		√
PLO-10 Leadership & Project Management)	√	√		√
PLO-11 (Professional Ethics)	√	√	√	√
PLO-12 (Life-long Learning)	√	√	√	√

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B.Sc. (Honours) Botany
Second Year
Courses and Marks Distribution

Course Code	Course Title		Marks	Credits
8223051	Higher Cryptogams		100	4
8223053	Gymnosperm and Palaeobotany, Palynology		100	4
8223055	Taxonomy of Angiosperms		100	4
8223056	Practical- II (Higher Cryptogams, Gymnosperm and Palaeobotany, Palynology, Taxonomy of Angiosperms)		100	4
8223157	Zoology- II (Chordates, Evolutionary and Applied Zoology)		100	4
8223158	Zoology Practical –II (Chordates)		50	2
8222861	Environmental Chemistry		50	2
8222859	General Chemistry-II/ OR	**Select any One Subject from the following**	100	4
8222159	Social Work Practice/ OR		100	4
8222059	Sociology of Bangladesh/ OR		100	4
8223257	Geography of Landforms		100	4
8221171	Functional English		100	4
8226601	Applied information and Communication Technology (Applied ICT)		75	3
8226602	Practical: Applied ICT		25	1
8223058	Viva-Voce (Botany)		50	2
Total =			**950**	**38**

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Detailed Syllabus

Course Code: 8223051	Marks: 100	Credits: 4	Class Hours: 56
Course Title: Higher Cryptogams			

Course Description

This course delivers a comprehensive exploration of non-vascular and early vascular land plants, focusing on the evolutionary biology, comparative anatomy, systematics, and ecological functions of Bryophytes and Pteridophytes. Students examine key structural adaptations and developmental life cycles across representative lineages, tracing pivotal transitions in terrestrial plant evolution such as the alternation of generations, stelar differentiation, heterospory, and the evolutionary origins of the seed habit. Supported by paleobotanical evidence, modern phylogenetic frameworks, and practical laboratory investigations, the curriculum emphasizes both the pioneering roles of cryptogams in terrestrial ecosystems and their applied significance in bio-fertilization, bioremediation, and soil conservation.

Course objectives

This course provides a comprehensive structural, evolutionary, and ecological analysis of Bryophytes and Pteridophytes. It aims to develop a deep foundational understanding of morphology, complex tissue systems, reproductive lineages, stelar evolution, heterospory, the evolution of the seed habit, and the paleobotanical significance of fossil cryptogams.

Course learning outcomes (CLOs)

After going through the course, the student would be able to learn the following outcomes:

CLO Code	Course Learning Outcome	Aligned with PLOs
CLO1	Classify the living and fossil lineages of Bryophytes and Pteridophytes by using modern taxonomic and phylogenetic frameworks.	PLO-1, PLO-2
CLO2	Analyze the structural variations, life histories, internal anatomy, and reproductive mechanisms of Bryophytes and Pteridophytes	PLO-1, PLO-2, PLO-4, PLO-5, PLO-7
CLO3	Evaluate core evolutionary milestones, including the alternation of generations, progressive stelar advancement, heterospory, and the origin of seed habits.	PLO-2, PLO-3
CLO4	Examine the fossil records of ancient land plants and interpret paleobotanical evidence regarding the origin of early vascular systems.	PLO-2, PLO-4
CLO5	Appraise the ecological significance, environmental adaptations, and diverse spore dispersal strategies of higher cryptogams in	PLO-1, PLO-2, PLO-7

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	pioneering ecosystems.	
CLO6	Asses and implicate the economic and biotechnological applications of cryptogams, such as biofertilizers (*Azolla*) and soil conservation systems, demonstrating awareness of sustainability.	PLO-5, PLO-2PLO-7, PLO-12

Mapping of CLOs with PLOs:

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11	PLO-12
CLO1	√	√										
CLO2	√	√		√	√		√					
CLO3		√	√									
CLO4		√		√								
CLO5	√	√					√					
CLO6						√	√					√

CLO–BNQF Learning Outcome Domain Mapping

CLOs	**F**	**S**	**T**	**P**
CLO1	√		√	
CLO2	√		√	
CLO3	√		√	
CLO4	√		√	
CLO5	√		√	√
CLO6	√	√		√

F = Fundamental; S = Social; T = Thinking; P = Personal

CLO–Assessment Mapping

Assessment Method	**Assessment type**	**CLO1**	**CLO2**	**CLO3**	**CLO4**	**CLO5**	**CLO6**
Quiz	Formative	√	√	√	√	√	√
Class Test	Formative	√	√	√			
Mid-Term Exam	Summative	√	√	√			
Assignment	Summative	√	√	√	√	√	√
Presentation	Summative	√	√	√	√	√	√
Viva-Voce	Formative	√	√	√	√	√	√
Final Examination	Summative	√	√	√	√	√	√

Key: √ = CLO assessed by the indicated method

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Course Contents

Part A: Bryophytes (50 Marks)

Title	Detailed Unit Contents	Teaching-Learning Strategies	Evaluation & Assessment Methods	Aligned CLO(s)
1. Introduction and Classification: (Weeks 1–3)	General characters and classification of Bryophytes; range of structures in relation to habit, habitat and distribution; alternation of generations in Bryophytes.	Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Online resources and Video documentation	Quiz, Assignment, Class test, Presentation, and Final exam	CLO1, CLO3
2. Group Profiles and Phylogeny: (Weeks 4–6)	Habit, habitat, distribution, external and internal features, growth, reproduction, spore dispersal mechanism, ecology, importance and phylogeny of the following groups: (i) Hepaticeae, (ii) Anthocerotae and (iii) Musci	Lectures, Multimedia projector, Illustrative Lectures, Visual Slide Analysis, Laboratory-linked Lectures	Mid-Term, Descriptive Exam, Quiz, Final Exam	CLO1, CLO2
3. Type Studies and Life Histories : (Weeks 7–10)	Life histories, morphology, anatomy, and reproduction timelines of (a)*Sphaerocarpales- Sphaerocarpus* (b)*Marchantiales- Riccia and Marchantia* (c)*Jungermanniales- Pelia and Porella* (d)*Anthocerotales-Anthoceros* (e)*Sphagnobrya- Sphagnum*	Lectures, Multimedia projector, Illustrative Lectures, Visual Slide Analysis	Class Test, Final Exam	CLO2
4. Fossil Bryophytes and Origins : (Weeks 11–12)	Geological records of ancient bryophytes; classicical theories regarding origin; evolutionary pathways to land plants, Evolution of gametophyte and sporophyte among bryophytes.	Group Presentations, Historical Case Studies, Presentation, Lectures, Multimedia projector	Presentation, Quiz, Final Exam	CLO4
5. Ecology, Dispersal and	Spore dispersal mechanisms and anatomy; ecological roles in	Field-based Discussions,	Field Report Checklist,	CLO5, CLO6

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Economy: (Weeks 13–14)	pioneering ecosystems; structural soil preservation; economic uses of Bryophytes (Household, Pharmaceutical, Horticultural, Construction, Decorative, Ecological Services, and Bioindicator and Bioremediation.	Lectures, Multimedia projector, Guided Discovery Inquiry	Home Assignment File Review, Viva-Voce Questions, Final Exam	

Part B: Pteridophytes (50 Marks)

Title	Detailed Unit Contents	Teaching-Learning Strategies	Evaluation & Assessment Methods	Aligned CLO(s)
1.Vascular Cryptogams Introduction: (Weeks 15–16)	General characters and classification of Pteridophytes. Origin and evolution of Pteridophytes.	Lecture with Multimedia, Virtual Specimen Spotting,	Quick Quiz on Taxonomy, Final Exam	CLO1, CLO3
2. Stele Evolution Mechanics: (Weeks 17–18)	Types of stele and their evolution.	Lectures, Multimedia projector, Participatory question-answer, Group discussion, Online resources	Mid-Term Exam, Short Viva, Final Exam	CLO3
3. Primitive Group Assessments : (Weeks 19–21)	Morphology, anatomy, reproduction, and economic status of *Psilophyta*, *Lepidophyta* (Heterospory vs. Homospory Focus), and *Calamophyta*.	Comparative Group Lectures, Lectures, Multimedia projector,	Written Assignment, Final Exam	CLO2, CLO3, CLO6
4. Advanced Pterophyta Profiles : (Weeks 22–24)	Habit, habitat, distribution, external and internal features, reproduction, ecological and economic importance and phylogeny of the following groups: 1. Psilophyta: Psilotales 2. Lepidophyta: Lycopodiales and Selaginellales (with reference to heterospory and seed habit) 3. Calamophyta: Equisetales 4. Pterophyta: (a) Definition of Eu- and Leptosporangiatae and development of Eu- and	Macro-photography Analysis, Lectures, Multimedia projector, Group discussion,	Class Test, Quiz, Final Exam	CLO1, CLO2

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	Leptosporangiate sporangia; (b) Eusporangiatae: Ophioglossales; (c) Leptosporangiatae: (i) Filicales-Osmundaceae, Polypodiaceae and Parkeriaceae, (ii) Marsileales and (iii) Salviniales.			
5. Comprehensive Type Studies : (Weeks 25–28)	Life cycles, vegetative structures, and reproductive organs of (i) *Psilopsida- Psilotum* (ii) *Eligulopsida- Lycopodium and Selaginella* (iii) *Calamopsida- Equisetum* (iv) *Eusporangiopsida- Ophioglossum* (v) *Protoleptosporangiopsida- Osmunda* (vi) *Leptosporangiopsida- Pteris, Marsilea and Azolla* Spore dispersal mechanisms in Pteridophyta. Economic importance of Pteridophytes.	Group discussion, Lecture with Multimedia	Presentation, Final Exam	CLO2, CLO3, CLO6

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Course Assessment Framework
Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	Incourse Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

List of Books

Bapna, K. R., & Kachroo, P. (2000). *Hepaticology in India* (Vols. 1–2). Himangshu Publications. Udaipur, Delhi.

Emes, A. J. (1964). *Morphology of vascular plants*. Tata McGraw-Hill Publishing Co., Ltd. Bombay.

Parihar, N. S. (1956). *An introduction to Embryophyta* (Vols. 1–2). Central Book Depot, Allahabad.

Rashid, A. (1976). *An introduction to Pteridophyta*. Vikas Publishing House Pvt. Ltd. New Delhi.

Smith, G. M. (1938). *Crytogamic Botany Vol. II. Bryophytes and pteridophytes*. Mc Graw Hill Book Company, London.

Smith, G. M. (1955). *Cryptogamic Botany* (Vols. 1–2). McGraw-Hill Book Company Inc, London.

Vashista, P. C. (1993). *Botany for Degree students: Pteridophyta*. S. Chand and Company Ltd. New Delhi.

Watson, E. V. (1974). *The structure and life of bryophytes*. B.I. Publications, Bombay-Calcutta-Delhi-Madras.

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Course Code: 8223053	Marks: 100	Credits: 4	Class Hours: 56
Course Title: Gymnosperm and Palaeobotany, Palynology			

Course Description

This course provides a comprehensive overview of the diversity, structural biology, and evolutionary dynamics of seed-bearing and extinct plant lineages, seamlessly integrating Gymnosperms, Palaeobotany, and Palynology. Students will examine the morphology, anatomy, life cycles, and phytogeographic distribution of living gymnosperms—with special reference to taxa in Bangladesh—while tracing the structural transitions connecting advanced pteridophytes to modern seed plants. The paleobotanical component investigates fossil types, preservation processes, geological time scales, and benchmark fossil lineages (such as *Lepidodendron*, *Calamites*, and *Lyginopteris*), highlighting the practical application of fossil floras in stratigraphic correlation and fossil fuel exploration. Concurrently, the course explores foundational and applied palynology, covering sporoderm stratification, NPC classification, and microsporogenesis, alongside applied domains such as melissopalynology (honey purity profiling), aeropalynology (allergen monitoring), paleopalynology, and forensic palynology. Through integrated lectures and laboratory sessions, learners develop analytical competence in morphological description, microscopic identification, and the real-world economic and environmental applications of plant microfossils and gymnosperms.

Course objectives

This course introduces the classification, distinguishing characteristics, morphology, anatomy, reproduction, life cycles, distribution, evolution, and economic importance of gymnosperms, with emphasis on Cycas, Pinus, Ginkgo, and Gnetum. It also covers the fundamentals of palaeobotany, including fossil types, fossilization processes, the geological time scale, fossil age determination, representative fossil plants, and the significance of fossils in understanding plant evolution and their applications in geology and fuel exploration.

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Course learning Outcome (CLOs)

After going through the course, the student would be able to learn the following outcomes:

CLO	Course Learning Outcome	Aligned PLOs
CLO1	Describe the foundational traits, life cycles, and phytogeographic distribution patterns of living gymnosperms, focusing on key resources within Bangladesh.	PLO-1, PLO-2
CLO2	Assess the evolutionary transitions and structural affinities linking advanced Pteridophytes to Gymnosperms and primitive Angiosperms.	PLO-1, PLO-3
CLO3	Interpret paleobotanical indices, fossilization pathways, and the morphological reconstructions of benchmark fossil plant lineages across the Geological Time Scale.	PLO-2, PLO-4

CLO4	Analyze pollen wall stratification, microsporogenesis phases, and palynomorph morphology by applying the standard NPC classification system.	PLO-1, PLO-5
CLO5	Apply palynological metrics in melissopalynology and aeropalynology to map honey purity calendars and forecast seasonal atmospheric allergy risks.	PLO-5, PLO-6, PLO-7
CLO6	Investigate the role of paleopalynology and pharmacopalynology in stratigraphic microfossil correlation, energy basin monitoring, and forensic crop profiling.	PLO-4, PLO-7, PLO-12

Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11	PLO-12
CLO1	√	√										
CLO2	√		√									
CLO3		√		√								
CLO4	√				√							
CLO5					√	√	√					
CLO6				√			√					√

CLO–BNQF Domain Mapping Matrix

CLOs	F	S	T	P
CLO1	√			
CLO2	√		√	
CLO3	√		√	
CLO4	√		√	
CLO5	√	√	√	
CLO6	√	√	√	√

F = Fundamental Domain, S = Social Domain, T = Thinking Domain, P = Personal Domain

CLO–Assessment Mapping

Assessment Method	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
Quiz	√	√	√	√		
Assignment	√	√	√	√	√	√
Class Test	√	√	√	√	√	√
Laboratory/Practical	√	√	√	√	√	√
Field/Project Report	√	√	√	√	√	√
Presentation/Seminar	√	√	√	√	√	√
Viva Voce	√	√	√	√	√	√
Final Examination	√	√	√	√	√	√

Key: √ = CLO assessed by the indicated method

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Course Contents

Part A: Gymnosperm and Palaeobotany (50 Marks)

Unit Title & Contact Hours	Detailed Unit Contents	Teaching–Learning Strategies	Evaluation & Assessment Methods	Aligned CLO(s)
1. Introduction and general characteristics: (Weeks 1–3)	Introduction and general characteristics of Gymnosperms, Classification of Gymnosperms Classification of Sporne (1965), Coulter and Chamberlain (1917), Economic importance of Gymnosperms, and phytogeography of gymnosperms with emphasis on Bangladesh.	Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion,	Quiz, Assignment, Class test, Presentation, and Final exam	CLO1
2. Evolutionary Transitions: (Weeks 4–5)	Evolutionary relationships between advanced pteridophytes, gymnosperms, and angiosperms.	Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation	Quiz, Assignment, Class test, Presentation, and Final exam	CLO1
3. Characteristics and Evolution of Major Gymnosperm Groups : (Weeks 6–9)	Features, Relationships, and Evolution of Major Gymnosperm Groups: Cycadofilicales, Cycadales, Bennettitales, Coniferales, Ginkgoales, Cordaitales, and Gnetales. Morphology, anatomy, reproduction, life cycle, and comparative study of *Cycas*, *Pinus*, and *Gnetum*, Primitive, advanced and relative characters of different gymnosperm genera.	Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation	Laboratory examination, practical assessment, final examination	CLO1
4. Palaeobotany & Fossilization: (Weeks 10–12)	Definition and scope of Palaeobotany, Types of fossils and fossilization process. Fossil types, fossilization processes, Determining the age of fossils. Applied aspects of Paleobotany- exploration of fossil fuels. Outline of different Paleogeological era, period and epoch with mentioning characteristic flora and its events,	Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation	Quiz, class assessment, final examination	CLO2

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	Gondwana flora of India and application of paleobotany (oil and coal)			
5. Fossil Taxa Evaluation and Geological time scale: (Weeks 13–14)	Study of Fossil Pteridophytes: Lepidodendron and Calamites. Study of Fossil Gymnosperms: Cycadophilicales- Lygenopteris, Oldhamia; Bennettitales-Cycadeoidea. Geological time scale of the earth., Appearance and extinction of life forms in different geological periods. Major Evolutionary Trends in Fossil Records	Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation	Assignment, seminar presentation, final examination	CLO2

Part B: Palynology (50 Marks)

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Unit Title & Contact Hours	Detailed Unit Contents	Teaching–Learning Strategies	Evaluation & Assessment Methods	Aligned CLO(s)
1. Palynomorphology Basics: (Weeks 15–18)	Historical review, fundamentals, branches, scope and application. Palynomorphology, Pollen grain-wall, development, character, morphology (primary, secondary and tertiary characters), sporoderm stratification, NPC-system, evolutionary aspect of pollen and spores, palynotaxonomical aspects, pollen flora.	Technical lectures, microscopic observation, laboratory exercises, Lectures, Multimedia projector	Class test, final examination	CLO3
2. Melissopalynology: (Weeks 19–21)	Bee and bee foraging, Pollen load, Honey pollen analysis, Floral source identification, and apicultural calendar Preparation, Marker pollen, Bee flora-importance and management.	Case studies, laboratory analysis, group activities, Lectures, Multimedia projector	continuous assessment	CLO4
3. Aeropalynology & Health: (Weeks 22–24)	Principles of aeropalynology, pollen productivity and release mechanisms, buoyancy, frequency, dissemination, distribution and dispersion of pollen, pollen as atmospheric pollutants and their impacts, scope and importance, airborne pollen monitoring and sampling techniques, pollen traps, environmental factors influencing pollen dispersion, allergenic pollen	Field demonstrations, laboratory practice, data interpretation, Lectures, Multimedia projector	Field report, assignment,	CLO4

	forecasting, and public health applications.			
4. Paleopalynology Exploration: (Weeks 25–26)	Principles, microfossils, reconstruction of vegetation; relation with archaeology and palaeobotany, tracing of pollen in geological era, scope and importance.	Research article review, data analysis, problem-based learning, Lectures, Multimedia projector	Project report, presentation, final examination	CLO2, CLO4
5. Pharmacopalyno -logy and Biogenic palynology: (Weeks 27–28)	Pollen nutrition and health, allergenic and forensic applications, scope and importance, pollen as biological material, and applications in agriculture, horticulture, and plant improvement.	Seminar, group discussion, literature review, Lectures, Multimedia projector	Seminar presentation, peer assessment, final examination	CLO4

Course Assessment Framework
Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	Incourse Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

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List of Books

Gymnosperm and Palaeobotany

Arnold, C. A. (1977). *An introduction to palaeobotany*. Tata McGraw Hill Pub. House Co., New Delhi.

Biswas, C., & Johri, B. M. (1997). *The gymnosperms*. Norasa Pub. House, New Delhi.

Coulter, J. M., & Chamberlain, C. J. (1964). *Morphology of gymnosperms*. Central Book Depot, Allahabad, India.

Mukherji, H. (1997). *Plant groups*. New Central Book Agency, Ltd. Calcutta.

Parihar, N. S. (1955). *An introduction to Embryophyta* (Vols. 1–2). Central Book Depot, Allahabad.

Sharma, O. P. (1980). *Gymnosperms: A treatise*. Progati Prakashan, Meerut, India.

Smith, G. M. (1955). *Cryptogamic botany* (Vol. 2: *Bryophyta and Pteridophyta*). McGraw Hill Co. London.

Vashishta, P. C. (1994). *Botany for degree students* (Vol. 5: *Gymnosperms*). S. Chand and Co. Ltd. Ramnagar, New Delhi.

রায়, কুমার, পাল, নিকুঞ্জ কুমার এবং পাশা, মোস্তফা কামাল। (১৯৯৫)। *অপুষ্পক উদ্ভিদ বিজ্ঞান* (খণ্ড ২)। বাংলা একাডেমি।

Palynology

Bhattacharya, K., Majumder, M. R., & Bhattacharya, S. G. (2008). *An introduction to palynology*. New Central Book Agency, New Delhi, India.

Erdtman, G. (1952). *Pollen morphology and plant taxonomy*. Waltham, MA, USA.

Erdtman, G. (1954). *An introduction to pollen analysis*. Waltham, MA, USA.

Faegri, K., & Iversen, J. (1990). *A textbook of modern pollen analysis*. Copenhagen, Denmark.

Knox, R. B. (1979). *Pollen and allergy*. Edward Arnold, London, UK.

Nair, P. K. K. (1985). *Essentials of palynology*. Asia Publishing House, New Delhi, India.

Saxena, M. R. (1993). *Palynology: A treatise*. Oxford & IBH Publishing, New Delhi, India.

Shivanna, K. R. (2005). *Pollen biology and biotechnology*. Oxford & IBH Publishing Company, New Delhi, India.

Shukla, A. K., Vijoyraghavan, M. R., & Choudhury, B. (1998). *Biology of pollen*. A.P.H. Publishing Corporation, New Delhi, India.

পাশা, এম. কে. (২০০৮)। *পরাগরেণু বিজ্ঞান*। বাংলা একাডেমি, ঢাকা।

PROVISIONAL

Course Code: 8223055	Marks: 100	Credits: 4	Class Hours: 56
Course Title: Taxonomy of Angiosperms			

Course Description

This course introduces the fundamental principles, modern concepts, and practical applications of angiosperm taxonomy and plant diversity. Students will explore the morphology, classification systems, and evolutionary relationships of flowering plants, alongside standard plant naming conventions under the International Code of Nomenclature (ICN). The curriculum covers key diagnostic features and economic importance of major dicotyledonous and monocotyledonous families, modern taxonomic approaches—such as chemotaxonomy, cytotaxonomy, and biosystematics—and essential hands-on skills in herbarium curation, field specimen collection, and plant identification for biodiversity conservation.

Course Objectives

This course provides an understanding of plant diversity, identification, description, nomenclature, classification, affinities, geographical distribution, habit characteristics, and economic importance of flowering plants. It covers the principles and modern approaches of taxonomy, taxonomic characters, evolutionary relationships, herbarium and botanical garden development, and the classification and significance of important angiosperm families with emphasis on plant identification, conservation, and sustainable utilization.

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Course learning outcome (CLOs)

After going through the course, the student would be able to learn the following outcomes:

CLO	Course Learning Outcome	PLOs
CLO1	Apply the rules, exceptions, and recommendations of the International Code of Nomenclature (ICN) to resolve complex plant naming problems.	PLO-1, PLO-2
CLO2	Compare major historical and modern plant classification frameworks (Bentham & Hooker, Engler & Prantl, Hutchinson) to trace taxonomic history.	PLO-1, PLO-3
CLO3	Evaluate plant systematically by integrating modern sub-disciplinary tools, including chemotaxonomy, cytotaxonomy, biosystematics, and numerical dendrogram construction.	PLO-2, PLO-4, PLO-5
CLO4	Differentiate the diagnostic vegetative, floral, and evolutionary traits of major Magnoliopsida (Dicot) and Liliopsida (Monocot) plant families.	PLO-1, PLO-10
CLO5	Execute standard herbarium curation procedures, field sampling methods, and systematic plant preservation techniques.	PLO-5, PLO-9
CLO6	Appraise regional plant resources and national flora distribution profiles to formulate actionable local conservation designs and economic sustainability strategies.	PLO-6, PLO-7, PLO-12

Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11	PLO-12
CLO1	√	√										
CLO2	√		√									
CLO3		√		√	√							
CLO4	√									√		
CLO5					√				√			
CLO6						√	√					√

CLOs mapping with BNQF domain

CLO	**F**	**S**	**T**	**P**
CLO1	√		√	
CLO2	√		√	
CLO3	√		√	√
CLO4	√		√	
CLO5	√	√	√	√
CLO6	√	√	√	√

F = Fundamental Domain, S = Social Domain, T = Thinking Domain, P = Personal Domain

CLO–Assessment Mapping

Assessment Method	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
Quiz	√	√	√	√		
Assignment	√	√	√	√	√	√
Class Test	√	√	√	√	√	
Mid-Term Examination	√	√	√			
Presentation/Seminar	√	√	√	√	√	√
Herbarium Sheet Assessment					√	√
Field Notebook/Field Report				√	√	√
Computer/Analytical Lab Report			√			
Research Paper/Case Analysis		√	√			√
Continuous Practical			√	√	√	√
Spotting/Specimen Identification				√	√	
Flower Dissection/Specimen Study				√	√	
Viva Voce	√	√	√	√	√	√
Final Practical Examination			√	√	√	√
Final Theory Examination	√	√	√	√	√	√

Key: √ = CLO assessed by the indicated method

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Course Contents

Unit Title & Contact Hours	Detailed Unit Contents	Teaching–Learning Strategies	Evaluation & Assessment Methods	Aligned CLO(s)
1. Angiosperm Morphology: (Weeks 1–3)	Morphological concepts and terminology; taxonomic significance of vegetative and reproductive structures; root, stem, and leaf morphology; inflorescence types including cyathium, hypanthodium, verticillaster, and panicle; flower morphology; fruit and seed morphology; and morphological adaptations and applications in plant identification and ecology. Angiosperms: General and key characters. Relationships of Angiosperms: Guiding principles of Angiosperm's relationships; relationships of Angiosperms with other groups and relationships within Angiosperms; molecular phylogeny of Angiosperms.	Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources	Quiz, Assignment, Class test, Presentation, and Final exam	CLO1, CLO2, CLO3, CLO4
1. Principles of Taxonomy: (Weeks 4–5)	Definition, scope, basic components, principles and units of classification, taxonomic hierarchy, aims and objectives of plant taxonomy. Origin and phylogeny of Magnoliopsida and Liliopsida.	Introductory lectures, structural framework overview	Diagnostic classroom quiz, final exam	CLO1
2. Systems of Classification: (Weeks 6–9)	Pre-Darwinian and post-Darwinian classification systems; comparison among the contemporary systems of classifications. Natural: Bentham and Hooker (detailed account), Phylogenetic classification: Englar and Prantl's System, Bessey's System, Hutchinson's System, Angiosperm phylogeny group system	Lectures, Multimedia projector, Participatory question-answer	Mid-term, Quiz, Assignment, Class test, Presentation, and Final exam	CLO1, CLO3
3. Nomenclature: (Weeks 10–12)	International Codes of Nomenclature (ICN/ICBN, BAP/IAPT, ICNCP); binomial nomenclature, author citation, valid publication, priority, name conservation and changes; nomenclatural principles, provisions, and taxonomic characters. Taxonomic Characters: Different	Nomenclatural problem solving, case-study workshops, Lectures, Multimedia projector,	Quiz, Assignment, Class test, Presentation, and Final exam	CLO1

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	types and neglected morphological characters	Participatory question-answer		
4. Herbarium Curation : (Weeks 13–15)	Herbarium and its importance, Functions of herbaria; field collection, specimen preservation, pressing, poisoning, mounting, herbarium techniques, major herbaria, National herbarium of Bangladesh and important herbaria of the world.	Practical curation demonstrations, fieldwork, Lectures, Multimedia projector, Participatory question-answer	Herbarium sheet assessment, field notebook audit, Quiz, Assignment, Class test, Presentation, and Final exam	CLO4
5. Advanced Sub-disciplines of Taxonomy: (Weeks 16–18)	Good and bad characters, exomorphic and endomorphic characters, taxonomic and diagnostic characters, Primary and secondary metabolites, semantides in taxonomy, Chromosomal characters used in taxonomy and their significance,	Lectures, Multimedia projector, Participatory question-answer	Quiz, final exam	CLO2
6 Biosystematics Concepts : (Weeks 19–20)	Population systematics; ecotypes, ecospecies, and coenospecies; biosystematics categories; principles, analysis, and construction of dendrograms; and experimental approaches to natural population studies.	Research paper review, group case analysis, Lectures, Multimedia projector, Participatory question-answer	Quiz, Assignment, Class test, Presentation, and Final exam oral questioning	CLO2
7. Diagnostic Characters and Phylogeny of Angiosperm Families Magnoliopsida (Dicots): (Weeks 21–25)	Vegetative and floral characteristics, floral formula, floral diagrams, classification, and economic importance of selected dicot families: Magnoliaceae, Nymphaeaceae, Tiliaceae, Rubiaceae, Lamiaceae, Polygonaceae, Euphorbiaceae, Acanthaceae, Moraceae Cucurbitaceae, Asclepiadaceae, Apocynaceae and Asteraceae.	Flower dissection, family description workshops, specimen observation, Lectures, Multimedia projector, Participatory question-answer	Continuous spotting exam, theory essay, Final Exam	CLO3
8. Diagnostic Characters and Phylogeny of Angiosperm Families Liliopsida (Monocots): (Weeks 26–28)	Vegetative and floral characteristics, floral formula, floral diagrams, classification, and economic importance of selected monocot families: Typhaceae, Arecaceae, Liliaceae, Poaceae, Cyperaceae and Orchidaceae	Floral formula exercises, spikelet sorting, specimen study, Lectures, Multimedia projector, Participatory question-answer	Lab quiz, final theory examination, Final Exam	CLO3

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Course Assessment Framework Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	Incourse Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

List of Books

Cronquist, A. (1968). *The evolution and classification of flowering plants*. Houghton Mifflin Company, Boston, MA, USA.

Davis, P. H., & Heywood, V. H. (1963). *Principles of angiosperm taxonomy*. Oliver & Boyd, Edinburgh and London, UK.

Lawrence, G. H. M. (1951). *Taxonomy of vascular plants*. The Macmillan Company, New York, NY, USA.

McNeill, J., Barrie, F. R., Buck, W. R., Demoulin, V., Greuter, W., Hawksworth, D. L., Herendeen, P. S., Knapp, S., Marhold, K., Prado, J., Prud'homme van Reine, W. F., Smith, G. F., Wiersema, J. H., & Turland, N. J. (Eds.). (2012). *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code): Adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011*. Koeltz Scientific Books, Königstein, Germany.

Radford, A. E. (1974). *Vascular plant systematics*. Harper & Row Publishers, New York, NY, USA.

Sharma, O.P. (2004). *Plant Taxonomy*. Tata MacGraw Hill Publihing Co. Ltd. New Delhi.

Singh, G. (2004). *Plant systematics: Theory and practice* (2nd ed.). Oxford & IBH Publishing Company, New Delhi, India.

Stace, C. A. (1989). *Plant taxonomy and biosystematics* (2nd ed.). Edward Arnold, London, UK.

হাসান, এম. এ. এবং এম. কে. আলম. (১৯৯৭). *উদ্ভিদ শ্রেণীবিন্যাস তত্ত* (৩য় সংস্করণ), হাসান বুক হাউস, ঢাকা।

PROVISIONAL

Course Code: 8223056	Marks: 100	Credits: 4	Class Hours: 56
Course Title: Practical-II (Higher Cryptogams, Gymnosperm and Palaeobotany, Palynology, Taxonomy of Angiosperms)			

N.B. Practical examination will be carried out in two days with 6 hours duration each under the same Paper code.

Course Description

This practical course provides hands-on laboratory and field-based training in the study, identification, and documentation of higher cryptogams, gymnosperms, fossil plants, palynomorphs, and flowering plants. Students develop essential laboratory competencies—including fresh tissue sectioning, differential staining, temporary and permanent slide mounting, microscopic palynological analysis (using acetolysis and honey pollen tracking), and floral dissection for family- and genus-level identification. Additionally, the course emphasizes core botanical field techniques such as plant collection, archival pressing and chemical poisoning, herbarium curation, and ecological survey reporting, preparing learners for biodiversity monitoring and advanced botanical research.

Course objectives

This practical course develops skills in the collection, observation, identification, classification, and documentation of higher cryptogams, gymnosperms, fossil plants, pollen, and angiosperms using laboratory and field techniques. It emphasizes herbarium preparation, pollen analysis, scientific documentation, field investigation, and taxonomic identification to support botanical research, biodiversity conservation, and professional practice.

Course learning outcome (CLOs)

After going through the course, the student would be able to learn the following outcomes:

CLO	Course Learning Outcome	Aligned PLOs
CLO1	Prepare high-quality microscopic slide mounts, performing precise free-hand tissue slicing and selective staining of cryptogamic and gymnosperm structures.	PLO-1, PLO-5
CLO2	Identify diagnostic anatomical configurations, including stelar networks, coralloid anomalies, anomalous thickness, and fossil casts through visual observation.	PLO-1, PLO-2
CLO3	Isolate and calculate pollen metrics using microscopic micro-maceration and acetolysis approaches for honey tracking and air-trap studies.	PLO-4, PLO-5
CLO4	Dissect complex angiosperm flower organs, constructing precise floral formulas and diagnostic floral diagrams to track specimens to their family and genus levels.	PLO-2, PLO-3
CLO5	Demonstrate professional technical skills in plant field-pressing, chemical poisoning, standard archival mounting, and herbarium cataloging.	PLO-5, PLO-9
CLO6	Maintain structured, professional-grade laboratory notebooks, specimen field logs, and excursion portfolios according to formal scientific standards.	PLO-10, PLO-12

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Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11	PLO-12
CLO1	√				√							
CLO2	√	√										
CLO3				√	√							
CLO4		√	√									
CLO5					√				√			
CLO6										√		√

CLOs mapping with BNQF domain

CLOs	F	S	T	P
CLO1	√		√	√
CLO2	√		√	
CLO3	√	√	√	√
CLO4	√		√	√
CLO5	√	√	√	√
CLO6	√	√		√

F = Fundamental; S = Social; T = Thinking; P = Personal

CLOs mapping with Assessment

Assessment Method	**CLO1**	**CLO2**	**CLO3**	**CLO4**	**CLO5**	**CLO6**
Practical Examination	√	√	√	√	√	
Specimen Identification / Spotting	√	√	√	√	√	
Slide Evaluation	√	√	√	√		
Drawing / Diagram	√	√	√	√		
Collection Assessment				√	√	√
Herbarium Evaluation					√	√
Practical Notebook Assessment	√	√	√	√	√	√
Field Notebook & Excursion Report					√	√
Presentation	√	√	√	√	√	√
Final Practical Examination	√	√	√	√	√	√

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Course Content
Part I: (Marks 50)

(Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany)

Component	**Practical Contents**	**Aligned CLO(s)**	**Teaching–Learning Strategies**	**Evaluation & Assessment Methods**
Bryophyta (15 Marks)	Study, identification, and description of *Riccia*, *Dumortiera*, *Plagiochasma*, *Marchantia*, *Lejeunea*, and *Anthoceros* up to genus; demonstration and recognition of *Riccia fluitans*, *Ricciocarpus natans*, *Sphagnum*, *Physcomitrium*, *Fissidens*, and *Taxithelium*.	CLO1	Laboratory observation, specimen demonstration, microscopic study, guided identification	Practical examination, specimen identification, notebook, Final exam, Viva voice, Presentation
Pteridophyta :(15 Marks)	The following members are to be studied and identified up to the genus: *Lycopodium*, *Selaginella*, *Equisetum*, *Nephrodium*, *Pteris*, *Lygodium*, *Marsilea*, *Azolla* and *Ceratopteris*. The following members are to be demonstrated in the practical classes: *Psilotum*, *Isoetes*, *Salvinia*, *Drynaria*, and *Niphobolus*.	CLO1	Laboratory practical, microscopic observation, specimen comparison	Practical examination, spotting, notebook
Gymnosperms & Palaeobotany: (8 Marks)	Study of museum and fossil specimens; dissection, mounting, description, drawing, and identification of Cycas and *Pinus*; and examination of representative fossil plants.	CLO2	Laboratory dissection, museum study, drawing exercises	Practical examination, drawing, viva
Collections: (7 Marks)	Collection and preservation of bryophyte and pteridophyte specimens.	CLO4	Field collection, specimen preservation	Collection assessment
Practical Notebook: (5 Marks)	Practical Notebook: Laboratory records, observations, scientific illustrations, and labeled diagrams.	CLO1–CLO4	Continuous documentation	Notebook assessment

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Part II: (Marks 50)

(Taxonomy of Angiosperms and Palynology)

Component	**Practical Contents**	**Aligned CLO(s)**	**Teaching–Learning Strategies**	**Evaluation & Assessment Methods**
Taxonomy of Angiosperms: (25 Marks)	Study of vegetative and floral morphology and taxonomic terminology; identification of angiosperm families using taxonomic keys; collection and preparation of herbarium specimens; and field excursion with field notebook and excursion report.	CLO5	Laboratory practical, herbarium preparation, field excursion, identification exercises	Practical examination, herbarium evaluation, spotting
Palynology : (5 Marks)	Pollen collection and permanent slide preparation; pollen morphology and identification; airborne pollen trapping and analysis; and pollen analysis of honey samples.	CLO3	Laboratory practical, microscopy, field demonstration	Slide evaluation, practical test, viva
Collections: (5 Marks)	Collection and preservation of angiosperm specimens.	CLO5	Field collection and preservation	Collection assessment
Field Notebook & Excursion Report : (10 Marks)	Field observations, ecological notes and scientific reporting.	CLO6	Field survey, report writing	Report and notebook evaluation
Practical Notebook: (5 Marks)	Practical records and labeled diagrams.	CLO5	Continuous documentation	Notebook assessment

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Instruction to the Examiners
Part I (Higher Cryptogams and Gymnosperms, Palaeobotany)

Time: 6 hours **Marks: 50**

1. Specimen A & B will be members of Bryophyta (these should be from different class)

	Distribution of marks	Marks
i)	Preparation of slide	2.0
ii)	Neat labelled diagrams	2.0
iii)	Identifying characters	1.5
iv)	Identifications	0.5
	Total	6.0×2=12.0

Specimen C & D will be members of Pteridophyta (non-fern and fern)

	Distribution of marks	Marks
i)	Preparation of slide	2.0
ii)	Neat labelled diagrams	2.0
iii)	Identifying characters	1.5
iv)	Identifications	0.5
	Total	6.0×2=12.0

Specimen / slide will have to be given for identification from Bryophyta and Pteridophyta:

E and F (Bryophyta), G and H (Pteridophyta)

Identifying characters: 1.0
Identification: 0.5
Total 1.5×4= 6.0

4. Specimen A will be from Gymnosperms.

Distribution of marks

Distribution	Marks
I) Preparation of slide	2.0
II) Labelled diagrams	2.0
III) Identifying characters	1.5
IV) Identification	1.5
Total	7.0

Collection (Bryophyta, Pteridophyta and Gymnosperms): 8.0
Practical Note Book: 5.0

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Part II (Taxonomy of Angiosperm and Palynology)
Time: 6 hours Marks: 50

1. Specimen A will be angiospermic plants with flowers for identification up to family.

	Distribution of marks	Marks
i)	Labelled diagrams of the flowers and floral parts	2.0
ii)	Description of the specimen with floral formula	2.0
iii)	Floral diagram	1.0
iv)	Identification up to family	2.0
	Total	7.0

2. Specimen B will be angiospermic plants with flowers for identification up to genus.

	Distribution of marks	Marks
i)	Labelled diagrams of the flowers and floral parts	2.0
ii)	Description of the specimen with floral formula	2.0
iii)	LS f flower	1.0
iv)	Floral diagram	1.0
v)	Identification up to genus	2.0
	Total	8.0

3. Specimen C, D, E, F, G & H should be selected from common available flowering plants of the locality for spotting. Students will write only their scientific names.

Scientific name: 1.0×6= 6.0

4. Specimen I & J should be special morphological features of plant parts/inflorescence/ flowers.

Identifying characters: 1
Identification: 0.5
Total 2×2= 4.0

5. Specimen B will be pollen from fresh flowers/honey samples.

Distribution of marks

Distribution	Marks
I) Preparation of slide	2
II) Labelled diagrams	2
III) Comment	1
Total	5.0

5. Collections (Minimum 10 herbarium sheet) 5.0

6. Field Note Book and Excursion Report: 10.0
7. Practical Note Book: 5.0

PROVISIONAL

Course Code: 8223157	Marks: 100	Credits: 4	Class Hours: 56
Course Title: Zoology II (Chordates, Evolutionary and Applied Zoology)			Exam Duration: 4 Hours

Course Objectives

To provide students with a comprehensive understanding of chordate diversity, comparative anatomy, and evolutionary biology, alongside foundational knowledge in palaeontology, zoogeography, ecology, genetics, and applied zoology. This course aims to develop taxonomic expertise, analytical skills in animal breeding and genetics, and practical awareness of conservation, fisheries, poultry, and pest management relevant to Bangladesh's socio-economic and environmental context.

Course Learning Outcomes (CLOs)

After going through the course, students will be able to learn the following outcomes

CLO1	Classify chordate taxa (Chondrichthyes to Mammalia) up to the order level by applying diagnostic morphological characteristics, and evaluate the evolutionary significance of transitional groups through palaeontological evidence.
CLO2	Compare and contrast the organ systems (skeletal, digestive, circulatory, respiratory, excretory, nervous, reproductive, and endocrine) across 9 type study organisms (Ascidia* to Cavia) to explain anatomical adaptations to diverse habitats and modes of life.
CLO3	Analyze zoogeographical regions of the world, marine ecological zonations, and biodiversity concepts to assess conservation challenges and sustainable management of natural resources.
CLO4	Apply principles of Mendelian genetics, multiple alleles, mutations, and chromosomal sex determination to solve inheritance problems and explain animal breeding strategies.
CLO5	Evaluate the principles and practices of applied zoology—including agricultural pest management, integrated fish farming, and poultry farming—and propose solutions for enhancing productivity and socio-economic conditions in Bangladesh.

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Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11	PLO-12
CLO1	√	√										
CLO2	√	√	√									
CLO3	√	√		√	√	√	√					
CLO4	√	√										
CLO5	√	√	√	√	√	√	√					

Course Contents

Week	Topic	Teaching Learning Strategy	CLOs
1-14	**Group – A: Chordates: (50 Marks)** 1. Broad classification of the following up to order with general and diagnostic characteristics of each taxonomic category with examples (preferably local) and affinities- Chondriththyes, Osteichthyes, Amphibia, Reptilia, Aves and Mammalia. 2. Type study of the following with their systematic position, habitats, distribution, external morphology, anatomy including skeletal, digestive, circulatory, respiratory, excretory, nervous, reproductive and endocrine systems; food & feeding habits and mode of life - *a.* Urachordata : *Ascidia* *b.* Cephalochordata : *Branchiostoma* *c.* Cephalaspimorpha: *Petromyzon* *d.* Chondrichthyes : *Scoliodon* *e.* Osteichthyes : *Labeo rohita* *f.* Amphibia : *Bufo* *g.* Reptilia : *Hemidactylus* *h.* Aves : *Columba livia* *i.* Mammalia : *Cavia porcellus.*	Lectures and Group discussions Fossil Timeline Jigsaw Virtual Dissection Lab Organ System Expert Jigsaw	CLO1 CLO2
15-28	**Group – B (50 Marks)** **Palaeontology, Zoogeography, Ecology, Genetics & Animal Breeding and Applied Zoology:** **Palaeontology:** Geologocal time table; extinction events of Mesozoic reptiles and dinosaurs; palaeontological history of Horse & Man; microfossil types and their structures. **Zoogeography:** Zoogeographical regions and sub-regions of the world, their boundaries, physical characteristics, climatic conditions, flora and fauna. **Ecology:** Marine ecology; Zonation and Animal Adaptation to Different Zonations; Concept of Biodiversity;	Lecture, Group Discussion, Assignments and tutorial sessions Zoogeographical Mapping Marine Zonation Poster Punnett Square Problem-Solving Mutation Case Studies Integrated Farming System Design Pest Identification & Management Plans	CLO3 CLO4 CLO5

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	Concept and Classification of Resources; Conservation of Natural Resources; Renewable and Non-Renewable Resources. **Animal Genetics:** Laws of inheritance, gene interactions and frequency, genotype frequency, Hardy-Weinberg Law, Mutation, genetic drift, Continuous variation, heritability, and repeatability of traits. **Animal Breeding:** Pedigree, progeny testing; Inbreeding, outbreeding, crossbreeding, and grading up; Selection response, selection index, and breeding value estimation (EBV); Marker-assisted selection and genomic selection in livestock. **Applied Zoology:** 1. **Major Branches:** Entomology, Fisheries, Wildlife Biology, Parasitology and others. 2. **Agricultural Pests:** Major Pests of Rice, Jute, Sugarcane & stored grain. 3. **Integrated Fish Farming:** Types; Poultry, Livestock and Paddy-cum -Fish Culture. 4. **Poultry farming:** System of poultry farming, diseases management, economic impacts.		

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Course Assessment Framework:
Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	Incourse Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

List of Books

Begon, M., & Townsend, C. R. (2021). *Ecology: From individuals to ecosystems* (5th ed.). Wiley-Blackwell.

Benton, M. J. (2014). *Vertebrate palaeontology* (4th ed.). Wiley-Blackwell.

Gupta, S. K. (2019). *Applied zoology*. Narendra Publishing House.

Hafez, E. S. E., & Hafez, B. (2013). *Reproduction in farm animals* (7th ed.). Wiley-Blackwell.

Hickman, C. P., Jr., Keen, S. L., Eisenhour, D. J., Larson, A., & I'Anson, H. (2024). *Integrated principles of zoology* (19th ed., International student ed.). McGraw Hill.

Jordan, E. L., & Verma, P. S. (2022). *Chordate zoology* (14th ed.). S. Chand and Company.

Kardong, K. V. (2019). *Vertebrates: Comparative anatomy, function, evolution* (8th ed.). McGraw-Hill Education.

Klug, W. S., Cummings, M. R., Spencer, C. A., Palladino, M. A., & Killian, D. J. (2021). *Concepts of genetics* (12th ed.). Pearson.

Pough, F. H., Janis, C. M., & Heiser, J. B. (2013). *Vertebrate life* (9th ed.). Pearson.

PROVISIONAL

Course Code: 8223158	**Marks: 50**	**Credits: 2**
Course Title: Zoology Practical II (Chordates)		

1. **Study of Museum Specimens:** Representative of Chordate phyla (at least 35 specimens to be studied)**.**

Chordates*:* *Ascidia mentula, Scoliodon laticaudus, Labeo rohita, Labeo calbasu, Catla catla, Cirrhinus mrigala, Channa striata, Channa punctata, Channa marulius, Clarias batrachus, Heteropneustes fossilis, Anabas testudineus, Wallago attu, Tenualosa Ilisha, Puntius sophore, Mystus vittatus, Pangasius pangasius, Ompok pabda, Mystus aoer, Mastacembelus armatus, Chanda nama, Monopterus cuchia, Labeo bata, Bufo melanostictus, Microhyla ornata, Rana tigrina, Naja kaouthia, Naja naja, Ophiophagus hannah, Python molurus, Calotes versicolor, Copsychus saularis, Corvus splendens, Acridotheres tristis, Passer domesticus, Halcyon smyrnensis, Columba livia, Macaca mulatta, Axis axis, Felis chaus, Platanista gangetica.*

2. **Study of Permanent Slides:** Whole mount, body parts, various cells & tissues and different larvae (at least 20 slides to be studied).
3. **Study of Bones:** Comparative study of the skeleton of amphibian, reptile, bird and mammal.
4. **Dissection: Dissection of the following Chordate Specimens-**
   a. Bufo/ any Carp - Brain and Cranial Nerves.
   b. Lata fish-Afferent and Efferent Blood Vessels
   c. Bufo - Circulatory System.
5. Temporary mounting of scales and fresh water organisms (staining 2+ mounting 2+ drawing 2 + labeling 2)
6. **Fresh Water Studies:** Identification of plankton and benthic microfauna in fresh water samples.

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Distribution of Marks for Second Year Final Practical Examination

No.	Particulars			Marks
1.	**Dissection:** One chordate item (Dissection – 5, display – 2, drawing & labeling - 3)			10
2.	Temporary mounting (staining 2+ mounting 2+ drawing 2 + labeling 2)			08
3.	Spotting of museum specimens			
	a.	Vertebrate specimens	4 items × 2 = 08 marks	
	b.	Permanent slides	3 items × 2 = 06 marks.	
	c.	Bones	2 items × 2 = 04 marks.	
			9 items × 2.0	18
4.	Freshwater studies (2 species of micro fauna to be shown – identification and , characteristics 1) – 2 items × 2 = 4			04
5.	Practical Class Note Books =			06
6.	Oral Test			04
			Total	50

Course Code: 8222861	Marks: 50	Credits: 2	Class Hours: 28
Course Title: Environmental Chemistry			

Course Description

This course provides a comprehensive introduction to the chemical principles governing the natural environment and the impact of anthropogenic activities on earth systems. It encompasses a detailed study of the structural segments of the environment atmosphere, hydrosphere, lithosphere, and biosphere and focuses on the chemical pathways, transport dynamics, and transformations of pollutants. Students will explore the mechanisms behind critical global phenomena, including acid rain, the greenhouse effect, ozone depletion, and bio-magnification. The curriculum emphasizes quantitative water quality metrics (pH, DO, BOD, COD), modern wastewater treatment processes, soil degradation vectors, and the biochemical toxicology of toxic persistent compounds like PCBs and heavy metals. Through theoretical frameworks, case studies, and numerical assessments, this course equips students with the essential analytical tools needed to evaluate environmental degradation and formulate sustainable mitigation strategies.

Course Objectives

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

1. Develop a fundamental understanding of the chemical composition, interactions, and structural layers defining environmental segments.
2. Analyze the chemical reactions, source identification methods, and transport pathways of hazardous air, water, and soil pollutants.
3. Evaluate industrial and municipal water contamination by measuring key water quality parameters and understanding standard purification technologies.
4. Explain the biochemical mechanisms of toxicity, bioaccumulation, and environmental hazards associated with heavy metals and persistent organic compounds.
5. Apply physical and chemical principles to design sustainable control mechanisms for industrial effluents, urban waste management, and soil remediation.
6. Cultivate scientific reasoning, problem-solving abilities, and an ethical foundation required to address domestic and global environmental challenges.

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Course Learning Outcomes (CLOs)

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

CLO	Course Learning Outcome	Bloom's Level
CLO 1	Define and explain the fundamental components of the environment and their systemic interactions.	Understand
CLO 2	Analyze the sources, chemical behavior, transport, and environmental consequences of air, water, and soil pollutants.	Analyze
CLO 3	Evaluate key water and wastewater quality parameters, including pH, DO, BOD, and COD, and interpret their environmental significance.	Evaluate

CLO 4	Assess the biochemical toxicity, environmental impacts, and control methods of heavy metals and hazardous compounds such as PCBs.	Evaluate

Mapping of CLOs to PLO Matrix

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11	PLO-12
CLO1	√	√										
CLO2	√	√		√		√	√					
CLO3	√	√	√	√		√	√					
CLO4	√	√		√	√	√	√					

Course Contents

The original topics have been chronologically balanced across the 28 class hours within 28 weeks using the layout patterns validated in the curriculum text:

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Week	Topics	Teaching-Learning Strategy	Assessment Strategy	CLO
Week 1-3	**1. Environment:** Introduction components of environment, factors affecting environment, environmental management, environment and health, environmental chemistry, segments of environment – atmosphere, hydrosphere, lithosphere and biosphere, structure of atmosphere.	Interactive Lecture, Group Discussion, Concept Mapping	Quiz, Class Test, Short Assignment	CLO1
Week 4-7	**2. Pollution and Pollutants:** Pollution, environmental pollution, pollutant, classification of pollutants, types of pollution. PCBs and their sources and hazards, Detection & estimation of PCBs. Bio-magnification/Biomultification.	Lecture, Case Study Analysis, Group Discussion	Class Test, Assignment, Viva-voce	CLO2 CLO4
Week 8-14	**3. Air Pollution:** Introduction, air quality, major sources of air pollution, gaseous pollutants. Acid rain-how acid rain is formed, adverse effects of acid rain. Greenhouse effect- how the greenhouse effect is produced, consequences of greenhouse effect and global warming. El Niño phenomenon and its effect. Ozone depletion, mechanism of ozone depletion, effects of ozone depletion.	Lecture, Multimedia Presentation, Problem-Based Learning	Quiz, Mid Term Exam, Assignment	CLO2
Week 15-19	**4. Water Pollution:** Introduction, classification of water pollutants. Physical, chemical and biological characteristics of wastewater. Industrial wastewater treatment, municipal water treatment. Water quality parameters and standards, measurements of important parameters such as pH, DO, BOD,	Interactive Lecture, Numerical Exercises, Laboratory Demonstration	Class Test, BOD/COD Problems, Report Writing	CLO3

	COD and temperature for water quality assessments.			
Week 20-24	**5. Soil Pollution:** Composition of soil, importance of soil to the biosphere, sources of soil pollution. Effects of soil pollution-synthetic fertilizer and pesticides, effects of industrial effluents, effects of urban wastes, control of soil pollution.	Lecture, Case Study Analysis, Group Discussion	Quiz, Assignment	CLO2
Week 25-28	**6. Heavy metals in the Environment:** Trace metals, light metals and heavy metals, deadly heavy metals, sources of heavy metals, biochemical effects, toxicity, toxicology, control and treatment of mercury, chromium, arsenic and lead.	Lecture, Problem-Based Learning, Course Revision	Final Assessment, Viva-voce	CLO4

Course Assessment Framework

Total Course Marks: 50

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	4%
	Incourse	10%
	Quiz / Assignment Presentation	6%
Summative Assessment (80%)	Final Examination • Students will have to answer 4 questions out of 6 • 10 marks per question ($4 \times 10 = 40$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

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List of Books

Dara, S. S., & Mishra, D. D. (2006). *A textbook of environmental chemistry and pollution control*. S. Chand Publishing.

De, A. K. (2017). *Environmental chemistry* (8th ed.). New Age International Publishers.

Manahan, S. E. (2010). *Environmental chemistry* (9th ed.). CRC Press.

Sharma, B. K., & Kaur, H. (2018). *Environmental chemistry* (16th ed.). Goel Publishing House.

Course Code: 8222859	Marks: 100	Credits: 4	Class Durations: 56
Course Title: General Chemistry-II			

Course Description

This course provides students with a comprehensive understanding of fundamental concepts and principles of general chemistry, including the chemistry of nonmetals and metals, thermodynamics, chemical kinetics, electrochemistry, catalysis, solid-state chemistry, coordination chemistry, aromatic and organic reactions, carbohydrates, amino acids, and polymers. The course emphasizes the understanding of chemical principles, structures, reactions, mechanisms, properties, and applications across inorganic, physical, organic, and coordination chemistry.

Course Objectives

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

1. Understand the fundamental properties and chemical behaviour of nonmetals, metals, transition metals, and inner transition metals.
2. Explain the principles of thermodynamics, energy changes, chemical kinetics, electrochemistry, and catalysis.
3. Describe the structures, properties, and characteristics of crystalline and amorphous solids and coordination compounds.
4. Explain aromaticity, heterocyclic compounds, major organic reactions, and their mechanisms and applications.
5. Understand the structures, classification, properties, and reactions of carbohydrates, amino acids, and polymers.
6. Apply fundamental chemical concepts to explain chemical properties, reactions, mechanisms, and related phenomena.

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Course Learning Outcomes (CLOs)

CLO	Course Learning Outcome	Bloom's Level
CLO1	Explain the general properties, structures, bonding, electronic characteristics, and chemical behaviour of nonmetals, metals, transition metals, and inner transition metals.	Understand
CLO2	Explain and apply fundamental principles of thermodynamics, energy changes in chemical reactions, chemical kinetics, electrochemistry, and catalysis.	Apply
CLO3	Describe the properties and structures of solids and explain fundamental concepts of coordination chemistry, including coordination compounds, ligands, nomenclature, bonding, and stability.	Understand

CLO4	Explain aromaticity, aromatic electrophilic substitution reactions, heterocyclic compounds, and major organic reactions with their mechanisms and applications.	Analyze
CLO5	Describe the definition, classification, structures, properties, and reactions of carbohydrates and amino acids and explain the basic concepts and classifications of polymers.	Understand
CLO6	Analyze chemical concepts, reactions, structures, mechanisms, and properties across inorganic, physical, organic, and coordination chemistry.	Analyze

Mapping CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11	PLO-12
CLO1	√	√										
CLO2	√	√										
CLO3	√	√										
CLO4	√	√										
CLO5	√	√										
CLO6	√	√		√								

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Course Content

Module No.	Contents	Teaching–Learning Strategies	Assessment Methods	CLOs
1	**Nonmetals:** General properties of nonmetals, ortho and para hydrogen molecules, allotropy of carbon, catenation, halogens and their basic properties, chemistry of noble gases.	Lecture, interactive discussion, concept explanation, molecular representation	Written examination, class test, short questions	CLO1
2	**Metals:** Metallic bond, electron sea theory of metallic bond, characteristics of metals, band theory of conductivity, conductors, semiconductors and insulators, transition metals and inner transition metals colour and magnetism in transition metal chemistry.	Lecture, discussion, diagrams, conceptual problem-solving	Written examination, class test, short questions	CLO1, CLO6
3	**Energy changes in chemical Reactions:** System and surroundings, open system and closed system, thermodynamics, state functions, the first law of thermodynamics, the	Lecture, numerical problem-solving, board work,	Numerical problems, written examination,	CLO2, CLO6

	concept of internal energy and enthalpy, measurement of enthalpy changes, enthalpy of formation, Hess's law, lattice enthalpy, Born-Haber cycle, second law of thermodynamics, entropy and free energy.	discussion	class test	
4	**Rates of chemical Reactions:** Reaction rate, rate constant, rate law, order of reactions, first order reaction, half-life, order and molecularity, effect of temperature on the rate of reaction, collision theory and reaction rates, activation energy, Arrhenius equation.	Lecture, numerical exercises, graphical explanation, problem-solving	Numerical problems, written examination, class test	CLO2, CLO6
5	**Electrochemistry:** Redox reactions, electrolytic and galvanic cells, cell notation, standard reduction potentials, emf of cells, the effect of concentration of cell emf, batteries, corrosion.	Lecture, cell-diagram demonstration, problem-solving, discussion	Written examination, numerical problems, class test	CLO2, CLO6
6	**Catalysis:** Catalyst, homogeneous catalysis, enzyme catalysis, auto catalysis.	Lecture, discussion, examples, conceptual explanation	Written examination, short questions, class test	CLO2
7	**Solids:** Properties of solids, crystalline and amorphous solids, distinction between crystalline and amorphous solids, isomorphism, polymorphism and allotropy, crystal lattice unit cell crystal systems Bragg's law.	Lecture, diagrams, model/visual demonstration, discussion	Written examination, short questions, problem-solving	CLO3, CLO6
8	**Coordination Chemistry:** Coordination compounds, ligands, coordination number, nomenclature, structures of complex compounds, Werner's primary and secondary valency concept, sidwick's electronic concept, valence bond theory, stability of coordination compounds.	Lecture, structural representation, nomenclature exercises, discussion	Written examination, nomenclature exercises, class test	CLO3, CLO6
9	**Aromatic Compounds:** Aromaticity aromaticity of benzene, Electrophillic aromatic substitution reactions with reference to nitration halogention, sulphonation and alkylation.	Lecture, structural representation, reaction mechanism	Written examination, reaction-based questions, class test	CLO4

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	Heterocyclic compounds: Pyrrole, furan, thiophene, pyridine.	discussion, problem-solving		
10	**Organic reactions:** Brief study on Electrophilic addition, Nucleophilic addition, Elimination reaction, condensation reaction, oxidation, and reduction reactions and organic compounds. Mechanism and application of the following reactions, Friedel Craft reaction, Clemmenson reduction, Wolf Krishner reduction, Perkin reaction, Claisen reaction, Cannizzaro reaction and Aldol condensation.	Lecture, reaction mechanism demonstration, structural representation, problem-solving	Written examination, reaction mechanisms, class test	CLO4, CLO6
11	**Carbohydrates:** Definition, classification, structure and reactions of monosacchanides. Polysaccharide-cellulose and strach.	Lecture, structural representation, discussion, reaction-based learning	Written examination, short questions, class test	CLO5
12	**Amino Acids:** Structures classification, synthesis physical and chemical properties of amino acids.	Lecture, structural representation, discussion, problem-solving	Written examination, short questions, class test	CLO5
13	**Polymer Chemistry:** Polymers homopolymer, heteropolymer, low density and high density polymer, copolymers, studies of some polymers- polyvinylchloride, nylon 66, silk and wool.	Lecture, classification charts, discussion, examples	Written examination, short questions, class test	CLO5

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Course Assessment Framework Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	Incourse Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

List of Books

Cotton, F. A., Wilkinson, G., & Gaus, P. L. (1987). *Basic inorganic chemistry*. John Wiley & Sons.

Ebbing, D. D., & Wrighton, M. S. (1996). *General chemistry*. Houghton Mifflin.

Finar, I. L. (1973). *Organic chemistry: Volume I: The fundamental principles*. Longmans.

Haider, S. Z. (n.d.-a). *Introduction to modern inorganic chemistry*. Friends International.

Haider, S. Z. (n.d.-b). *Selected topics on advanced inorganic chemistry*. Students' Publication.

Huque, M. M., & Nawab, M. A. (n.d.). *Principles of physical chemistry*. Students' Publications.

Madan, R. D. (n.d.). *Modern inorganic chemistry*. S. Chand & Company Ltd.

Malik, W. U., Tuli, G. D., & Madan, R. D. (n.d.). *Selected topics in inorganic chemistry*. S. Chand & Company Ltd.

Morrison, R. T., & Boyd, R. N. (n.d.). *Organic chemistry*.

Silberberg, M. (2009). *Chemistry: The molecular nature of matter and change*. McGraw-Hill Higher Education.

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Course Code: 8222159	**Marks: 100**	**Credits: 4**	**Credit Hours:** 56
Course Title: Social Work Practice (Allied Course)			

Course Description

This course provides an introductory and comprehensive understanding of Social Work as a knowledge-based, value-oriented and practice-focused discipline. It introduces students to the fundamental concepts, principles, values, ethics, historical development and contemporary fields of Social Work practice in Bangladesh and global context. The course highlights Social Work as an emerging profession in Bangladesh and examines its applications in hospitals, government social welfare programs, NGOs, community settings, probation and correctional services. It also explores major social problems and social services, basic Social Work methods and skills, social research, climate justice, sustainable development, and the implications of the Fourth and Fifth Industrial Revolutions and Artificial Intelligence for Social Work. Through field-based learning, students will develop basic communication, analytical, problem-solving, digital, AI-assisted and employability skills relevant to contemporary society and public and private service sectors.

Course Rationale and Objectives

1. **Introduce students to** the fundamental concepts, principles, values, ethics, scope and contemporary relevance of Social Work;
2. **Provide students with** a brief understanding of the historical emergence and development of Social Work in Bangladesh and the global context, and its evolution as an emerging profession;
3. **Familiarize students with** major fields of Social Work practice in Bangladesh, including hospitals, government social welfare services, NGOs, community settings, probation and correctional services;
4. **Develop students' ability to understand and respond to** contemporary social problems through basic Social Work methods, communication, helping, advocacy, networking, problem-solving, climate justice and sustainable development perspectives;
5. **Develop awareness of** the implications of the Fourth and Fifth Industrial Revolutions, Artificial Intelligence and digital transformation for Social Work practice, professional development and employment;
6. **Develop students' basic research, field-based and employability skills** through evidence-based learning, responsible use of AI tools, field observation, teamwork, communication, analytical reasoning and reflective practice.

Course Learning Outcomes (CLOs)

CLO Code	Bloom's Revised Taxonomy Stage	BNQF Learning Outcome Domains	Learning Outcomes
CLO1	Remember and Understand	Fundamental Skill	Explain the fundamental concepts, principles, values, ethics, scope, and historical foundations

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			of Social Work, Social Welfare, and related social development practices.
CLO2	Understand and Analyze	Fundamental Skill	Describe and analyze the emergence, development, and contemporary practice of Social Work in Bangladesh and the global context.
CLO3	Analyze	Thinking Skill	Analyze major social problems, social services, Social Work interventions, basic methods, research approaches, and emerging social risks from individual, community, and societal perspectives.
CLO4	Apply and Evaluate	Societal Skill	Apply basic Social Work knowledge, communication, helping, advocacy, networking, and problem-solving skills to contemporary social issues and field-based situations.
CLO5	Evaluate and Create	Personal Skill	Evaluate and develop personal digital, AI-assisted, analytical, communication, teamwork, adaptability, and employability skills to respond effectively to the challenges of the Fourth and Fifth Industrial Revolutions.
CLO6	Evaluate and Create	Societal Skill	Develop evidence-informed and socially responsible responses to social problems, climate vulnerability, social inequality, and sustainable development challenges through Social Work perspectives.

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CLO to PLO Mapping Matrix

CLO/ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	✓✓	✓								✓	✓	✓✓
CLO2	✓✓	✓✓		✓		✓			✓	✓	✓	✓
CLO3	✓✓	✓✓	✓	✓✓	✓✓	✓	✓	✓	✓	✓✓	✓	✓
CLO4	✓	✓✓	✓	✓✓	✓	✓✓	✓	✓	✓✓	✓✓	✓	✓✓
CLO5	✓	✓✓	✓	✓✓	✓	✓✓	✓✓		✓✓	✓	✓✓	✓✓
CLO6	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓	✓✓	✓✓	✓✓	✓✓	✓✓

✓✓ = Strong Relation	✓ = Moderate Relation	Blank = Limited or No Relation

Course Contents

Week	Topics	Teaching-Learning Strategy	Assessment Strategy	CLOs Alignment
1-3	**Chapter 1: Basic concepts and Issues relating to Social Work:** Social Work, Social Welfare, Social Reform, Social Legislation, Social Security, Social Development, Good Governance, Relevancy to social work with allied disciplines.	Interactive lecture; concept mapping; short case analysis; classroom discussion; real-life examples from Bangladesh.	Class Test/Quiz, Assignment/Written Task, Presentation/Viva, Class Participation & Learning Activity, Practical/ Field-based Task/ Project, Final Exam	CLO1, CLO6
4-6	**Chapter 2: Social Work: Global and Bangladesh Perspective:** Origin and evolution of Social Work; major stages of development in the UK and USA, social reform, reformers and humanitarian movements in undivided India; Development of Social Work in Bangladesh.	Lecture; timeline activity; visual presentation; comparative discussion; documentary/video-based learning.	Class Test/Quiz, Assignment/Written Task, Presentation/Viva, Class Participation & Learning Activity, Practical/ Field-based Task/ Project, Final Exam	CLO1, CLO2
7-8	**Chapter 3: Social Work Profession and Its Practice**: Profession, occupation, characteristics of a profession; Social Work as an emerging profession in Bangladesh: problem and prospects, probation, parole and correctional services, counselling and positive parenting.	Case study; practitioner interaction; role play; field-based examples; problem-based learning.	Class Test/Quiz, Assignment/Written Task, Presentation/Viva, Class Participation & Learning Activity, Practical/ Field-based Task/ Project, Final Exam	CLO2, CLO3, CLO4
9-10	**Chapter 4: Social Problems and Social Services in Bangladesh** Concept, characteristics, major social problems in Bangladesh and its interventions, social policy and planning for social problem mitigation.	Problem-based learning; case analysis; group discussion; service-mapping exercise; short presentations.	Class Test/Quiz, Assignment/Written Task, Presentation/Viva, Class Participation & Learning Activity, Practical/ Field-based Task/ Project, Final Exam	CLO3, CLO4, CLO6
11-13	**Chapter 5: Social Work Methods and Skills**: Types, methods and practicing skills in Social Work; rapport building, advocacy, networking.	Demonstration; role play; simulation; peer learning; skills practice; case	Class Test/Quiz, Assignment/Written Task, Presentation/Viva, Class Participation	CLO3, CLO4, CLO5

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		exercises.	& Learning Activity, Practical/ Field-based Task/ Project, Final Exam	
14-16	**Chapter 6: Industrial Transformation and Emerging Technologies:** Renaissance, Industrial Revolution, globalization; 4th IR and emerging social risks; AI and Social Work; digital literacy, analytical ability; communication; problem-solving; adaptability; ethical use of AI; 5th IR and need of human-centered technology.	Interactive lecture; AI-assisted learning; digital tools demonstration; scenario analysis; group problem-solving; presentation.	Class Test/Quiz, Assignment/Written Task, Presentation/Viva, Class Participation & Learning Activity, Practical/ Field-based Task/ Project, Final Exam	CLO3, CLO5, CLO6
17-19	**Chapter 7: Climate Justice and Sustainable Development**: Climate change and justice; migration and livelihood insecurity; community resilience; Sustainable Development Goals (SDGs), Social Work responses to climate-related problems, Green Social Work.	Case study; community mapping; SDG activity; problem-solving exercise; field observation.	Class Test/Quiz, Assignment/Written Task, Presentation/Viva, Class Participation & Learning Activity, Practical/ Field-based Task/ Project, Final Exam	CLO3, CLO5, CLO6
20-22	**Chapter 8: Social Research and AI Tools**: Social Research: types, methods, techniques and tools; sampling, qualitative and quantitative data; research proposal; ethics in research; basic use of AI tools in social research.	Mini research exercise; questionnaire design; sampling exercise; data interpretation; AI/digital demonstration; group assignment.	Class Test/Quiz, Assignment/Written Task, Presentation/Viva, Class Participation & Learning Activity, Practical/ Field-based Task/ Project, Final Exam	CLO3, CLO5, CLO6
23-25	**Chapter 9: Social Work Practice and Field-Based Learning**: Social Work practice in hospital, GO and NGOs, field work, report writing; presentation and teamwork.	Field visit (mandatory); observation; structured field notes; interview with practitioner/service provider; reflective report; group presentation; viva/field assessment.	Class Test/Quiz, Assignment/Written Task, Presentation/Viva, Class Participation & Learning Activity, Practical/ Field-based Task/ Project, Final Exam	CLO4, CLO5, CLO6

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26-28	**Chapter 10: Social Philosophy and Religion**: Social Philosophy, Individualism, Socialism, Practice of Welfare State in Bangladesh, Religions and Humanitarian Basis of Social Work.	Interactive lecture; concept mapping; short case analysis; classroom discussion; real-life examples from Bangladesh.	Class Test/Quiz, Assignment/Written Task, Presentation/Viva, Class Participation & Learning Activity, Practical/ Field-based Task/ Project, Final Exam	CLO1, CLO3, CLO6

Course Assessment Framework
Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	Incourse Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

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List of Books

Barker, R. L. (1995). *The Social Work Dictionary.* Washington DC: NASW Press.
Dominelli, L. (2012). *Green social work: From environmental crises to environmental justice*. Polity Press
Friedlander, W.A. (1977). *An Introduction to Social Welfare*. New York: Prentice Hall.
Houssian, M.N. & Alauddin, M. (1990). *Introduction to Social Work Methods*. Dhaka: Bangladesh, Anwari publication.
Morales, A. & Sheafor, B. W. (1977). *Social Work: A Profession of Many Faces*. Boston: USA, Allyn and Bacon.
Skidmore, R. A. & others. (1993). *Introduction to social work.* New Jersey: USA, Prentice Hall.
ইসলাম, ড. মো. নুরুল (২০১৪)। *সমাজকর্ম পরিচিতি*। তাসমিয়া পাবলিকেশন্স।
ইসলাম, মোঃ শহিদুল এবং হাসান, মো. খালিদ। (২০২৫)। *সমাজকর্ম পরিচিতি*। মাইলস্টোন পাবলিকেশন্স।
উদ্দিন, আহমেদ আয়েশ (১৯৭৮)। *রাষ্ট্রচিন্তা পরিচিতি প্লেটো থেকে মার্ক* (২য় সংস্করণ)। আইডিয়াল লাইব্রেরী।
করিম, রেজাউল (২০০৬)। *সমাজকর্ম: ধারণা , ইতিহাস ও দর্শন*। জ্ঞানকোষ প্রকাশনী।
রহমান, হাবিবুর, দাস, তুলসী, ইসলাম, মো. ফখরন্নল ও ইসলাম, মো. রেজাউল (অনূদিত) (১৯৯৭)। *সমাজকর্ম অনুশীলন*। গতিধারা।

Course Code: 8222059	Marks: 100	Credits:4	Class Hours: 56
Course Title: Sociology of Bangladesh			

Course Description

This course is designed to provide students with a comprehensive and analytical understanding of Bangladeshi society as a historically evolved, culturally diverse and continuously changing social system. It examines the interaction of historical forces, social institutions, family and kinship, religion and culture, population dynamics, rural and urban transformation, agrarian and industrial structures, class and inequality, education, migration, politics, governance, crime and social change. Particular attention is given to the effects of colonialism, the Pakistan period, the Language Movement, the Liberation War, globalization, urbanization, technological transformation and contemporary socioeconomic change. The course aims to enable students to connect sociological concepts and theories with the lived realities of Bangladesh, critically assess social problems and institutions, appreciate cultural and ethnic diversity, and develop evidence-based analytical, communicative, collaborative and research-oriented skills relevant to national development.

Course Objectives

1. To develop an understanding of the historical, cultural, demographic, social, economic, and institutional foundations of Bangladeshi society.
2. To analyze major social structures, institutions, inequalities, and processes of social change in rural and urban Bangladesh from a sociological perspective.
3. To apply fundamental sociological concepts and theories to examine contemporary social issues, including poverty, gender inequality, migration, urbanization, education, crime, and environmental vulnerability.
4. To develop students' abilities in critical thinking, collaborative learning, evidence-based analysis, and effective communication concerning social challenges and national development in Bangladesh.

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Course Learning Outcome (CLO)

After going through the course, students will be able to learn the following out comes

CLO1	Appreciate the importance of cultural diversity and ethnic coexistence in Bangladesh.
CLO2	Analyze several changing social issues of Bangladesh from sociological perspective.
CLO3	Explain the basic concepts, institutions and characteristics of society of Bangladesh.
CLO4	Apply fundamental sociological theories to be informed about social problems in Bangladesh.
CLO5	Illustrate the historical evolution, social background, family system, not only economy but also political system of Bangladesh.
CLO6	Collaborate with peers' sociological ideas effectively for Bangladeshi society.

CLO–PLO Mapping

CLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	✔	✔				✔	✔	✔		✔		✔
CLO2	✔	✔	✔	✔	✔	✔				✔	✔	✔
CLO3	✔	✔				✔	✔			✔	✔	
CLO4	✔	✔	✔	✔	✔	✔		✔		✔		✔
CLO5	✔	✔				✔	✔			✔	✔	✔
CLO6		✔	✔			✔			✔	✔		✔

Course Content

Week	Contents	Teaching–Learning Strategies	Module Assessment	CLOs
Week 1–3	**Sociological Background and Historical Context**: Physical and environmental factors shaping village society; British colonialism; Pakistan period; Language Movement; Liberation War and its influence on Bangladeshi society.	Interactive lectures; historical timeline mapping; group discussions; documentary analysis	Quiz; class test; timeline assignment; participation	CLO3 CLO5
Week 4–7	**Population Dynamics and Ethnicity**: Population composition; age-sex structure; marital status; literacy; labour force; fertility, mortality and migration; population policies; ethnic diversity and social roles of different ethnic groups.	Demographic data analysis; case studies; documentary screening; group discussion	Data-analysis assignment; quiz; presentation; class test	CLO1 CLO3
Week 8–10	**Socialization, Family, Culture and Identity**: Marriage, divorce, family and kinship; socialization; religious beliefs and rituals; language and cultural patterns; cultural identity; modernization, globalization and cultural change.	Reflective essays; small-group debates; peer dialogue; case studies	Reflective essay; group debate; presentation; class test	CLO1, CLO3, CLO5, CLO6
Week 11–14	**Macroeconomic Structure and Industrialization**: Farm and non-farm activities; agrarian transformation; industrialization; working class and informal economy; labour migration; RMG sector; remittance economy.	Lecture-discussion; economic report review; concept mapping; case-study analysis	Assignment; report review; class presentation; class test	CLO3, CLO5
Week 15–	**Rural Society and Urbanization**: Land tenure; rural class structure;	Role-play; guest lecture; problem-based	Role-play assessment;	CLO2, CLO3,

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18	Samaj and Salish; patron-client relations; social hierarchy; rural-to-urban migration; urbanization and associated challenges.	learning; group discussion	case-study assignment; group presentation; class test	CLO6
Week 19–21	**Social Inequality, Class Structure and Poverty**: Social, economic, gender, ethnic and status inequalities; middle-class formation; poverty trends; social mobility and vulnerability.	Critical literature review; comparative analysis; student presentations; discussion	Literature review; presentation; class test; analytical assignment	CLO2, CLO4
Week 22–24	**Politics, State and Governance**: Structure and functions of the state; civil bureaucracy; political institutions; political culture; governance; local government and community-level institutions.	Case studies; seminar presentations; group brainstorming; panel discussion; policy-analysis workshop	Case-study analysis; seminar presentation; group activity; class test	CLO2, CLO4, CLO6
Week 25–28	**Crime, Education and Social Control**: Crime patterns; penal and correctional systems; policing; civil society and crime prevention; education systems; enrolment and dropout; social mobility; educational inequality and policy challenges.	Panel discussion; policy-analysis workshop; collaborative projects; case studies	Policy-analysis assignment; group presentation; project; final examination	CLO2, CLO4, CLO6

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Course Assessment Framework
Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	Incourse Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

List of Books

Chowdhury, A. (1982). *Agrarian social relations and rural development in Bangladesh*. Oxford & IBH Publishing.

Chowdhury, A. M., & Alam, F. (Eds.). (2002). *Bangladesh at the threshold of the twenty-first century*. Asiatic Society of Bangladesh.

Karim, A. K. N. (1980). *The dynamics of Bangladesh society*. Vikas Publishing House.

Khan, A. A. (1996). *Discovery of Bangladesh*. University Press Limited.

Rahman, A. (1986). *Bangladesher krishi kathamo* [Agricultural structure of Bangladesh]. University Press Limited.

Siddiqui, K. (2000). *Jagatpur*. University Press Limited.

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Course Code : 8223257	Marks: 100	Credits: 4	Class Hours: 56
Course Title : Geography of Landforms			

Course Description

This course introduces the scientific principles of geomorphology, focusing on the origin, evolution, and spatial distribution of landforms and the geomorphic processes that shape the Earth's surface. It examines the interactions between endogenic and exogenic processes, including tectonism, weathering, mass movement, fluvial, aeolian, glacial, periglacial, coastal, and karst processes. The course also explores major geomorphological theories, landscape evolution models, palaeo-geomorphology, and contemporary approaches to geomorphic analysis. Particular emphasis is placed on the geomorphology of Bangladesh, including its physiographic evolution, river systems, deltaic and coastal environments, and geomorphic hazards. Through case studies, maps, diagrams, satellite imagery, and field-based interpretation, students will apply geomorphological concepts to environmental management, hazard assessment, land-use planning, and sustainable development.

Course Objectives

Upon completion of the course, students will be able to:

1. Develop a comprehensive understanding of the fundamental concepts, principles, methods, theories, and approaches of geomorphology and landscape evolution.
2. Analyze the processes and interactions of endogenic and exogenic forces, including tectonism, weathering, mass wasting, fluvial, aeolian, glacial, coastal, periglacial, and karst processes, in shaping landforms.
3. Interpret and evaluate major geomorphological theories, models, landforms, and geomorphic environments using maps, diagrams, satellite imagery, case studies, and palaeo-geomorphological evidence.
4. Apply geomorphological knowledge and analytical techniques to understand Bangladesh's physiography, river and deltaic systems, coastal environments, and geomorphic hazards, with emphasis on environmental management, land-use planning, and sustainable development.

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Course Learning Outcomes (CLOs)

CLO	Course Learning Outcome (CLO)	Bloom's Taxonomy Level
CLO1	Explain the fundamental concepts, scope, principles, methods, and evolution of geomorphology, including major geographic features and process, geomorphological theories and geomorphic systems.	**Understand**
CLO2	Analyze the role of endogenic and exogenic processes, geomorphological structures, tectonic activities, weathering, and mass wasting in landform development and landscape evolution.	**Analyze**
CLO3	Interpret the geomorphic processes, characteristics, and landforms associated with fluvial, arid, glacial, periglacial,	**Analyze**

	coastal, and karst environments.	
CLO4	Analyze major geomorphological theories, models, and approaches, including those of William Morris Davis, Walther Penck, L. C. King, morphoclimatic concepts, and palaeo-geomorphic reconstruction.	**Analyze**
CLO5	Examine the geomorphology of Bangladesh and the relationships among landforms, geomorphic hazards and disasters, human settlements, environmental management, and sustainable development.	**Analyze**
CLO6	Apply geomorphological concepts and techniques, including maps, diagrams, satellite imagery, and geomorphic interpretation, to analyze geographical and environmental problems.	**Apply**
CLO7	Demonstrate teamwork, scientific communication, critical thinking, and problem-solving skills through geomorphic interpretation, field observations, case studies, and collaborative learning activities.	**Apply**

Mapping CLOs with PLOs

CLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	✔	✔				✔		✔				
CLO2	✔	✔	✔		✔				✔			
CLO3	✔	✔	✔		✔	✔						
CLO4	✔	✔	✔	✔		✔		✔				
CLO5	✔	✔	✔	✔	✔	✔		✔	✔			✔
CLO6	✔	✔	✔	✔	✔	✔	✔		✔			
CLO7						✔	✔	✔	✔	✔	✔	✔

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Course Contents

Week	Contents	Teaching–Learning Strategies	Assessment Methods	CLOs
1-2	**Introduction to Geomorphology:** Definition, concepts, scope, nature, methods of geomorphological explanation; form, processes and patterns; applications of geomorphology in environmental studies.	Interactive lecture (PPT), concept mapping, group discussion	Class participation, short quiz, concept map assignment and discussion assignment	CLO1
3-5	**Development of Geomorphological Thoughts and Modern Approaches:** Historical development; Uniformitarianism	Multimedia lecture, Video Clip Presentation,	Quiz, group presentation, comparative theory	CLO1 CLO4

	and Catastrophism; Davisian Cycle of Erosion; Penck's Slope Development Theory; King's Pediplanation Theory; Morphometric and Morphoclimatic concepts; contemporary geomorphic approaches and impact of climate change on geomorphic processes.	comparative model analysis, timeline activity, group discussion	assignment, written examination	
6-7	**Palaeo-geomorphology: P**rinciples of palaeo-geomorphic interpretation; methods of landscape reconstruction; applications in understanding past environmental changes and landscape evolution.	Lecture, geological time scale demonstration, landscape reconstruction exercise, case study discussion	Short assignment, reconstruction exercise, class test, case study report	CLO4
8-10	**Geomorphological Processes and Landforms:** Endogenic Process and landforms; Exogenetic Process and landforms	Diagram demonstration, Multimedia lectures, case study discussion, process-based interpretation	Laboratory exercise, class test, case study report, diagram interpretation assignment	CLO2
11-12	**Geomorphic Environment and its Classification**	concept mapping, environmental classification exercise, thematic map interpretation	Short quiz, classification exercise, concept map assignment, map interpretation,	CLO2 CLO3
13-15	**The Humid Geomorphic Environment:** Characteristics of humid environments; fluvial processes; origin and evolution of rills, gullies and drainage patterns; channel types; erosion, transportation and deposition; stream flow, velocity and discharge	Video demonstration, problem-solving exercise, group presentation, hydrograph interpretation	Problem-solving assignment, presentation, hydrograph analysis, midterm examination	CLO2 CLO6
16-17	**The Arid and Semi-arid Geomorphic Environment:** Characteristics of arid and semi-arid environments; wind action and aeolian processes; erosional and depositional aeolian landforms.	Case study, map interpretation, image analysis, class discussion	Case study report, map interpretation exercise, quiz, landform identification assignment	CLO3 CLO6
18-19	**The Glacial and Periglacial Geomorphic Environment:**	Multimedia lecture,	Practical exercise,	CLO3

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	Characteristics of glacial and periglacial environments; glacial processes and products; erosional and depositional glacial landforms; periglacial processes and features.	landform identification exercise, image interpretation, collaborative learning	assignment, oral presentation, image interpretation test	
20-21	**Karst Topography:** Conditions for karst development; karst processes; solution and deposition processes; surface and subsurface karst landforms; caves, sinkholes, limestone pavements and other karst features.	Multimedia lecture, diagram demonstration, landform identification exercise, case study discussion	Karst feature identification exercise, assignment, class test, practical interpretation	CLO3
22-24	**Coastal Geomorphic Environment:** Coastal classification and shoreline delineation; coastal geomorphic processes and products; waves, tides, winds and ocean currents; erosional and depositional coastal landforms; coral environments; delta formation, classification, types and structures; coastal landscape evolution.	Satellite image interpretation, coastal case studies, collaborative learning, map analysis	GIS/map interpretation assignment, group presentation, class test, coastal case study report	CLO3 CLO4
25-28	**Geomorphology of Bangladesh:** Geomorphological evolution of Bangladesh; quaternary geology and sedimentary sequences; physiographic regions; river dynamics; coastal and deltaic geomorphology; geomorphology and human settlement	Bangladesh case studies, field-based examples, seminar presentation	Seminar presentation, field report, using GIS & Rs, case study assignment, final examination	CLO5 CLO6 CLO7

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Course Assessment Framework
Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	Incourse Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12	80%

	• 10 marks per question (8 × 10 = 80 marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	

List of Books

Bierman, P. R., & Montgomery, D. R. (2020). *Key concepts in geomorphology*. W. H. Freeman.

Chorley, R. J., Schumm, S. A., & Sugden, D. E. (1984). *Geomorphology*. Methuen.

Christopherson, R. W., & Birkeland, G. H. (2018). *Geosystems: An introduction to physical geography* (10th ed.). Pearson.

Embleton, C., & Thornes, J. B. (1979). *Process in geomorphology*. Edward Arnold.

Huggett, R. J. (2017). *Fundamentals of geomorphology* (4th ed.). Routledge.

Islam, M. S. (2001). *Sea level changes in Bangladesh: Last ten thousand years*. Asiatic Society of Bangladesh.

Knighton, D. (1998). *Fluvial forms and processes: A new perspective*. Arnold.

Leopold, L. B., Wolman, M. G., & Miller, J. P. (1964). *Fluvial processes in geomorphology*. W. H. Freeman.

Schumm, S. A. (1977). *The fluvial system*. Wiley.

Singh, S. (2018). *Geomorphology* (Latest ed.). Prayag Pustak Bhawan.

Small, R. J. (1978). *The study of landforms* (2nd ed.). Cambridge University Press.

Strahler, A. N., & Strahler, A. H. (2013). *Introducing physical geography* (6th ed.). Wiley.

Summerfield, M. A. (1991). *Global geomorphology*. Longman.

Tarbuck, E. J., Lutgens, F. K., & Tasa, D. (2021). *Earth science* (15th ed.). Pearson.

Thornbury, W. D. (1969). *Principles of geomorphology* (2nd ed.). Wiley.

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Course Code: 8223058	**Marks: 50**	**Credits: 2**	**Credit Hours:** 30
Course Title: Viva-Voce			

Course Description

The Viva-Voce (Botany) course is designed as an integrated outcome-based assessment of the knowledge and practical competencies acquired by students during the second year of the B.Sc. (Honours) programme in Botany. The course brings together Higher Cryptogams; Gymnosperm and Palaeobotany, Palynology; Taxonomy of Angiosperms; and Practical-II. Rather than assessing memorisation alone, the viva provides an opportunity to evaluate students' ability to explain botanical concepts, identify representative specimens and structures, apply diagnostic characters, compare plant groups, interpret basic palaeobotanical and palynological features, and communicate scientific ideas accurately.

Course Objectives

1) To assess students' integrated understanding of major concepts covered in the second-year Botany curriculum.
2) To assess knowledge of the morphology, anatomy, reproduction, classification and evolutionary significance of major plant groups.
3) To develop and assess the ability to identify representative specimens and structures using diagnostic characters.
4) To assess the application of taxonomic principles to the identification and classification of angiosperms.
5) To assess students' understanding of basic palaeobotanical and palynological features and their biological significance.
6) To assess practical competencies acquired through specimen observation, identification and description.
7) To strengthen scientific reasoning and concise communication using appropriate botanical terminology.

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Course Learning Outcomes (CLOs):

Students, on completion of the course, will be able to:

CLOs	Course Learning Outcomes	Bloom's Level	BNQF Domain	Mapped PLOs
CLO1	Identify and recall the major characteristics, terminology and representative taxa of Higher Cryptogams, Gymnosperms and Angiosperms.	Remember	Knowledge	PLO-1
CLO2	Explain the morphological, anatomical, reproductive and evolutionary characteristics of major plant groups.	Understand	Knowledge	PLO-1, PLO-2
CLO3	Apply diagnostic characters and taxonomic principles to identify representative plant specimens and taxa.	Apply	Knowledge & Skills	PLO-1, PLO-2

CLO4	Differentiate and analyse major plant groups, reproductive structures, taxonomic characters, fossils and pollen features.	Analyse	Knowledge & Skills	PLO-1, PLO-2
CLO5	Interpret basic palaeobotanical and palynological features in relation to plant diversity and evolution.	Analyse	Knowledge & Skills	PLO-1, PLO-2, PLO-7
CLO6	Demonstrate appropriate practical skills in specimen observation, identification and scientific description.	Apply	Skills	PLO-2, PLO-3
CLO7	Communicate botanical knowledge clearly, logically and scientifically during viva voce examination.	Apply	Skills & Responsibility/ Autonomy	PLO-9

Course Contents

Area	**Major Contents**	**Bloom's Level**
Higher Cryptogams	General characteristics; classification; morphology; anatomy; reproduction; life cycles; diagnostic characters; representative taxa; evolutionary significance of algae, bryophytes and pteridophytes.	Remember, Understand, Apply, Analyse
Gymnosperm and Palaeobotany	General characteristics and classification of gymnosperms; morphology; anatomy; reproductive structures; life cycle; representative genera; fossils; fossilization; evolutionary and geological significance.	Remember, Understand, Apply, Analyse
Palynology	Pollen morphology; pollen wall; apertures; surface ornamentation; pollen identification; basic applications of palynology.	Understand, Apply, Analyse
Taxonomy of Angiosperms	Principles of taxonomy; taxonomic hierarchy; nomenclature; identification; diagnostic characters; classification systems; floral characters; important angiosperm families; fruits and seeds.	Remember, Understand, Apply, Analyse
Practical-II	Specimen identification; morphological and anatomical characterization; reproductive structures; microscopic observations; identification of angiosperm families; scientific description.	Apply, Analyse
Integrated Viva	Comparative and application-based questions integrating the four second-year areas; specimen-based reasoning; interpretation of diagnostic characters; scientific communication.	Apply, Analyse

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CLOs with Course Contents Mapping

Course Content	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6	CLO7
Higher Cryptogams	✓	✓	✓	✓	✓	✓	✓
Gymnosperm & Palaeobotany	✓	✓	✓	✓	✓	✓	✓
Palynology	✓	✓	✓	✓	✓	✓	✓
Taxonomy of Angiosperms	✓	✓	✓	✓	✓	✓	✓
Practical-II	✓	✓	✓	✓	—	✓	✓
Integrated Viva	✓	✓	✓	✓	✓	✓	✓

Assessment Plan

Assessment Component	Marks	CLOs	Bloom's Level
Theoretical/conceptual questions	15	CLO1, CLO2	Remember, Understand
Specimen/structure identification	10	CLO3, CLO6	Apply
Comparative and analytical questions	10	CLO4, CLO5	Analyse
Practical-based questions	10	CLO3, CLO6	Apply, Analyse
Scientific communication	5	CLO7	Understand, Apply
Total	50		

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Suggested Viva Examination Procedure

1. Each student will appear individually before the viva board.
2. Questions should be drawn proportionately from all four constituent areas.
3. At least part of the examination should be specimen-, structure- or practical-based.
4. Questions should progress from conceptual understanding to application and analysis where appropriate.
5. Examiners should record marks using a common rubric to improve consistency and transparency.
6. The assessment should emphasize observable learning outcomes rather than rote memorisation.

Viva Assessment Rubric:

Criterion	Excellent	Good	Satisfactory	Needs Improvement
Subject knowledge	Accurate, comprehensive and well-organised	Mostly accurate	Basic understanding	Limited/incorrect
Identification skill	Correct identification with diagnostic justification	Correct identification with minor gaps	Identification with some assistance	Unable to identify
Analytical ability	Logical comparison and interpretation	Appropriate analysis	Basic analysis	Unable to analyse
Practical competence	Confident and accurate	Generally competent	Some assistance required	Major difficulty
Scientific communication	Clear, precise and systematic	Generally clear	Understandable but incomplete	Unclear/inaccurate

Individual examiner mark sheet

Institution	**Department**	**Programme**	**Year**
National University	Department of Botany	B.Sc. (Honours) in Botany	2nd Year

Student Information	**Details**	**Examination Information**	**Details**
Student Name		Roll/Registration No.	
Session		Date of Viva	
College/Institution		Examiner	Internal / External

Individual Examiner Marking

Sl.	**Assessment Area**	**CLOs**	**Bloom's Level**	**Marks**	**Remarks**
1	Higher Cryptogams	CLO1, CLO2, CLO4	Remember / Understand / Analyse	10	
2	Gymnosperm & Palaeobotany	CLO1, CLO2, CLO4, CLO5	Understand / Apply / Analyse	10	
3	Palynology	CLO2, CLO4, CLO5	Understand / Apply / Analyse	5	
4	Taxonomy of Angiosperms	CLO1, CLO2, CLO3, CLO4	Remember / Understand / Apply / Analyse	10	

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5	Practical-II / Specimen Identification	CLO3, CLO6	Apply / Analyse	10	
6	Scientific Communication & Viva Performance	CLO7	Understand / Apply	5	
				Total = 50	

Viva-voce marks Sheet

Institution	**Department**	**Programme**	**Year**
	Department of Botany	B.Sc. (Honours) in Botany	2nd Year

Sl.	**Student**	**Roll/Reg.**	**Higher Cryptogams 10**	**Gymnosperm & Palaeobotany 10**	**Palynology 5**	**Taxonomy 10**	**Practical-II 10**	**Communication 5**	**Total 50**
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
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19									
20									

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This sheet may be maintained separately by the internal and external examiner. Their component-wise totals can then be transferred to the consolidated average sheet.

Examiner's qualitative remarks:

Examiner's Certification: I certify that the above marks represent my independent assessment of the student's performance in the Viva-Voce examination.

Examiner Name	Designation	Signature	Date

Internal and external examiner average sheet

Student Information	Details	Examination Information	Details
Session		Date of Viva	
College/Institution		Batch	
Number of Students		Internal Examiner	
		External Examiner	

Combined Marks and Final Average

Sl.	Student Name	Roll/Reg. No.	Internal Examiner (50)	External Examiner (50)	Average = (I+E)/2	Final Mark / 50
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

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Formula: Final Viva Mark = (Internal Examiner's Mark + External Examiner's Mark) ÷ 2

Note: Both examiners should independently assess each student. The final mark is calculated from the arithmetic mean of the internal and external examiner marks, subject to the approved institutional examination rules.

Internal Examiner	External Examiner	Chair/Head of Department
Name: _____ Signature: _____	Name: _____ Signature: _____	Name: _____ Signature: _____

Date: _____