

NATIONAL UNIVERSITY BANGLADESH



Syllabus

**Bachelor of Science (Honours) Second Year
Department of Geography and Environment**

Effective from the Academic Year: 2024–2025 and onward

1. Vision of the University

We expect that on 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.

2. 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.

3. Name of the Program: B.Sc. (Honours) in Geography and Environment

4. Program Educational Objectives (PEOs)

PEO 1: Technical and Professional Competence

Graduates will demonstrate strong theoretical knowledge and practical skills in the field of Geography and Environment, enabling them to meet contemporary market demands in education, research, planning, and development sectors.

PEO 2: Research and Problem Solving

Graduates will be equipped to carry out collaborative, multidisciplinary research, evaluate geoenvironmental problems critically, and offer creative, evidence-based solutions to promote sustainable development in Bangladesh and elsewhere.

PEO 3: Social Responsibility and Ethics

Graduates will demonstrate a strong sense of social, ethical, and environmental responsibility, making valuable contributions to environmental management, community development, and the accomplishment of the Sustainable Development Goals (SDGs).

PEO 4: Lifelong Learning and Leadership

Graduates will pursue lifelong learning through continuous education and professional development, demonstrating leadership, teamwork, and communication skills essential for adapting to the dynamic global landscape.

5. Program Learning Outcomes (PLOs)

At the time of graduation, B.Sc. (Honours) in Geography and Environment students will have achieved the ability to:

PLO 1: Core Disciplinary Knowledge: Demonstrate a comprehensive understanding of fundamental concepts, theories, and frameworks in both human and physical geography, environmental science, and geospatial studies.

PLO 2: Application of Knowledge: Apply disciplinary knowledge and analytical skills to understand, explain, and address various spatio-temporal, environmental and Socio-economic phenomena using appropriate models, methods, and technologies.

PLO 3: Problem Solving and Critical Thinking: Identify, analyze, and propose solutions to complex geo-environmental problems using scientific reasoning, critical thinking, and decision-making abilities in real-world contexts.

PLO 4: Research and Innovation: Design and conduct scientific research through observation, data collection, analysis, interpretation, and presentation, using innovative approaches to solve contemporary problems in geography and environment.

PLO 5: Use of Modern Tools: Utilize modern tools, including GIS, remote sensing, statistical software, field instruments, and environmental monitoring systems, adhering to scientific, safety, and ethical standards.

PLO 6: Communication Skills: Effectively communicate geography and environmental ideas, data, and findings in oral, written, and visual formats to both specialist and non-specialist audiences.

PLO 7: Teamwork and Leadership: Demonstrate leadership, interpersonal, and collaborative skills required to work in diverse teams and manage geography and environment projects efficiently and ethically.

PLO 8: Professionalism and Ethics: Practice ethical conduct, social responsibility, and professional integrity in academic and field-based activities while addressing environmental and societal issues.

PLO 9: Lifelong Learning: Recognize the necessity for engagement in continuous learning, self-improvement, and professional development to adapt and evolve technologies and global challenges.

PLO 10: Societal and Environmental Responsiveness: Respond effectively to national and global environmental challenges, contributing to policy, planning, and community-based development aligned with the Sustainable Development Goals (SDGs).

PLO 11: Entrepreneurial and Employment Readiness: Demonstrate skills, attitudes, and knowledge required for employment in government, NGOs, academia, consultancy, research institutions, and geo-entrepreneurial ventures.

PLO 12: Project and Time Management: Plan, organize, and execute fieldwork and academic projects efficiently, demonstrating time management, task delegation, and responsibility in both individual and group settings.

6. Mapping PEO with PLO:

Program Learning Outcomes (PLOs)	PEO 1	PEO 2	PEO 3	PEO 4
PLO 1	✓			
PLO 2	✓	✓		
PLO 3	✓	✓	✓	
PLO 4	✓	✓		
PLO 5	✓	✓	✓	
PLO 6	✓		✓	✓
PLO 7	✓		✓	✓
PLO 8	✓		✓	✓
PLO 9				✓
PLO 10		✓	✓	✓
PLO 11	✓			✓
PLO 12	✓	✓		✓

7. Year wise Courses and marks distribution

SECOND YEAR

Paper Code	Paper Title		Marks	Credits
8223251	Geomorphology		100	4
8223253	Climatology		100	4
8223255	Economic Geography		100	4
8223256	Practical-II		100	4
8221171	Functional English		100	4
8226601	Applied information and Communication Technology (Applied ICT)		75	3
8226602	Practical: Applied ICT		25	1
8223258	Viva-voce (Geography and Environment)		50	2
Students Follow Either Group-A or Group-B				
	Group-A (Any Two)			
8222859	{General Chemistry-II Environmental Chemistry		100	4
50			2	
8223757	{Calculus-II and Differential Equations Math Lab (Mathematica)		100	4
50			2	
8223057	{Botany-II Botany Practical-II		100	4
8223058			50	2
8223157	{Zoology-II Zoology Practical-II		100	4
8223158			50	2
8223659	Methods of Statistics		100	4
8223660	{Statistics Practical-II		50	2
	Group-B (Any Three)			
8222059	Sociology of Bangladesh	or	100	4
8222165	Bangladesh Society and Culture		100	4
8221959	Political Organization and The Political System of UK and USA		100	4
8222259	Bangladesh Economy		100	4
	Total =		950	38

Course Code	8223251	Marks: 100	Credits: 4	Class Hours: 56
Course Title	Geomorphology			

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.

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, coastal, and karst environments.	Analyze
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						✓	✓	✓	✓	✓	✓	✓

Course Contents

Module	Contents	Teaching– Learning Strategies	Assessment Methods	CLOs
1	Introduction to Geomorphology: Definition, concepts, scope, nature, methods of geomorphological explanation; form, processes and patterns; applications of geomorphology in environmental	Interactive lecture (PPT), concept mapping, group discussion	Class participation, short quiz, concept map assignment and discussion	CLO1

	studies.		assignment	
2	Development of Geomorphological Thoughts and Modern Approaches: Historical development; Uniformitarianism 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.	Multimedia lecture, Video Clip Presentation, comparative model analysis, timeline activity, group discussion	Quiz, group presentation, comparative theory assignment, written examination	CLO1 CLO4
3	Palaeo-geomorphology: Principles 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
4	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
5	Geomorphic Environment and its Classification	concept mapping, environmental classification exercise, thematic map interpretation	Short quiz, classification exercise, concept map assignment, map interpretation,	CLO2 CLO3
6	The Humid Geomorphic Environment: Characteristics of humid environments; fluvial processes; origin and evolution of rills, gullies and drainage patterns; channel types; erosion,	Video demonstration, problem-solving exercise, group presentation, hydrograph	Problem-solving assignment, presentation, hydrograph analysis, midterm	CLO2 CLO6

	transportation and deposition; stream flow, velocity and discharge	interpretation	examination	
7	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
8	The Glacial and Periglacial Geomorphic Environment: Characteristics of glacial and periglacial environments; glacial processes and products; erosional and depositional glacial landforms; periglacial processes and features.	Multimedia lecture, landform identification exercise, image interpretation, collaborative learning	Practical exercise, assignment, oral presentation, image interpretation test	CLO3
9	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
10	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
11	Geomorphology of Bangladesh: Geomorphological evolution of Bangladesh; quaternary geology and sedimentary sequences; physiographic regions; river dynamics; coastal and deltaic	Bangladesh case studies, field-based examples, seminar presentation	Seminar presentation, field report, using GIS & Rs, case study assignment,	CLO5 CLO6 CLO7

	geomorphology; geomorphology and human settlement		final examination	
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Course Assessment Framework:

Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course 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

- 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.
- Tarbut, E. J., Lutgens, F. K., & Tasa, D. (2021). *Earth science* (15th ed.). Pearson.
- Thornbury, W. D. (1969). *Principles of geomorphology* (2nd ed.). Wiley.

Course Code	8223253	Marks: 100	Credits: 4	Class Hours: 56
Course Title	Climatology			

Course Description

The course provides a comprehensive knowledge of climatology through introduction to the structure and composition of the atmosphere, solar energy balance, circulation systems, weather processes, climatic classification and global climate dynamics. The course focuses on the interconnections between atmospheric processes, climate variability and environmental systems. Topics include climate change, extreme weather events and their implications for sustainable development, environmental management and disaster risk reduction. Special focus has been given on the climatic characteristics of Bangladesh and application of climatological knowledge in urban and rural development plans and policies in sustainable approaches.

Course Objectives

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

1. Develop a comprehensive understanding of the fundamental concepts, principles, structure, composition, and dynamics of the atmosphere and the scientific basis of climatology.
2. Analyze atmospheric processes, including solar radiation and energy balance, temperature, pressure, circulation, wind systems, relative humidity, precipitation, air masses, fronts, and major weather phenomena.
3. Examine climatic classification systems, global climatic regions, atmospheric circulation models, climate variability, extreme weather events, and the causes and impacts of climate change.
4. Apply climatological knowledge, data, weather maps, climatic diagrams, satellite information, and GIS-based approaches to assess climate-related hazards and environmental problems, with particular emphasis on Bangladesh, environmental planning, disaster risk reduction, adaptation, and sustainable development.

Course Learning Outcomes (CLOs)

CLO	Course Learning Outcome (CLO)	Bloom's Taxonomy Level
CLO1	Explain the fundamental concepts, scope, principles, and interdisciplinary nature of climatology, including the structure, composition, and dynamics of the atmosphere.	Understand
CLO2	Analyze solar energy balance, temperature, pressure, atmospheric circulation, wind systems, moisture processes, and weather phenomena using scientific principles.	Analyze
CLO3	Interpret the formation, characteristics, and spatial distribution of air	Understand

	masses, fronts, climatic regions, and major climatic types using standard climatic classification systems.	
CLO4	Analyze atmospheric circulation models, climate variability, extreme weather events, and climate change processes with particular reference to Bangladesh and global environmental systems.	Analyze
CLO5	Apply knowledge of the causes, impacts, mitigation, and adaptation strategies of climate change to sustainable environmental management and disaster risk reduction.	Apply
CLO6	Apply climatological data, weather maps, climatic diagrams, satellite information, and scientific evidence to analyze environmental and geographical problems.	Apply / Analyze
CLO7	Demonstrate teamwork, scientific communication, and critical thinking through interpretation of climatic data, case studies, presentations, and collaborative learning activities.	Apply

Mapping CLOs with PLOs

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

Course Contents

Module No.	Contents	Teaching– Learning Strategies	Assessment Methods	CLOs
1	Introduction to Climatology: Definition, scope, nature and historical development of climatology; weather and climate; importance and applications of climatology.	Interactive lecture (PPT), concept mapping, group discussion	Class participation, short quiz, concept map assignment	CLO1
2	Atmosphere and Atmospheric Energy: Origin, structure and composition of the atmosphere; insolation, terrestrial radiation, heat transfer (conduction, convection and advection); Earth's heat budget; global warming; greenhouse effect; horizontal	Multimedia lecture, animation, diagram interpretation, problem-solving	Quiz, class test, problem-solving assignment	CLO1, CLO2

	and vertical distribution of temperature; temperature inversion.			
3	Atmospheric Pressure and Circulation: Atmospheric pressure belts; isobars; pressure gradients; forces controlling wind (pressure gradient, Coriolis effect, friction, centrifugal forces); global circulation models; Hadley, Ferrel and Polar cells; Walker circulation; ITCZ; El Niño–Southern Oscillation (ENSO); El Niño and La Niña.	Simulation, weather map analysis, class discussion	Weather map analysis, written assignment, class test	CLO2
4	Wind Systems and Atmospheric Moisture: Planetary, seasonal, local and upper-air winds; jet streams; cloud types and formation; cyclones, anticyclones, thunderstorms and tornadoes; Asian monsoon	Weather chart interpretation, case study, video demonstration	Case study report, practical exercise, presentation	CLO2, CLO6
5	Air Masses, Fronts and Weather Systems: Air masses origin, source regions, classification and modification; fronts and frontogenesis.	Synoptic weather map interpretation, group exercises	Synoptic chart interpretation, quiz, assignment	CLO3
6	Climate Classification and Climatic Regions: Principles of climatic classification; Köppen's climatic classification; Thornthwaite's climatic classification; Trewartha's modification; major climatic regions of the world and their characteristics.	Climatic map interpretation, comparative analysis, collaborative learning	Map interpretation exercise, class presentation, midterm examination	CLO3
7	Climate Variability and Climate Change: Factors; climate change impact feedback mechanisms; evidence of climate change impact; mitigation and adaptation strategies; IPCC perspectives; Climate change in Bangladesh and vulnerability, climate negotiations, loss and damage and net-zero pathways.	Case studies, seminar, policy review, group presentation	Seminar presentation, policy review report, case study analysis	CLO4, CLO5, CLO7
8	Climate Change and Human Adaptation: Climate and anthropogenic activities; agro-climatology; urban climatology; microclimate and local climate; climate hazards and disaster risk reduction; weather forecasting; application of climatology in environmental planning, sustainable development and SDGs; interpretation of climatic data (climographs,	Data interpretation, GIS demonstration, project-based learning, seminar	GIS/data interpretation report, project report, final examination	CLO5, CLO6, CLO7

	hythergraphs, weather maps and satellite images), Climate Modeling, Big data in meteorology, GIS based climate risk management.			
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Course Assessment Framework:

Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course 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

- Aguado, E., & Burt, J. E. (2021). *Understanding weather and climate* (8th ed.). Pearson.
- Ahmed, R. (2010). *Abhawa o jalabayu biggan* [Meteorology and climatology]. Sujanesu Prokashani. (In Bangla)
- Barry, R. G., & Chorley, R. J. (2010). *Atmosphere, weather and climate* (9th ed.). Routledge.
- Bonan, G. B. (2016). *Ecological climatology: Concepts and applications* (3rd ed.). Cambridge University Press.
- Critchfield, H. J. (1983). *General climatology* (4th ed.). Prentice Hall.
- Goosse, H. (2015). *Climate system dynamics and modelling*. Cambridge University Press.
- IPCC. (2023). *Climate change 2023: Synthesis report*. Intergovernmental Panel on Climate Change.
- Lal, D. S. (2018). *Climatology*. Chaitanya Publishing House.
- Oliver, J. E., & Hidore, J. J. (2002). *Climatology: An atmospheric science* (2nd ed.). Pearson.
- Singh, S. (2021). *Climatology*. Prayag Pustak Bhawan.
- Strahler, A. N., & Strahler, A. H. (2013). *Introducing physical geography* (6th ed.). Wiley.
- Tarback, E. J., Lutgens, F. K., & Tasa, D. (2021). *Earth science* (15th ed.). Pearson.
- Trewartha, G. T., & Horn, L. H. (1980). *An introduction to climate* (5th ed.). McGraw-Hill.

Course Code	8223255	Marks:100	Credits: 4	Class Hours:56
Course Title	Economic Geography			

Course Description

This course provides an introduction to the fundamental concepts, theories and applications of Economic Geography with an emphasis on the spatial organization of economic activities, resource distribution, production systems, trade, transportation and regional development. The course will examine primary, secondary, tertiary, quaternary and quinary economic activities and major location theories, globalization, regional economic integration and economic development along with global change of economic activity. Further the impact of natural resources, industrialization, international trade and financial institutions on economic landscape with special reference to Bangladesh economy and sustainable development will be discussed.

Course Objectives

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

1. Develop a comprehensive understanding of the concepts, principles, scope, evolution, and interdisciplinary nature of Economic Geography and the spatial organization of economic activities;
2. Analyze the spatial distribution and characteristics of primary, secondary, tertiary, quaternary and quinary economic activities, natural resources, transportation systems, trade networks, and industrial regions at global, regional, and national scales;
3. Evaluate major theories and models of Economic Geography, economic growth and development, globalization, regional economic integration, and emerging concepts such as the green, blue, circular, and knowledge economies;
4. Apply economic-geographical concepts, statistical data, thematic maps, GIS-based approaches, and case studies to examine Bangladesh's economic landscape, regional disparities, resource management, sustainable development, and contemporary economic and environmental challenges;

Course Learning Outcomes (CLOs)

CLO	Course Learning Outcome (CLO)	Bloom's Taxonomy Level
CLO1	Explain the concepts, principles, scope, evolution, and interdisciplinary nature of Economic Geography together with the spatial organization of economic activities.	Understand
CLO2	Interpret the geographical distribution of natural resources, industrial regions, transportation systems, trade networks, and	Understand

	regional economic integration using geographical approaches.	
CLO3	Apply spatial concepts, economic indicators, thematic maps, statistical data, and case studies to examine economic and environmental problems.	Apply
CLO4	Analyze the distribution, characteristics, and spatial patterns of primary, secondary, tertiary, and quaternary economic activities at global, regional, and national scales.	Analyze
CLO5	Analyze major theories and models of economic geography, including agricultural, industrial, and central place location theories, in explaining economic landscapes.	Analyze
CLO6	Examine economic growth, development, globalization, national income, and sustainable resource management with special reference to Bangladesh.	Analyze
CLO7	Demonstrate teamwork, communication, and critical thinking through presentations, policy analysis, economic mapping, and collaborative problem-solving.	Apply

Mapping CLOs with PLOs

CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO10	PLO11	PLO12
CLO 1	✓	✓				✓		✓				
CLO 2	✓	✓	✓		✓	✓		✓		✓	✓	
CLO 3	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	
CLO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CLO 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CLO 6	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
CLO 7	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓

Course Contents

Module No.	Contents	Teaching– Learning Strategies	Assessment Methods	CLOs
1	Introduction to Economic Geography: Definition, scope, nature, branches, evolution and importance of Economic Geography; methodology and applications in planning and sustainable development.	Interactive lecture (PPT), concept mapping, group	Class participation, short quiz, concept mapping	CLO1

		discussion, think-pair-share	assignment, written assignment	
2	Fundamental Concepts and Economic Activities: Concepts of space, location, interaction, distribution, production, consumption and exchange; nature and classification of economic activities (primary, secondary, tertiary, quaternary and quinary sectors); changing economic structure in the global economy.	Multimedia lecture, brainstorming, concept mapping, collaborative learning	Quiz, classroom activity, short analytical assignment	CLO1, CLO2
3	Primary and Secondary Economic Activities: Nature and characteristics of primary economic activities ; resource and extraction utilization activities; hunting, gathering, forestry, fishing, mining, livestock rearing, and agriculture; agricultural systems and global distribution patterns of major crops (rice, wheat, cotton, jute, tea, sugarcane, and rubber); distribution of mineral and energy resources; secondary economic activities ; manufacturing industries, industrial location factors, major industrial regions of the world; selected case studies of iron and steel, textile, automobile, and energy industries; environmental impacts of resource extraction and industrial activities.	Case study analysis, thematic map interpretation, comparative discussion	Thematic map exercise, case study report, class test, assignment	CLO2, CLO3
4	Tertiary, Quaternary and Quinary Activities: Transportation systems and networks; transportation and regional development; international trade and globalization; regional economic blocs (EU, ASEAN, USMCA/NAFTA, SAARC, BRICS); service sector activities including banking, finance, tourism, communication, healthcare, education, and public administration; knowledge economy, ICT, innovation, and digital economy, global supply chain shifts and platform based digital outsourcing services.	Trade flow mapping, policy discussion, group presentation	Trade flow mapping exercise, group presentation, assignment, class discussion evaluation	CLO2, CLO3
5	Theoretical Foundations of Economic Geography: Distance decay; spatial interaction; Von Thünen's Agricultural Location Theory; Alfred Weber's	Model demonstration, diagram interpretation,	Theory-based assignment, model/diagram analysis, quiz,	CLO4

	Industrial Location Theory; Walter Christaller's Central Place Theory; theories of economic growth and development (Marx, Rostow) .	problem-based learning	written examination	
6	Economic Growth and Development: Concepts and indicators of economic development; GDP, GNP, NNP, PCI, HDI; measurement techniques; determinants and barriers of development; globalization; sustainable economic development; blue economy; green economy; circular economy; knowledge economy; digital transformation.	Data analysis, graph interpretation, classroom seminar	Data interpretation exercise, seminar presentation, analytical report	CLO4, CLO5
7	Economic Geography of Bangladesh: Resource base; agriculture, industry and service sectors; export-import structure; RMG industry; special economic zones; transportation and logistics; banking and financial institutions; role of Bangladesh Bank, commercial banks and development partners; regional disparities; sustainable development and SDGs, post-LDC graduation economic transition challenges and prospects of mega infrastructure projects.	Bangladesh case studies, policy review, economic data analysis	Case study report, policy review assignment, economic data analysis exercise, presentation	CLO5 CLO6
8	Population Change and Structure of Economy with Reference to Demographic Transition Model	Industry Visit	Presentation,	CLO6 CLO7

Course Assessment Framework:

Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course 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

- Alexander, J. W. (1988). *Economic geography*. Prentice Hall.
- Aoyama, Y., Murphy, J. T., & Hanson, S. (2011). *Key concepts in economic geography*. Sage.
- Coe, N. M., Kelly, P. F., & Yeung, H. W. C. (2019). *Economic geography: A contemporary introduction* (3rd ed.). Wiley.
- Dicken, P. (2015). *Global shift: Mapping the changing contours of the world economy* (7th ed.). Sage.
- Hartshorne, T. A., & Alexander, J. W. (1988). *Economic geography* (3rd ed.). Prentice Hall.
- Hodder, B. W., & Lee, R. (2015). *Economic geography*. Routledge.
- Knox, P., Agnew, J., & McCarthy, L. (2014). *The geography of the world economy* (6th ed.). Routledge.
- Lloyd, P. E., & Dicken, P. (1977). *Location in space: A theoretical approach to economic geography* (2nd ed.). Harper & Row.
- Maurya, S. D. (2018). *Economic geography*. Pravalika Publications.
- Rashid, H. E. (2005). *Economic geography of Bangladesh*. University Press Limited.
- Rasheed, K. B. S. (2008). *Bangladesh: Resource and environmental profile*. A. H. Development Publishing House.
- World Bank. (2009). *World development report 2009: Reshaping economic geography*. World Bank.

Course Code	8223256	Marks: 100	Credits: 4	Class Hours: 56
Course Title	Practical-II			

Course Description

This course offers hands-on training in survey, map projections and study of geological specimens for geographical and environmental studies. Students learn to use the standard surveying instruments to acquire skills of land surveying, collection of field data, topographical mapping and drawing up of survey maps. The course covers the principles, selection and construction of map projections for spatial analysis and cartographic representation. It also gives students hands-on experience in identifying and classifying rocks and minerals according to their physical and geological attributes. Overall, the course builds up practical skills in spatial data collection, map interpretation and geological analysis for geographical research, environmental assessment and planning.

Course Objectives

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

1. Develop practical knowledge and skills in surveying, including the use of surveying instruments, field measurements, data recording, triangulation, and topographical mapping;
2. Construct and interpret different types of map projections using graphical and mathematical techniques and select appropriate projections for different geographical purposes;
3. Apply surveying, cartographic, and geographical techniques to collect, analyze, interpret, and present spatial and field-based information for geo-environmental research, geo-environmental assessment, urban and rural planning and sustainable resource management;
4. Identify and classify common rocks and minerals based on their physical and geological characteristics through systematic laboratory observation and specimen analysis;

Section-I: Surveying

Course Learning Outcomes (CLOs)

CLO	Course Learning Outcome (CLO)	Bloom's Taxonomy Level
CLO1	Define the fundamental concepts, principles, and types of surveying and explain their applications in geography and environment studies.	Understand
CLO2	Explain surveying instruments, field procedures, data recording techniques, triangulation principles, and topographical mapping methods.	Understand
CLO3	Apply conduct survey chain and tape, plane table, prismatic compass, and leveling techniques to collect, record, and plot field data	Apply

	accurately.	
CLO4	Prepare and interpret survey maps using appropriate surveying techniques and demonstrate professional, ethical, and teamwork skills during field investigations.	Apply

Mapping CLOs with PLOs

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	✓	✓						✓				
CLO2	✓	✓	✓		✓			✓	✓	✓	✓	
CLO3	✓	✓	✓		✓	✓		✓			✓	✓
CLO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Contents

Module No.	Contents	Teaching–Learning Strategies	Assessment Methods	CLOs
1	Introduction to Surveying: Concept and types of surveying (plane and geodetic); surveying as the basis of topographic mapping; map scales and topographic maps; principles of triangulation; primary, secondary, and tertiary triangulation networks.	Interactive lecture with multimedia presentation, instructor-led discussion, concept mapping, instrument demonstration, field orientation	Short quiz, class participation, written assignment, instrument identification exercise	CLO1 CLO2
2	Chain and Tape Surveying: Instruments and accessories; ranging, chaining, offsetting, field procedures, field-book recording; tie lines and check lines; preparation of chain survey framework; measurement across obstacles; plotting procedures; sources of errors; advantages and limitations.	Lecture and demonstration, guided field practice, hands-on surveying exercise, collaborative fieldwork, instructor supervision	Practical field assessment, field-book evaluation, sketch map preparation, survey report, practical examination	CLO2 CLO3
3	Plane Table Surveying: Instruments; preparation and orientation of the plane table; methods of surveying by radiation, intersection, traversing, and resection; adjustment of plotting errors; plotting procedures	Field demonstration, practical mapping exercise, collaborative learning, instructor-guided practice, map interpretation	Practical mapping assessment, plotted map evaluation, field performance assessment, assignment, practical test	CLO2 CLO3
4	Prismatic Compass	Field survey,	Field survey	CLO3

	Surveying and Levelling: Compass bearings and traverse surveying; field observations; data recording; plotting traverses; levelling instruments; reduction of levels using Height of Instrument (HI) and Rise-and-Fall methods; preparation of longitudinal and cross-sectional profiles	instrument demonstration, practical exercises, problem-solving activities, peer learning, supervised data analysis	report, levelling calculation exercise, traverse plotting assignment, practical examination, class test	CLO4
5	Preparation, Interpretation, and Presentation of Survey Maps: Preparation and interpretation of survey maps; comparison of surveying methods; map accuracy and precision; identification and adjustment of survey errors; preparation of technical survey reports and presentations.	Seminar presentation, practical mapping session, group discussion, peer review, report writing, instructor feedback	Survey map evaluation, technical report, group presentation, practical viva voce, final practical examination	CLO3 CLO4

Section-II: Map Projection

Course Learning Outcomes (CLOs):

CLO	Course Learning Outcome (CLO)	Bloom's Taxonomy Level
CLO1	Define the fundamental concepts, principles, classifications, and applications of map projections.	Understand
CLO2	Explain the criteria for selecting appropriate map projections, including latitude, longitude, central meridian, standard parallel, and projection scale.	Understand
CLO3	Construct graphical and mathematical map projections using cylindrical, conical, zenithal, and conventional projection methods.	Apply
CLO4	Select and interpret appropriate map projections for different geographical regions while demonstrating practical cartographic skills.	Apply

Mapping CLOs with PLOs

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO10	PLO11	PLO12
CLO 1	✓	✓						✓				

CLO 2	✓	✓	✓		✓			✓	✓	✓	✓	
CLO 3	✓	✓	✓		✓	✓		✓			✓	✓
CLO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Contents

Module No.	Contents	Teaching–Learning Strategies	Assessment Methods	CLOs
1	Introduction to Map Projections: Definition, uses and classification of map projections (Perspective, Non-perspective, Cylindrical, Conical, Zenithal, and Conventional projections).	Lecture with demonstration, interactive discussion, multimedia presentation, question–answer session, class discussion	Short quiz, class participation, conceptual assignment, written test	CLO1 CLO2
2	Criteria for Selecting Map Projections: Latitude, longitude, equator, central meridian, standard parallel, scale of projection, and projection surface; selection of suitable projections for different geographical regions.	Lecture, guided practice, map analysis exercise, group discussion, problem-solving activities	Map analysis assignment, projection selection exercise, quiz, class test	CLO2 CLO3
3	Construction of Cylindrical and Conical Projections: Construction of cylindrical and conical group of projections using graphical or mathematical methods; preparation of graticules; merits, demerits	Hands-on practical session, guided drawing practice, drawing laboratory, demonstration, individual exercise	Practical drawing assessment, constructed map evaluation, laboratory report, assignment	CLO3 CLO4
4	Construction of Zenithal and Conventional Projections:	Practical mapping session, visual demonstration,	Practical examination, map construction	CLO3 CLO4

	Construction of zenithal projections (polar, equatorial, and oblique cases) and conventional projections using graphical or mathematical methods; comparison of projection characteristics and applications.	collaborative learning, instructor-guided practice, observation task	assessment, individual exercise, class performance evaluation	
5	Selection, Interpretation and Evaluation of Map Projections: Selection and interpretation of map projections for different geographical purposes; comparison of projection properties; preparation and presentation of projection-based maps.	Seminar, practical mapping exercise, GIS-based demonstration (where available), peer review, map presentation and discussion	Map project/report, presentation, projection evaluation assignment, final practical examination	CLO3 CLO4

Section-III: Identification of Rocks and Minerals

CLO	Course Learning Outcome (CLO)	Bloom's Taxonomy Level
CLO1	Define the fundamental concepts, classifications, and physical characteristics of rocks and minerals.	Understand
CLO2	Explain the physical properties of rocks and minerals, including the Mohs hardness scale, and distinguish among major rock and mineral groups.	Understand
CLO3	Identify and classify common igneous, sedimentary, and metamorphic rocks and important rock-forming minerals through laboratory observation and specimen analysis.	Apply
CLO4	Interpret the geological significance and environmental applications of rocks and minerals using scientific observation and practical investigation.	Analyze

Mapping CLOs with PLOs

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO10	PLO11	PLO12
CLO 1	✓	✓						✓				
CLO 2	✓	✓	✓		✓			✓	✓	✓	✓	
CLO 3	✓	✓	✓		✓	✓		✓			✓	✓
CLO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Contents

Module No.	Contents	Teaching–Learning Strategies	Assessment Methods	CLOs
1	Introduction to Rocks and Minerals: Definition, classification, origin, and comparison of rocks (igneous, sedimentary, and metamorphic) and minerals; geological importance and occurrence of rocks and minerals.	Lecture with demonstration, interactive discussion, multimedia presentation, question answer session, class discussion	Short quiz, class participation, written assignment, conceptual test	CLO1 CLO2
2	Physical and Chemical Properties of Minerals: Chemical composition and structure	Laboratory demonstration, hands-on specimen observation, guided practical exercise, group discussion	Mineral identification exercise, laboratory record evaluation, practical assignment, specimen observation test	CLO2 CLO3
3	Identification and Classification of Rocks and Minerals: Physical identification and classification of common igneous, sedimentary, and metamorphic rocks and economically important minerals using hand	Laboratory practical session, specimen identification exercise, observation task, peer learning, instructor-guided practice	Practical examination, specimen identification test, laboratory report, field/practical assignment	CLO3 CLO4

	specimens;			
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List of Books

- Ahmed, K. S. (n.d.). *Simple map projection*. Dhaka.
- Ajaegbu, H. I., & Faniran, A. (1988). *A new approach to practical work in geography*. Heinemann Educational Books.
- Bennison, G. M. (1994). *An introduction to geological structures and maps*. Chapman & Hall.
- Breed, C. B., & Hosmer, G. L. (1907). *The principles and practice of surveying* (Vol. 1). John Wiley & Sons.
- Bygott, J. (1983). *An introduction to map work and practical geography*. Longman.
- Compton, R. R. (1985). *Geology in the field*. John Wiley & Sons.
- Kahmen, H., & Faig, W. (2012). *Surveying*. Walter de Gruyter.
- Khullar, D. R. (2019). *Essentials of practical geography*. Chaukhamba Orientalia.
- Lutgens, F. K., Tarbuck, E. J., & Tasa, D. (2021). *Essentials of geology* (13th ed.). Pearson.
- Maltman, A. (2012). *Geological maps: An introduction*. Springer.
- Monkhouse, F. J., & Wilkinson, H. R. (1976). *Maps and diagrams: Their compilation and construction*. Methuen.
- Montgomery, C. W. (1995). *Environmental geology* (4th ed.). McGraw-Hill.
- Park, R. G. (2013). *Foundations of structural geology* (3rd ed.). Routledge.
- Robinson, A. H. (1978). *Elements of cartography* (4th ed.). John Wiley & Sons.
- Rouf, K. A., & Halim, A. (2005). *Baboharic Bhugol (Practical Geography)* (in Bangla). Dhaka.
- Roy, S. K. (2010). *Fundamentals of surveying*. PHI Learning.
- Sarkar, A. (2015). *Practical geography: A systematic approach*. Orient Blackswan.
- Shahjahan, M., & Aziz, M. A. (2005). *A text book of surveying*. Hafiz Book Center.

Distribution of Marks for Second Year Final Examination (Section I, II & III)

Total Marks=100

1. Final Exam: 60 Marks

Time: 6 (Six) Hours

Section I-Surveying: 24 Marks

- a) Five questions shall be set from the five modules, of which candidates shall answer any three. (3x8=24)
- b) Each question carries 8 marks.
- c) Each question will be segmented into (a/b/c) or (a/b) as applicable.

Section II-Map Projection: 24 Marks

- a) Five questions Shall be set from the five modules, of which candidates shall answer any three. (3x8=24)
- b) Each question carries 8 marks.
- c) Each question will be segmented into (a/b/c) or (a/b) as applicable.
- d) Questions may include definition, principles, classification, selection, construction, calculation, interpretation, comparison, identification of distortion, evaluation of projection properties, and application of map projections, as applicable.

Section III- Identification of Rocks and Minerals: 12 Marks

- a) Four questions shall be set from the three modules, of which candidates shall answer any two. (2x6=12)
- b) Each question carries 6 marks.
- c) Each question will be subdivided into (a/b/c) or (a/b) as applicable
- d) Questions may include definitions, classification, origin and occurrence, comparison, physical properties, mineral hardness and the Mohs hardness scale, specimen identification, interpretation of geological significance, and environmental applications of rocks and minerals, as applicable

2. Lab Notebook: 10 Marks

3. Lab Viva-voce: 10 Marks

4. Presentation:10 Marks

5. Field Report: 10 Marks (Day-long fieldwork)

GROUP-A (Any Two)

Course Code	8222859	Marks: 100	Credits: 4	Class Durations: 28 Weeks
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. Explain 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.

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

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

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, 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 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.	Lecture, numerical problem-solving, board work, discussion	Numerical problems, written examination, class test	CLO2, CLO6
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	Lecture, cell-diagram demonstration, problem-solving,	Written examination, numerical problems, class	CLO2, CLO6

	of cell emf, batteries, corrosion.	discussion	test	
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. Heterocyclic compounds: Pyrrole, furan, thiophene, pyridine.	Lecture, structural representation, reaction mechanism discussion, problem-solving	Written examination, reaction-based questions, class test	CLO4
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	Lecture, reaction mechanism demonstration, structural representation, problem-solving	Written examination, reaction mechanisms, class test	CLO4, CLO6

	condensation.			
11	Carbohydrates: Definition, classification, structure and reactions of monosaccharides. Polysaccharide-cellulose and starch.	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

Course Assessment Framework

Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	Incourse	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.

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.

Course Learning Outcomes (CLOs)

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,	Evaluate

	DO, BOD, and COD, and interpret their environmental significance.	
CLO 4	Assess the biochemical toxicity, environmental impacts, and control methods of heavy metals and hazardous compounds such as PCBs.	Evaluate

Mapping CLOs to PLO Matrix

CLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
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:

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.	Interactive Lecture, Numerical	Class Test, BOD/COD Problems,	CLO3

	Industrial wastewater treatment, municipal water treatment. Water quality parameters and standards, measurements of important parameters such as pH, DO, BOD, COD and temperature for water quality assessments.	Exercises, Laboratory Demonstration	Report Writing	
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%

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	8223757	Marks: 100	Credits: 4	Class Hours: 56
Course Title	Calculus II and Ordinary Differential Equations			

Course Description

This course introduces the fundamental concepts of multivariable calculus and ordinary differential equations. It develops students' analytical and problem-solving skills through the study of vector-valued functions, functions of several variables, multiple integrals, and ordinary differential equations. The course emphasizes the application of calculus and differential equations to mathematical modelling and problems arising in science, engineering, and related disciplines.

Course Objectives (COs)

This course aims to

1. develop a sound understanding of multivariable calculus and ordinary differential equations.
2. develop analytical and problem-solving skills for vector functions, partial differentiation, multiple integration, and differential equations.
3. enable students to apply calculus and differential equation techniques to mathematical models and problems in science, engineering, and related disciplines.

Course Learning Outcomes (CLOs)

CLO	Course Learning Outcome	Bloom's Taxonomy Level
CLO1	Explain and analyze vector-valued functions of a single variable, including limits, derivatives, integrals, and geometric properties such as tangent lines and arc length.	Analyze
CLO2	Determine the curvature and radius of curvature, and identify properties of space curves using Cartesian and parametric equations.	Apply
CLO3	Compute limits, partial derivatives, and differentials of functions of several variables, and apply optimization techniques including Lagrange multipliers.	Apply
CLO4	Evaluate double and triple integrals over different regions and coordinate systems to compute areas, volumes, and other applications.	Evaluate
CLO5	Classify ordinary differential equations and interpret their solutions using direction fields and basic existence and uniqueness concepts.	Analyze
CLO6	Apply appropriate methods to solve first-order differential equations, including separable, linear, exact, homogeneous, Bernoulli, Riccati, and Clairaut's forms.	Apply
CLO7	Solve higher-order linear differential equations, both homogeneous and non-homogeneous, using linear operators, reduction of order, and constant coefficient methods.	Apply

Mapping of CLOs with PLOs

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

Course Contents

Week	Topic	Teaching Learning Strategy	Assessment	CLOs
1–3 (3 weeks)	Vector-valued functions of a single variable: Limits. Derivatives and integrals. Tangent lines to graphs of such functions. Arc length from the vector viewpoint. Arc length parametrization.	Lecture; Whiteboard Teaching; Worked Examples	Written Quiz; Tutorial Exercise; Class Test	CLO1
4–6 (3 weeks)	Curvature of space curves: Definition. Curves of zero curvature. Curves of constant non-zero curvature. Cartesian equations and parametric equations. Radius of curvature. Centre of curvature.	Lecture; Worked Examples; Tutorial	Tutorial Exercise; Problem Solving; Class Test	CLO2
7–11 (5 weeks)	Functions of several variables: Limits and continuity. Partial derivatives. Differentiability, linearization, and differentials. The chain rule. Partial derivatives with constrained variables. Extreme values and saddle points of functions of several variables. Lagrange multipliers.	Lecture; Whiteboard Teaching; Problem Solving	Assignment; Problem Solving; Class Test	CLO3
12–15 (4 weeks)	Multiple Integration: Double integrals and iterated integrals. Double integrals over nonrectangular regions. Double integrals in polar coordinates. Area by double integrals. Triple integrals and iterated integrals;	Lecture; Worked Examples; Tutorial	Tutorial Exercise; Problem Solving; Class Test	CLO4

	Volume as a triple integral.			
16–18 (3 weeks)	Ordinary differential equations and their solutions: Classification of differential equations. Solutions. Implicit solutions. Singular solutions. Initial value problems. Boundary value problems. Basic existence and uniqueness theorems (statement and illustration only). Direction fields. Phase plane.	Lecture; Whiteboard Teaching; Interactive Discussion	Written Quiz; Tutorial Exercise; Class Test	CLO5
19–23 (5 weeks)	Solution of first-order differential equations: Separable equations. Linear equations. Exact equations. Special integrating factors. Substitutions and transformations. Homogeneous equations. Bernoulli equation. Ricatti equation. First-order higher degree equation solvable for x, y, and p. Clairaut's equation.	Lecture; Worked Examples; Problem Solving	Assignment; Problem Solving; Class Test	CLO6
24–28 (5 weeks)	Solution of higher-order linear equations: Linear differential operators. Basic theory of linear differential equations. Solution space of homogeneous linear equations. Fundamental solutions of homogeneous solutions. Reduction of orders, Homogeneous linear equations with constant coefficients. Non-homogeneous equation.	Lecture; Worked Examples; Problem Solving	Problem Solving; Tutorial Exercise; Class Test	CLO7

Course Assessment Framework:

Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course 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

Anton, H. (1995). *Calculus* (5th ed.). Wiley.

Ayres, F., & Ayres, J. R. (1999). *Theory and problems of differential equations* (Schaum's Outline Series). McGraw-Hill.

Braun, M. (1983). *An introduction to differential equations and their applications*. Springer-Verlag.

Gill, D. (1986). *Introduction to differential equations*. McGraw-Hill.

Ross, S. L. (1984). *Differential equations*. John Wiley & Sons.

Zill, D. G. (2009). *A first course in differential equations with applications*. Brooks/Cole, Cengage Learning.

PROVISIONAL

Course Code	8223758	Marks: 50	Credits: 2	Class Hours: 42
Course Title	Math Lab (Mathematica)			

Course Description

This course introduces students to the use of Mathematica, a powerful Computer Algebra System (CAS), for solving mathematical problems. Students will perform symbolic, numerical, and graphical computations. Emphasis is placed on applying these skills to topics from first-year mathematics courses.

Course Objectives

The main objectives of the course are as follows:

1. To familiarize students with Mathematica software.
2. To teach students how to use Mathematica for symbolic and numerical calculations, data analysis, visualization, and problem-solving in mathematics and scientific research.
3. To enhance students' proficiency in utilizing Mathematica to improve their understanding and problem-solving abilities in various mathematical domains.

Course Learning Outcomes (CLOs)

CLO	Course Learning Outcome	Bloom's Taxonomy Level
CLO1	Demonstrate fundamental skills in operating the Mathematica software interface and executing basic commands.	Apply
CLO2	Apply Mathematica for symbolic and numerical computation, including operations with expressions, equations, and matrices.	Apply
CLO3	Apply Mathematica to compute and verify derivatives, integrals, limits, and series solutions for problems drawn from Calculus and related mathematical courses.	Apply
CLO4	Create 2D and 3D graphical representations of mathematical functions and data using Mathematica's visualization tools.	Create
CLO5	Solve problems from first- and second-year allied math courses (e.g., Foundations of Mathematics, Calculus I, Calculus II, and Ordinary Differential Equations) using Mathematica's built-in functions and packages.	Apply
CLO6	Utilize Mathematica to explore mathematical patterns, test conjectures, and support experimental mathematics.	Analyze
CLO7	Integrate Mathematica into scientific or mathematical reporting, presentations, and research-oriented tasks.	Apply

Mapping of CLOs with PLOs

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

Course Contents:

Problem-solving using the Computer Algebra System (CAS) Mathematica: Running the package. Numerical computation. Algebraic computation. Mathematical functions. Derivatives and integrals. Limits and series. Lists and matrices. Graphics. Standard packages. Solving problems in Foundations of Mathematics, Calculus I, Calculus II, and Ordinary Differential Equations that students studied in the first and second years.

Teaching Learning Activities:

Class Lecture Lab-based 21 (Each 2-hour lab class covers first- and second-year problems of allied Mathematics courses)

Class Test 1

Lab Notebook 1 (Instructors will assign at least 15 lab tasks)

Assessment Strategy:

Type of evaluation	Time	Marks	Guideline
Final Exam	2 hours	30	Three questions have to be answered out of the five questions
Continuous Assessment (Class Test)	1 hour	10	Internal Assessment: Conducted during the academic year
Continuous Assessment (Lab Performance & Notebook)	-----	5	Internal Assessment: Based on laboratory performance and completion of at least 15 laboratory exercises
Continuous Assessment (Class attendance)	-----	5	Internal Assessment: Assessed according to the University's attendance policy
Total		50	

List of Books

- Don, E. (2009). *Schaum's outline of Mathematica and the Wolfram language* (2nd ed.). McGraw-Hill Education.
- Mangano, S. (2009). *Mathematica cookbook: Building blocks for science, engineering, finance, music, and more*. O'Reilly Media.
- Wolfram Research, Inc. (2024). *Mathematica (Student Edition)* [Software]. Wolfram Research,

Course Code	8223057	Marks:100	Credits: 4	Class Hours: 56
Course Title	Botany - II			

Course Description

This course provides an integrated understanding of fundamental concepts in cell biology, genetics, plant breeding, biotechnology, ecology, conservation biology, plant physiology, and phytochemistry. It examines cellular organization and division, inheritance and genetic variation, plant improvement and evolution, biotechnological applications, ecosystem structure and function, biodiversity conservation, plant physiological processes, and major plant biomolecules. The course emphasizes the application of botanical knowledge to plant growth, crop improvement, environmental management, biodiversity conservation, and sustainable development.

Course Objectives (COs)

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

1. Develop a comprehensive understanding of cell biology, genetics, plant breeding, and evolutionary principles underlying plant growth, reproduction, inheritance, and variation.
2. Explain the fundamental principles and applications of biotechnology in agriculture, industry, environmental management, plant improvement, and sustainable resource utilization.
3. Develop an understanding of ecological processes, environmental issues, ecosystem functioning, and biodiversity conservation, with emphasis on sustainable management of plant resources.
4. Apply knowledge of plant physiology and phytochemistry to explain plant growth, metabolism, productivity, adaptation, and the importance of major plant biomolecules

Course Learning Outcomes (CLOs)

CLO	Course Learning Outcome (CLO)	Bloom's Taxonomy Level
CLO1	Explain the ultrastructure of plant cells, chromosome organization, and the mechanisms and significance of mitosis and meiosis.	Understand
CLO2	Explain the fundamental principles of inheritance, linkage, crossing over, mutation, and their roles in plant genetics and crop improvement.	Understand
CLO3	Describe the principles and applications of plant breeding, artificial pollination, selection methods, and theories of evolution.	Understand
CLO4	Explain the basic concepts and applications of biotechnology, including microbial fermentation, dairy biotechnology, and biogas production.	Understand

CLO5	Analyze ecological principles, ecosystem structure and function, ecological adaptations, biogeochemical cycles, environmental pollution, and greenhouse effects.	Analyze
CLO6	Explain the importance of biodiversity conservation and evaluate in-situ and ex-situ conservation strategies for sustainable management of plant resources.	Evaluate
CLO7	Explain the physiological processes of plants, including water relations, mineral nutrition, photosynthesis, respiration, enzyme action, photoperiodism, vernalization, and plant hormones.	Understand
CLO8	Describe the classification, structure, biological functions, and economic importance of major plant carbohydrates and communicate scientific concepts effectively through assignments and examinations.	Apply

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√	√										
CLO2			√	√								
CLO3					√	√	√					
CLO4								√	√	√		
CLO5										√	√	√
CLO6	√	√	√									
CLO7				√	√							
CLO8						√	√					

Course Content

Unit Title	Detailed Unit Contents	Teaching– Learning Strategies	Assessment	CLO
Unit 1. Cytology Weeks 1–4	Ultra-structure of a eukaryotic cell, differences between prokaryotic and eukaryotic cells, physical and chemical composition of cell wall and plasma membrane. Chromosome: Physical and chemical nature, chromosome organization, types of chromosomes and role in heredity. Cell division: Mitosis and meiosis, stages and significance in growth, reproduction, genetic variation and evolution. Cell organelles: Structure and functions of nucleus, mitochondria, chloroplast, endoplasmic reticulum, ribosome, Golgi apparatus, vacuole and other cellular components.	Interactive lectures, multimedia presentations, classroom discussion, diagrams	Quiz, class test, assignment, final examination	CLO1
Unit 2.	Basic concepts of genetics: Gene,	Lectures,	Quiz,	CLO1

Genetic Weeks 5–8	DNA and RNA structure, DNA replication, gene expression, Mendel's laws; linkage and crossing over; mutation, point mutation, physical and chemical mutagens and significance.	multimedia presentations	assignment, midterm, final examination	, CLO2
Unit 3. Plant Breeding and Evolution Weeks 9–11	Plant Breeding and Evolution: Definition and significance of plant breeding. Method of artificial pollination in plants. Selection method. Theories of evolution: Darwin's theory and synthetic theory of evolution.	Lectures, case studies, group discussion	Class presentation, assignment, written examination	CLO2
Unit 4. Biotechnology Weeks 12–15	Definition, concept, history and scope of biotechnology; applications in agriculture, industry, medicine and environmental management. Milk products: Techniques of production of curd and butter; role of microorganisms in dairy fermentation. Biogas technology: Production methods, microbial role, composition of biogas and its uses as renewable energy. Plant tissue culture and its applications: Principles, techniques, micropropagation and importance in crop improvement and conservation. Biofertilizers and biopesticides: Types, production, applications and importance in sustainable agriculture.	Interactive lectures, demonstrations, case studies	Quiz, assignment, final examination	CLO2
Unit 5. Plant Ecology and Environmental Science Weeks 16–20	Definition, differences between autecology and synecology. Ecological factors: Climatic, edaphic and biotic. Ecological adaptation: Characteristics of hydrophytes, xerophytes and halophytes. Ecosystem: Definition; pond ecosystem; food chain; food web; ecological pyramids. Biogeochemical cycles: Nitrogen and carbon cycles. Pollution: Air and water pollution. Greenhouse effects: Definition, sources of greenhouse gases; causes and effects of greenhouse gases; CO ₂ , CFC, CH ₄ and N ₂ O; ozone layer depletion; carbon dioxide and the world climate; control of greenhouse effects.	Lectures, field examples, case studies, group discussion	Assignment, presentation, midterm, final examination	CLO3

Unit 6. Conservation Biology	Conservation: Importance of conservation of plant species. Methods of ex-situ and in-situ conservation.	Interactive lecture, case studies	Assignment, written examination	CLO3
Unit 7. Plant Physiology and Phytochemistry Weeks 21–28	Water relation: Mechanisms of absorption of water and minerals. Mineral nutrition. Photosynthesis: General account and modern concept. Respiration: Aerobic and anaerobic. Enzymes: Definition and properties. Photoperiodism. Vernalization: Definition and mechanism. Plant hormones: A general account. Carbohydrates: Classification with examples; structures of important monosaccharides and oligosaccharides and isomerism; storage polysaccharides; starch, inulin, glycogen; structural polysaccharides; cellulose and economic importance of carbohydrates.	Lectures, tutorials, problem-solving, multimedia presentations	Quiz, class test, assignment, midterm, final examination	CLO4, CLO5

Course Assessment Framework:

Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course 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

- Agrios, G. N. (1997). *Plant pathology* (4th ed.). Academic Press, London, UK.
- Lewin, B. (2000). *Gene 2000*. Oxford University Press & Cell Press, Oxford, UK.
- Devlin, M. R., & Witham, H. F. (1986). *Plant physiology* (4th ed.). CBS Publishers and Distributors, New Delhi, India.
- Esau, K. (1953). *Plant anatomy*. John Wiley & Sons, Inc., New York, USA.
- Kumar, H. D. (1995). *General ecology*. Vikas Publishing House, New Delhi, India.
- Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (1993). *Microbiology: Concepts and applications*. McGraw-Hill Book Company, New York, USA.
- Vashishta, P. C. (1993). *Botany for degree students: Pteridophyta*. S. Chand & Company Ltd., New Delhi, India.
- আখতারজ্জামান, ম. (২০০০). *বিবর্তনবাদ*, হাসান বুক হাউজ, ঢাকা।
- কর্মকার, যদুলাল. (২০০০) *উদ্ভিদ শরীর বিজ্ঞান*, হাসান বুক হাউজ, ঢাকা।
- খন্দকার এম. (১৯৯৪). *ডলমেনোলজী*, ঢাকা বিশ্ববিদ্যালয় প্রকাশনা, ঢাকা।
- বাসার, এম. এ., এম.এ. হাসান এবং ম. রফিকুল ইসলাম. (২০০৪). *উদ্ভিদ বিজ্ঞান*, হাসান বুক হাউজ, বাংলা বাজার, ঢাকা।
- হাসান, এম. এ. (১৯৯৬). *ডাংলাদেশের ভেষজ উদ্ভিদ*, আশরাফিয়া বই ঘর, বাংলা বাজার, ঢাকা।
- হাসান, এম. এ. এবং এম. কে. আলম. (১৯৯৭). *উদ্ভিদ শ্রেণী বিন্যাস তত্ত্ব (৩য় সংস্করণ)*, হাসান বুক হাউস, ঢাকা।

Course Code	8223058	Marks:50	Credits: 2	Class Hours: 42
Course Title	Botany -II Practical			Time: 6 hours

Course Description

This practical course develops fundamental skills in the identification, classification, and study of major plant groups, including algae, fungi, bryophytes, pteridophytes, gymnosperms, and angiosperms. It provides hands-on experience in specimen collection, dissection, mounting, microscopy, scientific drawing, plant physiology experiments, mitotic cell division, and ecological adaptation studies. The course emphasizes accurate observation, laboratory techniques, scientific documentation, specimen identification, and interpretation of botanical characteristics and their ecological significance.

Course Objectives (Cos)

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

1. Develop practical skills in the identification, classification, and study of representative algae, fungi, bryophytes, pteridophytes, gymnosperms, and angiosperms through dissection, mounting, observation, and illustration.
2. Explain the morphological and anatomical characteristics of different plant groups and relate their structural adaptations to their ecological habitats.
3. Perform basic physiological experiments to understand fundamental plant processes such as plasmolysis, osmosis, and photosynthetic oxygen evolution.
4. Observe and identify different stages of mitotic cell division using plant materials and understand their significance in growth and development.
5. Develop skills in scientific observation, laboratory techniques, record keeping, scientific drawing, and interpretation of botanical specimens.

Course Learning Outcomes (CLOs)

CLO	Course Learning Outcome	Bloom's Taxonomy Level
CLO1	Identify and classify representative genera of algae, fungi, bryophytes, pteridophytes, gymnosperms, and angiosperms through practical study.	Understand
CLO2	Perform dissection, mounting, microscopic observation, scientific drawing, and description of plant specimens.	Apply
CLO3	Conduct basic plant physiology experiments and interpret the results related to water relations and photosynthesis.	Analyze
CLO4	Identify different stages of mitosis and explain their importance in plant growth and development.	Understand

CLO5	Analyze ecological adaptations of hydrophytic and xerophytic plants through morphological and anatomical observations.	Analyze
CLO6	Maintain laboratory records, prepare scientific reports, and demonstrate botanical knowledge through viva-voce.	Apply

Mapping of CLOs with PLOs

CLOs	PLO 1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√	√										
CLO2		√	√	√								
CLO3				√	√	√	√					
CLO4	√	√		√				√	√			
CLO5		√				√	√		√	√		
CLO6	√	√	√								√	
CLO7				√	√					√		
CLO8					√	√						

Course Content

Unit Title	Detailed Unit Contents	Teaching– Learning Strategies	Assessment	CLO(s)
Unit 1: Plant Diversity, Identification and Systematics	1. Detailed study including dissection (where necessary), mounting, drawing, description and identification with classification of the following genera: Algae: <i>Chlamydomonas</i> , <i>Oedogonium</i> and <i>Vaucheria</i> . Fungi: <i>Yeast</i> and <i>Ascobolus</i> . Bryophyte: <i>Riccia</i> and <i>Marchantia</i> . Pteridophyte: <i>Selaginella</i> . Gymnosperms: <i>Cycas</i> . Angiosperm: <i>Poaceae</i> and <i>Fabaceae</i> .	Demonstration of specimens, laboratory observation, microscopic study, dissection and temporary slide preparation, scientific drawing practice, guided identification exercises.	Practical examination, specimen identification, laboratory performance, scientific drawing, practical record assessment.	CLO1 CLO2
Unit 2: Identification of Plant Genera with Diagnostic Characters	2. Identification of the following genera with reasons: Algae: <i>Volvox</i> , <i>Polysiphonia</i> and <i>Fucus</i> . Fungi: <i>Agaricus</i> ,	Specimen display, field-based observation, herbarium study,	Spot identification test, viva-voce, practical examination, herbarium/specimen	CLO1 CLO2

	<i>Puccinia</i> and <i>Penicillium</i> . Lichen: <i>Crustose</i> , <i>Foliose</i> and <i>Fructose</i> . Bryophyte: <i>Anthoceros</i> . Pteridophyte: <i>Psilotum</i> , <i>Azolla</i> and <i>Pteris</i> . Gymnosperms: Male and female cones of <i>Cycas</i> . Angiosperms: Scientific names of common plants.	comparative analysis, identification keys and discussion.	report evaluation.	
Unit 3: Plant Physiology Experiments	Experimental study of basic physiological processes: (a) Demonstration of plasmolysis: principle, experimental procedure, observation and precautions. (b) Demonstration of osmosis: experimental setup, observation and interpretation. (c) Evolution of oxygen during photosynthesis: experimental demonstration and factors affecting photosynthetic activity.	Laboratory demonstration, hands-on experimentation, observation recording, data interpretation and discussion of physiological processes.	Experimental performance, observation note, practical report, viva-voce.	CLO3
Unit 4: Cytology and Cell Division	Study of different stages of mitosis in onion (<i>Allium cepa</i>) root tip: -Preparation of root tip squash. – Identification of stages: prophase, metaphase, anaphase and telophase. - Significance of mitosis in plant growth and development.	Microscopic observation, slide preparation demonstration, image-based learning, identification and interpretation of mitotic stages.	Microscopic identification, slide preparation assessment, practical examination and viva.	CLO4
Unit 5: Plant Ecology and Adaptation Studies	(a) Morphological and anatomical studies of hydrophytic and xerophytic plants. (b) Ecological identification of plants: – Identification of plants according to habitat. – Scientific naming and ecological significance.	Field observation, specimen collection, ecological comparison, anatomical study, group discussion and field-based	Field report, plant identification test, practical record evaluation, viva- voce.	CLO5

		learning.		
Unit 6: Laboratory Documentation and Scientific Communication	Preparation and maintenance of laboratory notebook including: – Recording observations. – Scientific drawings and labeling. – Classification and description of specimens. – Preparation of practical reports.	Guided note preparation, feedback on scientific documentation, demonstration of proper laboratory practices.	Laboratory notebook evaluation, report assessment, continuous assessment.	CLO6
Unit 7: Viva-Voce and Practical Competency Evaluation	Viva-Voce: Assessment of students' understanding of: – Plant identification and classification. – Laboratory techniques. – Experimental principles and observations. – Ecological and cytological concepts.	Interactive questioning, specimen-based discussion, problem-solving and conceptual assessment.	Final practical examination, viva-voce, overall laboratory performance assessment.	CLO6

List of Books

Agrios, G.N. (1997). *Plant Pathology* (4th ed.). Academic Press, London.

Benjamin L. (2000). *Gene 2000*. Oxford University Press and Cell Press. Bold, H.C. and Kumar, H.D. (1995). *General Ecology*, Vikash Pub. House, India.

Lawrence, G.H.M. (1951). *Taxonomy of Vascular Plants*. The Macmillan Co. New York.

Pelczar, M. J., Chan, E. C. S. & Krieg, N. R. (1993). *Microbiology: Concepts and Applications*. McGraw Hill Book Co. Inc. New York.

Vashista, P.C. 1993). *Botany for Degree Students: Pteridophyta*. S.C. Chand & Co. Ltd. Ramnagar, New Delhi.

আখতারজ্জামান, ম. (২০০০). *বিবর্তন বাদ*, হাসান বুক হাউজ, ঢাকা।

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খন্দকার মনিরজ্জামান, (১৯৯৪). *লিমনোলজী*, ঢাকা বিশ্ববিদ্যালয় প্রকাশনা, ঢাকা।

বাসার, এম. এ., এম.এ. হাসান এবং ম. রফিকুল ইসলাম. (২০০৪). *উদ্ভিদ বিজ্ঞান*, হাসান বুক হাউজ, বাংলা বাজার, ঢাকা।

হাসান, এম. এ. (১৯৯৬). *বাংলাদেশের ভেষজ উদ্ভিদ*, আশরাফিয়া বই ঘর, বাংলা বাজার, ঢাকা।

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

Instruction to the Examiners

Time: 6 hours

Marks: 50

1. Detailed Study, Dissection, Mounting, Description and Identification of Plant Genera

Marks: 12 (Slide preparation/mounting: 2+ Neat labeled diagrams: 2+ Identification: 0.5+ Classification and identifying characters: $1.5 \times 6 = 9$)

Specimen A and B:

Two specimens will be provided from the following groups:

- Algae: *Chlamydomonas*, *Oedogonium*, *Vaucheria*
- Fungi: Yeast, *Ascobolus*
- Bryophyta: *Riccia*, *Marchantia*
- Pteridophyta: *Selaginella*
- Gymnosperms: *Cycas*
- Angiosperms: Families Poaceae and Fabaceae

Students will perform:

- Dissection (where necessary)
- Preparation of slides/mounting
- Observation and identification
- Classification
- Description of diagnostic features
- Scientific drawings with proper labeling

2. Spot Identification of Plant Genera with Reasons

Marks: 9

(Identification: 0.5+ Identifying Characteristics: $1.0 \times 6 = 6$)

Specimens C–H will be provided for identification from the following groups:

Algae: *Volvox*, *Polysiphonia*, *Fucus*; Fungi: *Agaricus*, *Puccinia*, *Penicillium*

Lichens: Crustose, Foliose, Fruticose; Bryophyta: *Anthoceros*

Pteridophyta: *Psilotum*, *Azolla*, *Pteris*

Gymnosperms: Male and female cones of *Cycas*;

Angiosperms: Common flowering plants with scientific names

3. Plant Physiology Experiments

Marks: 6

(Experimental setup and procedure: 3+ Observation and interpretation: 2 + Precautions and conclusion: 1=6)

Students will perform experiments related to:

(a) Demonstration of Plasmolysis: Principle, Experimental procedure, Observation, Precautions

(b) Demonstration of Osmosis: Experimental setup, Observation and interpretation

(c) Evolution of Oxygen During Photosynthesis: Experimental demonstration, Observation of oxygen release, Factors affecting photosynthetic activity

4. Cytology: Study of Mitosis in Onion Root Tip

Marks: 6

(Preparation of slide: 2+ Identification of mitotic stages: 2+ Neat labelled diagrams: 1+ Significance/comment:1=6)

Students will prepare and study onion (*Allium cepa*) root tip squash.

Stages to be studied: Prophase, Metaphase, Anaphase, Telophase

5. Plant Ecology and Adaptation Study

Marks: 4

Specimen I and J (Identification:0.5+ Identifying characters/adaptive features:1.5=2×2=4)

Specimens will be selected from:

- Hydrophytic plants
- Xerophytic plants

Students will study:

- Morphological adaptations, Anatomical adaptations
- Ecological significance, Identification of plants with scientific names

6. Collection, Laboratory Record and Viva-Voce

Marks: 13

Components	Marks
Collection of plant specimens (Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms)	3.0
Practical Laboratory Notebook	5.0
Viva-Voce	5.0
Total	13.0

Total Marks Distribution

Examination Component	Marks
Detailed study of specimens (A & B)	12
Spot identification (C–H)	9
Plant physiology experiment	6
Cytology (Mitosis)	6
Ecology and adaptation study	4
Collection	3
Practical Notebook	5
Viva-Voce	5
Grand Total	50

General Instructions

- Students must submit properly prepared practical notebooks containing classification, descriptions, observations and labelled drawings.
- Slides must be prepared carefully following standard laboratory techniques.
- Identification answers must include appropriate diagnostic characters.
- Scientific names should be written according to accepted botanical nomenclature.
- Herbarium specimens and field collections must include proper labels.
- Viva-voce will evaluate students' understanding of practical techniques, specimen identification and botanical concepts.

Course Code	8223157	Marks: 100	Credits: 4	Class Hours: 56
Course Title	Zoology-II			Exam Duration: 4 Hours

Course Description

This course provides an integrated understanding of chordate diversity, comparative anatomy, evolution, palaeontology, zoogeography, ecology, genetics, animal breeding, and applied zoology. It emphasizes taxonomic classification, structural and functional adaptations, biodiversity and conservation, genetic principles, breeding techniques, and the applications of zoological knowledge in fisheries, poultry, agriculture, and sustainable resource management.

Course Objectives

1. To develop a comprehensive understanding of chordate diversity, classification, comparative anatomy, evolutionary relationships, and palaeontological evidence.
2. To develop knowledge of zoogeography, marine ecology, biodiversity, natural resources, conservation, and animal adaptations to different environments.
3. To develop an understanding of genetic principles, inheritance, mutation, population genetics, animal breeding methods, and modern breeding techniques.
4. To apply zoological knowledge to agricultural pest management, fisheries, integrated farming, poultry production, and sustainable resource utilization in the socio-economic context of Bangladesh.

Course Learning Outcome (CLOs)

CLO	Course Learning Outcome	Bloom's Taxonomy Level
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.	Analyze / Evaluate
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.	Analyze
CLO3	Analyze zoogeographical regions of the world, marine ecological zonations, and biodiversity concepts to assess conservation challenges and sustainable management of natural resources.	Analyze / Evaluate
CLO4	Apply principles of Mendelian genetics, multiple alleles, mutations, and chromosomal sex determination to solve inheritance problems and explain animal breeding strategies.	Apply
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-	Evaluate / Create

	economic conditions in	
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Mapping of CLOs with PLOs

CLO / PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO 1	✓	✓							✓			
CLO 2	✓	✓										
CLO 3	✓	✓	✓	✓						✓		
CLO 4	✓	✓	✓								✓	
CLO 5	✓	✓	✓							✓	✓	

Course Content

Topic	Teaching Learning Strategy	Assessment	CLOs
<u>Group – A: Chordates: (50 Marks)</u> 1. Broad classification of the following up to order with general and diagnostic characteristics of each taxonomic category with examples (preferably local) and affinities- Chondrichthyes, 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 - - Urachordata : <i>Ascidia</i> - Cephalochordata : <i>Branchiostoma</i> - Cephalaspimorpha: <i>Petromyzon</i> - Chondrichthyes : <i>Scoliodon</i> - Osteichthyes : <i>Labeo rohita</i> - Amphibia : <i>Bufo</i> - Reptilia : <i>Hemidactylus</i> - Aves : <i>Columba livia</i> - Mammalia : <i>Cavia porcellus</i>.	Lectures and Group discussions Fossil Timeline Jigsaw Virtual Dissection Lab Organ System Expert Jigsaw	Class test, specimen-based identification , comparative anatomy assignment, virtual dissection activity, group presentation, written examination	CLO1 CLO2

Group – B (50 Marks) Palaeontology, Zoogeography, Ecology, Genetics & Animal Breeding and Applied Zoology: Palaeontology: Geological 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; 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: Major Branches: Entomology, Fisheries, Wildlife Biology, Parasitology and others. Agricultural Pests: Major Pests of Rice, Jute, Sugarcane & stored grain. Integrated Fish Farming: Types; Poultry, Livestock and Paddy-cum -Fish Culture. Poultry farming: System of poultry farming, diseases management, economic impacts.	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	Quiz, map-based assessment, case-study analysis, problem-solving exercises, assignment, group presentation, farming-system design, pest-management plan, class test and written examination	CLO3 CLO4 CLO5
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List of Books

- 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.

References

- 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.

Course Code	8223158	Marks: 50	Credits: 2	Class Hour 42
Course Title	Zoology Practical-II			

Course Description

This practical course develops hands-on skills in the identification, classification, comparative study, dissection, and microscopic examination of chordates. It includes museum specimens, permanent slides, comparative osteology, chordate dissection, temporary mounting, and freshwater microfauna studies, with emphasis on accurate observation, scientific drawing, laboratory techniques, and practical documentation.

Course Objectives

1. To develop practical skills in the identification, classification, and comparative study of representative chordate specimens, permanent slides, and vertebrate bones.
2. To develop competency in chordate dissection, temporary mounting, staining, microscopic observation, scientific drawing, and labeling techniques.
3. To develop practical skills in identifying freshwater plankton and benthic microfauna and interpreting their diagnostic characteristics through systematic observation and laboratory records.

Course Content

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 albus*, *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. Lizard - 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.

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	8223659	Marks: 100	Credits: 4	Class Hours:56
Course Title	Methods of Statistics			Exam Duration: 4 hours

Course Description

This course provides a rigorous mathematical and applied introduction to the core pillars of statistical inference. Students will explore the theoretical foundations of sampling distributions (Normal, χ^2 , t, and F), the logic of experimental design and ANOVA (CRD, RBD, LSD, and Factorials), probabilistic survey sampling techniques (SRS, Stratified, Systematic, Cluster, and Multistage), and the Neyman-Pearson paradigm of hypothesis testing. The curriculum culminates in the practical application of parametric and non-parametric tests for means, variances, proportions, correlation, regression, and goodness-of-fit, equipping students to design studies, analyze data critically, and communicate findings effectively.

Course Objectives

1. To develop a strong understanding of sampling distributions, experimental design, survey sampling methods, and the theoretical foundations of statistical inference.
2. To develop students' ability to design and analyze experimental studies using CRD, RBD, Latin Square, and factorial designs, and to interpret main and interaction effects.
3. To develop competency in applying parametric and non-parametric statistical methods, hypothesis testing, confidence intervals, correlation, regression, and goodness-of-fit techniques to real-world data.
4. To develop students' ability to design statistical investigations, critically interpret data and statistical evidence, use appropriate analytical tools, and communicate evidence-based conclusions effectively.

Course Learning Outcomes (CLOs)

CLO #	Course Learning Outcomes	Bloom's Level
CLO-1	Define sampling distributions, mathematically derive the standard error of statistics, and differentiate the properties, assumptions, and appropriate applications of the Normal, χ^2 , t, and F distributions.	Level 1, 4: Understand, Analyze
CLO-2	Apply the principles of Randomization, Replication, and Local Control to construct complete ANOVA tables, estimate parameters, and perform missing plot analysis for CRD, RBD, and LSD.	Level 3, 4: Apply, Analyze

CLO-3	Design, analyze, and interpret main and interaction effects for 2^2 and 2^3 factorial experiments, utilizing interaction plots to draw valid conclusions.	Level 4, 5: Analyze, Evaluate
CLO-4	Distinguish between censuses and sample surveys, identify sampling and non-sampling errors, and execute parameter estimation (means, totals, proportions) using SRS, Stratified, Systematic, Cluster, and Multistage sampling designs.	Level 3, 4: Apply, Analyze
CLO-5	Critically evaluate the statistical and logistical trade-offs between probability sampling methods and non-probability quota sampling in real-world survey contexts.	Level 5: Evaluate
CLO-6	Explain the Neyman-Pearson logic of hypothesis testing, formulate null/alternative (simple/composite) hypotheses, and correctly compute Type I/II errors, power, significance levels, and p-values for one- and two-tailed tests.	Level 1, 3: Understand, Apply
CLO-7	Execute significance tests and construct confidence intervals for single/double means, variances, proportions, correlation coefficients, and regression coefficients (including paired t-tests).	Level 3, 4: Apply, Analyze
CLO-8	Apply χ^2 tests of homogeneity to compare several population means, variances, and proportions, and perform χ^2 goodness-of-fit tests for theoretical distributions.	Level 3, 5: Apply, Evaluate
CLO-9	Synthesize sampling, experimental design, and hypothesis testing methods to design a complete statistical investigation, analyze data using appropriate tools, and communicate evidence-based conclusions effectively.	Level 5, 6: Evaluate, Synthesize

Mapping of CLOs with PLOs

This table demonstrates how each CLO contributes to achieving the broader Program Learning Outcomes.

Indication: ✓ = Mapped / Aligned

CLOs 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
CLO 1	✓	✓										
CLO 2	✓	✓		✓								
CLO 3	✓	✓	✓	✓		✓						

CLO 4	✓	✓		✓	✓								
CLO 5	✓	✓	✓			✓	✓						
CLO 6	✓	✓											
CLO 7	✓	✓		✓		✓							
CLO 8	✓	✓		✓		✓							
CLO 9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Content

Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 1 (Class Hours 10)	Sampling Distributions • Concept of sampling distribution of a statistic. • Derivation of Standard Error (SE) for sample means and proportions. • χ^2 distribution: properties, degrees of freedom, and uses. • t-distribution: properties, relationship to Normal, and uses. • F-distribution: properties, ratio of variances, and uses.	• Lectures: Interactive chalk-and-talk for derivations. • Collaborative Learning: Group problem-solving sessions on deriving SE. • Inquiry-Based: Students compare shapes of t, χ^2, and F curves for different df using software.	• Quiz 1 • Assignment 1 • Class Test 1	CLO 1

Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 2 (Class Hours 12)	Design of Experiments (Part A: Basic Designs) • Principles: Randomization, Replication, Local Control. • ANOVA logic and construction of analysis tables. • Completely Randomized Design (CRD): Analysis & parameter estimation. • Randomized Block Design (RBD): Analysis & parameter estimation. • Latin Square Design (LSD): Analysis & parameter estimation. • Missing plot estimation techniques and adjusted analysis.	• Lectures: Step-by-step construction of ANOVA tables. • Flipped Classroom: Students watch video on missing plot estimation before class; practice in class. • Hands-on Lab: Use R/Minitab to analyze RBD and validate manual calculations.	• Lab Assignment 1 • Assignment 2 • Class Test 2	CLO 2
Module 2 (Class Hours 8)	Design of Experiments (Part B: Factorial Designs) • Introduction to factorial experiments. • 2^2 Factorial design: Main effects, interaction effects, and analysis. • 2^3 Factorial design: Main effects, two-way and three-way interactions. • Interpretation of results and interaction plots. • Choosing the appropriate design based on experimental constraints.	• Lectures: Demonstrate effect calculation using contrast coefficients. • Visual Learning: Construct interaction plots using data from case studies. • Case-Based Learning: Real-world factorial experiments (e.g., agriculture, manufacturing).	• Assignment 3 • Lab Assignment 2 • Class Test 3	CLO 3

Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 3 (Class Hours 12)	Survey Methods & Sampling Techniques - Population, sample, census vs. surveys; Sampling frame. - Sampling vs. Non-sampling errors. - Simple Random Sampling (SRS): Estimation of mean, total, proportion, and SE. - Stratified Random Sampling: Proportional & Optimal (Neyman) allocation. - Systematic Sampling: Selection methods and variance estimation. - Cluster Sampling (equal & unequal clusters). - Quota Sampling and Multistage Sampling: Concepts and practical trade-offs.	- Lectures: Derive estimators for each sampling method. - Problem-Based Learning: Real-world survey data (e.g., national census, health surveys). - Comparative Analysis: Compare variance reduction across SRS, Stratified, and Cluster using simulated data.	- Assignment 4 - Quiz 2 - Class Test 4	CLO 4, CLO 5
Module 4 (Class Hours 8)	Test of Hypothesis (Theory & Logic) - Concept and logic of hypothesis testing. - Neyman-Pearson approach to testing. - Null (H_0) and Alternative (H_1) hypotheses; Simple vs. Composite. - Test of significance procedures. - Type I error, Type II error, and Statistical Power. - Level of significance (2-level concept). - One-tailed vs. Two-tailed tests. - P-value interpretation and decision-making. - Overview of test statistics: Normal, χ^2, t, and F.	- Lectures: Build the Neyman-Pearson framework step-by-step. - Interactive Discussion: Real-world analogies (e.g., medical trials, court trials) to explain Type I/II errors. - Peer Instruction: Students formulate H_0 and H_1 for given scenarios and share with peers.	- Quiz 3 - Assignment 5 - In-course Exam 1	CLO 6

Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 5 (Class Hours 10)	Statistical Tests (Parametric & Non-Parametric) • Single mean, single variance, single proportion (tests & CIs). • Difference of two means (independent) and two proportions. • Ratio of two variances (F-test) and confidence intervals. • Confidence intervals for simple correlation coefficient (ρ). • Confidence intervals for regression coefficients (single & double sample). • Paired t-test (dependent samples). • χ^2 test of Homogeneity for several population means, variances, and proportions. • χ^2 Test of Goodness of Fit.	• Lectures: Derive test statistics for each test type. • Demonstration: Use software to run tests and compare with manual calculations. • Capstone Project: Students design a mini-study, collect data, and apply appropriate tests. • Case Studies: Real datasets from public health, economics, and education.	• Lab Assignment 3 • Assignment 6 • In-course Exam 2	CLO 7, CLO 8, CLO 9

Course Assessment Framework:

Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course 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

- Casella, G., & Berger, R. L. (2024). *Statistical Inference* (2nd Edition, Cengage Learning). [Excellent for Modules 1, 4, and 5—covers distributions, Neyman-Pearson lemma, and tests with mathematical rigor.]
- Montgomery, D. C. (2023). *Design and Analysis of Experiments* (10th Edition, Wiley). [The definitive text for Module 2—contains detailed chapters on CRD, RBD, LSD, factorial designs, and missing plot techniques.]
- Cochran, W. G. (1977; Re-printed 2022). *Sampling Techniques* (3rd Edition, Wiley Classics Library). [Still the gold-standard for Module 3—comprehensive coverage of SRS, stratification, systematic, cluster, and multistage sampling.]
- Peck, R., Olsen, C., & Devore, J. L. (2020). *Introduction to Statistics and Data Analysis* (6th Edition, Cengage). [Excellent supplementary text for practical examples of hypothesis testing, CIs, and real-data case studies for Module 5.]
- Agresti, A. (2018). *Statistical Methods for the Social Sciences* (5th Edition, Pearson). [Highly recommended for applied χ^2 tests, homogeneity, and goodness-of-fit applications in Module 5.]

Course Code: 8223660	Marks: 50	Credits:2	Class Hours: 42
Course Title: Statistics Practical-II			Exam Duration: 5 hours

Course Description

This practical-oriented course is designed to provide hands-on experience in advanced statistical methods, including design of experiments, sampling techniques, and hypothesis testing. Students will learn to analyze basic and factorial designs, handle missing plot estimation, and compute measures of relative efficiency. The course covers various sampling methods such as Simple Random Sampling (SRS), Stratified, Cluster, and Systematic sampling, along with estimation of population parameters. Additionally, students will gain proficiency in conducting common tests of significance for means, variances, proportions, correlation, and regression coefficients, fitting theoretical distributions, testing goodness-of-fit, and constructing confidence intervals. The course emphasizes practical problem-solving, data analysis using statistical software, report writing, and teamwork through a mini-project, preparing students for careers in research, data management, and academia.

Course Objectives

1. To provide hands-on training in designing and analyzing basic and factorial experiments, estimating missing plots, and computing measures of relative efficiency.
2. To develop practical skills in applying various sampling techniques (Simple Random, Stratified, Cluster, and Systematic sampling) and estimating population parameters.
3. To train students in conducting tests of significance for means, variances, proportions, correlation, and regression coefficients, as well as constructing confidence intervals.
4. To enable students to fit theoretical probability distributions to empirical data and perform goodness-of-fit testing.
5. To build proficiency in using statistical software for practical problem-solving and real-world data analysis.
6. To foster collaborative research, critical thinking, and technical report writing abilities through a team-based mini-project.

Course Learning Outcomes (CLOs)

CLO #	Course Learning Outcomes	Bloom's Level
CLO-1	Describe the fundamental concepts and formulas related to design of experiments (basic and factorial designs), missing plot estimation, and relative efficiency.	Level 1: Remembering
CLO-2	Explain the principles and assumptions underlying various sampling techniques (SRS, Stratified, Cluster, Systematic) and hypothesis testing procedures.	Level 2: Understand
CLO-3	Apply appropriate statistical methods to analyze basic and factorial designs, estimate missing plot values, compute relative efficiency, draw various types of samples, and estimate population parameters with standard errors.	Level 3: Apply

CLO-4	Analyze and interpret statistical outputs from hypothesis tests (means, variances, proportions, correlation, regression), goodness-of-fit tests, and tests of homogeneity to draw valid conclusions.	Level 4: Analyze
CLO-5	Evaluate the appropriateness of different statistical techniques for given research problems and justify the selection of specific sampling designs or hypothesis tests based on data characteristics.	Level 5: Evaluate
CLO-6	Create comprehensive statistical reports and deliver effective presentations based on practical projects, demonstrating the ability to synthesize statistical findings and communicate them clearly to diverse audiences.	Level 6: Create

Mapping of CLOs with PLOs

This table demonstrates how each CLO contributes to achieving the broader Program Learning Outcomes.

Indication: ✓ = Mapped / Aligned

CLOs 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
CLO-1	✓	✓	✓	✓	✓		✓					✓
CLO-2	✓	✓	✓	✓			✓					✓
CLO-3	✓	✓		✓		✓	✓					✓
CLO-4	✓	✓		✓		✓	✓					✓
CLO-5	✓	✓		✓		✓	✓	✓		✓		✓
CLO-6	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓

Course Content

Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 1: Design of Experiments (8 Hours)	Introduction to basic experimental designs: CRD, RCBD, and LSD. - Analysis of variance (ANOVA) for CRD, RCBD, and LSD. - Missing plot estimation techniques for RCBD and LSD. - Measures of relative efficiency of designs. - Introduction to factorial designs (2^2 and 2^3). - Analysis of factorial designs: main effects and interactions.	- Lectures: Conceptual explanation and derivation of formulas. - Demonstrations: Step-by-step problem-solving on board. - Practical Sessions: Hands-on lab work using manual calculations.	- Practical Assignments: - Viva Voce, - Quiz:	CLO 1, CLO 2, CLO 3
Module 2: Sampling Techniques (10 Hours)	- Simple Random Sampling (SRS) with and without replacement. - Estimation of population mean, total, and proportion with standard errors in SRS. - Stratified Random Sampling: proportional and Neyman allocation. - Estimation of population mean and variance from stratified samples. - Cluster Sampling: introduction and estimation procedures. - Systematic Sampling: introduction and estimation procedures. - Determination and interpretation of Relative Efficiency of different sampling designs. - Practical exercises comparing sampling methods using simulated data.	- Lectures: Conceptual framework and formulas for each sampling method. - Demonstrations: Selecting samples using random number tables and software. - Practical Sessions: Simulating different sampling designs and comparing estimates. - Case Studies: Real-world applications.	- Practical Report, - Problem-Solving Exercises: - Group Activity:	CLO 1, CLO 2, CLO 3, CLO 5

Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 3: Hypothesis Testing and Confidence Intervals (8 Hours)	- Tests of significance for a single mean (z-test, t-test). - Tests for difference of two means (independent and paired samples). - Tests for variance (Chi-square test). - Tests for proportion (z-test). - Tests for correlation coefficient (t-test). - Tests for regression coefficient (t-test). - Construction of confidence intervals for means, proportions, and variances. - Fitting of theoretical distributions (Binomial, Poisson, Normal). - Testing goodness-of-fit using Chi-square test. - Large sample tests (z-tests). - Tests of homogeneity (Chi-square test for contingency tables). - Practical exercises using real-world datasets.	- Lectures: Step-by-step guide to hypothesis testing procedures and assumptions. - Practical Sessions: Performing tests on real-world datasets using software and manual calculations. - Case Studies: Applying tests to problems in public health, business, and social sciences. - Peer Teaching: Students explain concepts to each other.	- Practical Assignments, - Quiz: - Viva Voce, - Problem-Solving:	CLO 2, CLO 3, CLO 4, CLO 5
Module 4: Project Work and Communication Skills (4 Hours)	- Identification of a real-world research problem. - Data collection and management. - Application of appropriate statistical techniques (designs, sampling, hypothesis tests). - Analysis using statistical software. - Interpretation of results and drawing logical conclusions. - Report writing: structure, content, and formatting. - Presentation of findings using tables, graphs, and oral communication. - Peer review and feedback.	- Project-Based Learning: Students work in teams on a mini-project.	- Mini-Project Report: , - Oral Presentation: - Peer Evaluation: , - Project Viva	CLO 1, CLO 2, CLO 3, CLO 4, CLO 5, CLO 6

List of Books

- Montgomery, D. C. (2017). *Design and Analysis of Experiments* (9th ed.). Wiley.
(Comprehensive coverage of CRD, RCBD, LSD, factorial designs, and missing plot estimation.)
- Cochran, W. G. (2015). *Sampling Techniques* (3rd ed.). Wiley-India.
(Classic and authoritative text covering SRS, stratified, cluster, and systematic sampling.)
- Casella, G., & Berger, R. L. (2024). *Statistical Inference* (3rd ed.). Cengage Learning.
(Rigorous coverage of theoretical distributions, hypothesis testing, and confidence intervals.)
- Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2021). *Probability & Statistics for Engineers & Scientists* (9th ed.). Pearson. (Excellent for practical applications of tests of significance, regression, and goodness-of-fit.)
- Field, A. (2018). *Discovering Statistics Using IBM SPSS Statistics* (5th ed.). SAGE Publications.
(Focuses on practical application and interpretation using software, suitable for lab sessions.)
- Devore, J. L., & Berk, K. N. (2021). *Modern Mathematical Statistics with Applications* (3rd ed.). Springer. (Bridges theory and application with modern examples and datasets.)

GROUP-B (Any Three)

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

Course Description

This course provides a comprehensive understanding of the foundations, cultural diversity, and dynamic transformations of Bangladeshi society. It bridges sociological theory with everyday social realities by examining how ecological conditions, colonial legacies, and the 1971 Liberation War have shaped the country's social institutions and patterns of social organization. Students critically examine rural and urban social structures, class relations, changing family patterns, economic transformations associated with the ready-made garment (RMG) sector and international remittances, and the diverse forms of ethnic coexistence. The course further applies foundational sociological perspectives to contemporary issues such as gender inequality, poverty, social transformation, and vulnerability to climate change. Through critical analysis, discussion, and collaborative learning, students develop the ability to connect sociological knowledge with national development, social challenges, and real-world issues, fostering informed, analytical, and socially responsible perspectives on Bangladeshi society.

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.

Course Learning Outcome (CLO)

CLO	Course Learning Outcome	Bloom's Taxonomy Level
CLO1	Appreciate the importance of cultural diversity and ethnic coexistence in Bangladesh.	Understand
CLO2	Analyze several changing social issues of Bangladesh from sociological perspective.	Analyze
CLO3	Explain the basic concepts, institutions and characteristics of society of Bangladesh.	Understand

CLO4	Apply fundamental sociological theories to be informed about social problems in Bangladesh.	Apply
CLO5	Illustrate the historical evolution, social background, family system, not only economy but also political system of Bangladesh.	Understand
CLO6	Collaborate with peers' sociological ideas effectively for Bangladeshi society.	Apply

Mapping with CLOs with PLOs

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;	Reflective essays; small-group debates; peer dialogue; case studies	Reflective essay; group debate; presentation; class test	CLO1, CLO3, CLO5, CLO6

	modernization, globalization and cultural change.			
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 15–18	Rural Society and Urbanization: Land tenure; rural class structure; Samaj and Salish; patron-client relations; social hierarchy; rural-to-urban migration; urbanization and associated challenges.	Role-play; guest lecture; problem-based learning; group discussion	Role-play assessment; case-study assignment; group presentation; class test	CLO2, CLO3, 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

Course Assessment Framework:

Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course 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%

Lists 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.

Course Code	8222165	Marks: 100	Credits:4	Class Hours: 56
Course Title	Bangladesh Society and Culture			

Course Description

This course provides a sociological and anthropological understanding of Bangladesh's historical development, social structures, cultural diversity, and contemporary transformations. It examines social stratification, rural and urban society, family and kinship, religion and cultural expressions, marginalized communities, and the effects of globalization, migration, industrialization, and climate change on Bangladeshi society.

Course Objectives

1. To provide students with a comprehensive understanding of the historical, social, and cultural evolution of Bangladesh from ancient Bengal to the post-independence era.
2. To analyze the core social structures, institutions, and forms of stratification, including class, gender, caste, and power relations in rural and urban settings.
3. To explore the pluralistic nature of Bangladeshi culture, covering religious traditions, secular celebrations, folk philosophies, and diverse artistic expressions.
4. To examine the socio-economic challenges and cultural dynamics of ethnic minorities and marginalized communities within Bangladesh.
5. To critical evaluate the impacts of globalization, urbanization, climate change, and economic transformations on contemporary Bangladeshi society.
- 6.

Course Learning Outcomes (CLOs)

CLO No.	Course Learning Outcome	Bloom's Taxonomy Level
CLO 1	Trace and explain the historical trajectories, turning points, and cultural shifts that shaped the national identity of Bangladesh.	Understand
CLO 2	Critically analyze structural inequalities, power dynamics, and institutional transitions within rural and urban families and communities.	Analyze
CLO 3	Demonstrate a nuanced understanding of cultural syncretism, literary heritages, and folk traditions unique to the Bengal delta.	Understand
CLO 4	Assess the distinct socio-legal and economic vulnerabilities faced by indigenous peoples and marginalized groups in the country.	Evaluate
CLO 5	Evaluate how global vectors such as the Readymade Garment (RMG) industry, international migration, and climate vulnerability drive social change in Bangladesh.	Evaluate

Mapping of CLOs with PLOs.

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

Course Content

Week	Topic	Teaching–Learning Strategies	Module Assessment	CLOs
Week 1–4	Historical Foundations and Emerging Identity: Ancient Bengal and archaeological heritage; religious transformations; British colonialism and Permanent Settlement; Language Movement; Liberation War and emergence of Bangladesh.	Interactive lectures; historical video screenings; guided group discussions; timeline activities	Quiz; class test; historical timeline assignment	CLO1
Week 5–7	Social Structure and Stratification: Agrarian structures; class dynamics; caste; elite groups; patron-client relations; power relations; income and resource inequalities; social mobility.	Problem-Based Learning; case studies; sociological concept mapping; group discussion	Case-study assignment; concept map; class presentation; class test	CLO2
Week 8–11	Rural and Urban Society: Village structure, <i>Gram</i> , <i>Samaj</i> and local leadership; agrarian transformation; sharecropping and land reforms; urbanization; migration; slums and informal economies.	Comparative group analysis; documentary analysis; guest lecture; Problem-Based Learning	Comparative assignment; documentary review; group presentation	CLO2
Week 12–14	Family, Kinship and Marriage: Family types; joint and nuclear households; kinship networks; lineage and social identity; marriage practices; dowry; divorce; gender roles and decision-making.	Reflexive dialogue workshops; genogram exercises; Think-Pair-Share; case studies	Genogram exercise; reflective assignment; class discussion; quiz	CLO2
Week 15–17	Religion, Festivals and Rituals: Religious pluralism; syncretism;	Field observation; textual analysis;	Field-observation report; cultural	CLO3

	Sufism; secular traditions; Eid, Durga Puja, Christmas and Buddha Purnima; Pohela Boishakh; Nabanna; Baul philosophy; shrines and folk beliefs.	group-led cultural panels; multimedia learning	presentation; textual analysis	
Week 18–20	Cultural Expressions: Art, Literature and Media: Tagore, Kazi Nazrul Islam and Zainul Abedin; Lalon Geeti, Bhatiali, Jatra, Nakshi Kantha; food culture; cinema, television and digital media.	Multimedia presentations; visual and textual artifact analysis; class debate; group discussion	Artifact analysis; presentation; debate participation; short essay	CLO3
Week 21–24	Ethnicity and Marginalized Communities: Indigenous communities of the Chittagong Hill Tracts and plains regions; land rights; cultural preservation; minority issues; Bihari communities; gender and third-gender rights.	Case-study review; human-rights framework analysis; guided discussion; empathy mapping	Case-study report; human-rights analysis; presentation; class test	CLO4
Week 25–28	Globalization and Contemporary Social Change: RMG sector; women's employment and labour rights; international migration and remittances; climate vulnerability and displacement; river erosion; adaptation; youth culture, technology and changing values.	Research-paper workshop; policy-brief simulation; Socratic seminar; case-study analysis	Research paper/policy brief; seminar presentation; final examination	CLO5

Course Assessment Framework:

Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course 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

- Ahmed, I. (Ed.). (2013). *The cultural characteristics of Bangladeshis*. University Press Limited.
- Chowdhury, A. M., & Fakrul, A. (Eds.). (2016). *Bangladesh: History, politics, economy, society and culture*. Essays in honour of Professor Professor Emeritus Anisuzzaman. University Press Limited.
- Jansen, E. G. (1987). *Rural Bangladesh: Competition for scarce resources*. University Press Limited.
- Kabeer, N. (2000). *The power to choose: Bangladeshi women and labour market decisions in London and Dhaka*. Verso.
- Karim, A. K. N. (1980). *The dynamics of Bangladesh society*. Vikas Publishing House.
- Lewis, D. (2011). *Bangladesh: Politics, economy and civil society*. Cambridge University Press.
- Siddiqui, K., Ahmed, J., Kaniz, F., Shafi, S., Islam, M. S., & Asaduzzaman, M. (2010). *Social formation in Dhaka City: A study in third world urban sociology*. University Press Limited.
- Van Schendel, W. (2020). *A history of Bangladesh*. Cambridge University Press.

Course Code	8221959	Marks: 100	Credits: 4	Class Hours:56
Course Title	Political Organization and the Political System of UK and USA			

Course Description

The course provides a concise understanding of political organization, constitutional principles, forms of government, and major organs of government. It examines democracy, dictatorship, parliamentary, presidential, unitary, and federal systems, along with the separation of powers, political parties, pressure groups, and public opinion. Special emphasis is placed on the political systems of the United Kingdom and the United States, including their constitutions, legislatures, executives, judiciaries, electoral systems, and party structures, enabling students to develop a comparative understanding of their institutional frameworks and functioning.

Course Objectives

1. To develop a comprehensive understanding of constitutions, their significance, classifications, methods of establishment, and essential characteristics of a good constitution.
2. To explain and analyze major forms of government, the theory of separation of powers, and the roles and functions of the legislature, executive, judiciary, and electorate.
3. To examine political behavior, including the roles of political parties, pressure groups, and public opinion in political processes and governance.
4. To develop comparative analytical skills through the study of the constitutional structures, institutions, electoral systems, and political processes of the United Kingdom and the United States, while strengthening students' communication, critical thinking, and teamwork skills.

Course Learning Outcomes (CLOs)

CLO	Course Learning Outcome	Bloom's Taxonomy Level
CLO1	Explain the meaning, significance, classification, methods of establishing constitutions and the requisites of a good constitution.	Understand
CLO2	Explain and analyze the major forms of government, including democracy, dictatorship, parliamentary, presidential, unitary and federal systems.	Analyze
CLO3	Analyze the meaning, significance and working of the theory of separation of powers and the roles of the major organs of government.	Analyze
CLO4	Explain and analyze political behavior with reference to political parties, pressure groups and public opinion.	Analyze
CLO5	Analyze the nature, features, sources and functioning of the	Analyze

	British political system, including conventions, monarchy, Parliament, the Prime Minister, Cabinet and party system.	
CLO6	Analyze the nature and features of the American political system, including the Constitution, checks and balances, President, Congress, Judiciary and political parties.	Analyze
CLO7	Demonstrate critical thinking, comparative analysis, effective communication and teamwork through discussion, debate, presentations and comparative study of the political systems of the UK and USA.	Apply

Mapping CLOs with PLOs

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

Course Content

Week	Contents	Teaching–Learning Strategies	Assessment Methods	CLOs
Week 1–4	Constitution: Meaning and significance, Classification, Methods of Establishing Constitution, Requisites of a good Constitution.	Interactive lecture, concept mapping, group discussion, comparative analysis	Class participation, short quiz, written assignment	CLO1
Week 5–8	Forms of Government: The Concept of Traditional and Modern Forms, Democracy, Dictatorship, Parliamentary, Presidential, Unitary and Federal.	Interactive lecture, comparative discussion, group work, case study	Quiz, class test, comparative assignment	CLO2 CLO7
Week 9–11	Theory of Separation of Power: Meaning, Significance and Working.	Lecture, conceptual discussion, diagrammatic presentation, case analysis	Class test, analytical assignment, presentation	CLO3

Week 12–15	Organs of Government: Legislature, Executive, Judiciary and Electorate.	Interactive lecture, institutional analysis, group discussion, case study	Short quiz, written assignment, class presentation	CLO3 CLO7
Week 16–19	Political Behavior: Political Parties, Pressure Groups and Public Opinion.	Lecture, group discussion, debate, role play, case study	Quiz, group presentation, case-study assignment	CLO4 CLO7
Week 20–23	British Political System: Nature, Features and Sources of the Constitution, Conventions, Monarchy, Parliament, The Prime Minister and the Cabinet, Party System.	Multimedia lecture, institutional analysis, case study, group discussion, debate	Class test, case-study analysis, presentation	CLO5 CLO7
Week 24–28	American Political System: Nature and Features of the Constitution, The System of Checks and Balances, The President and Congress, Judiciary and Political Parties.	Multimedia lecture, constitutional analysis, case study, group discussion, comparative learning	Quiz, analytical assignment, presentation, final examination	CLO6 CLO7

Course Assessment Framework:

Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course 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

MacIver, R. M. (1960). *The web of government* (7th ed.). Macmillan.

Strong, C. F. (1952). *Modern political constitutions: An introduction to the comparative study of their history and existing form* (4th ed.). Sidgwick & Jackson.

Wheare, K. C. (1963). *Federal government* (4th ed.). Oxford University Press.

Wheare, K. C. (1966). *Modern constitutions* (2nd ed.). Oxford University Press.

Willoughby, W. F. (1936). *The government of modern states* (2nd rev. ed.). D. Appleton-Century Company.

রহমান, ম. ম. (১৯৯১). *রাষ্ট্রীয় সংগঠনের রূপরেখা*. রাজশাহী বুকস প্যাভিলিয়ন.

ভূঁইয়া, ও. (হ.ফ.). *রাষ্ট্রবিজ্ঞান*.

নাথ, বিপুল রঞ্জন. (হ.ফ.). *রাষ্ট্রীয় সংগঠন*.

ঘোষ, নির্মল কান্তি. (হ.ফ.). *আধুনিক রাষ্ট্রবিজ্ঞানের ভূমিকা*.

Course Code	8222259	Marks: 100	Credits: 4	Class Hours: 56
Course Title	Bangladesh Economy			

Course Description

This course examines the structure, performance, and management of the Bangladesh economy from a political science perspective. It covers macroeconomic trends, national income, fiscal and monetary management, agriculture, industry, external trade, employment, poverty, human development, infrastructure, private-sector development, and environmental challenges. The course also highlights the relationship between economic policies, governance, public administration, and political decision-making in Bangladesh.

Course Objectives

1. To develop a fundamental understanding of Bangladesh's macroeconomic structure, economic performance, growth, savings, investment, and policy framework.
2. To examine the roles, performance, and challenges of the agriculture, industrial, external, and private sectors in Bangladesh's economic development.
3. To develop an understanding of fiscal and monetary management, including taxation, public expenditure, budgeting, banking, financial markets, and economic reforms.
4. To analyze trends in employment, wages, prices, poverty, human development, and social protection, and examine relevant government initiatives.
5. To evaluate the relationship between economic performance, governance, public policy, and political decision-making in Bangladesh.
6. To develop students' ability to interpret economic information and critically assess contemporary economic and development issues through a political science perspective.

Course Learning Outcomes (CLOs)

CLO	Course Learning Outcome	Bloom's Level
CLO1	Explain Bangladesh's macroeconomic structure, growth performance, national income, savings, investment, and institutional policy framework.	Understand
CLO2	Analyze the contribution, performance, and challenges of the agriculture, industrial, external, infrastructure, and private sectors in Bangladesh's economic development.	Analyze
CLO3	Evaluate Bangladesh's fiscal and monetary management, including taxation, public expenditure, budgeting, banking, financial markets, and economic reforms.	Evaluate
CLO4	Analyze trends in employment, wages, prices, poverty, human development, and social protection, including relevant government programs.	Analyze
CLO5	Evaluate the political economy dimensions of Bangladesh's development by	Evaluate

	linking economic outcomes with governance, public policy, planning, and administration.	
CLO6	Critically interpret economic data, policy documents, and contemporary development issues and communicate evidence-based analyses effectively.	Evaluate

Mapping of CLOs with PLOs

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

Course Content

Week	Course Content	Teaching– Learning Strategy	Assessment Methods	Mapped CLOs
Week 1–3	Overview of the Bangladesh Economy: growth performance, savings and investment trends, and the institutional and policy framework guiding macroeconomic management, including the medium-term macroeconomic framework and ongoing reform programs.	Interactive lectures, discussion on recent Bangladesh Economic Review data	Class participation, short quiz, written assignment	CLO1
Week 4–7	National Income and Price Trends: sector-wise growth of GDP, savings and investment; consumer price index and inflation; wage trends, labor force, employment, overseas employment, and remittances.	Interactive lectures, data reading exercises, class discussion	Quiz, class test, data-analysis assignment	CLO1 CLO4 CLO6
Week 8–10	Fiscal Policy and Public Finance Management: government receipts and tax management, revenue collection, public expenditure and the Annual Development Programme, budget balance and financing, and public debt management.	Interactive lectures, case-based discussion, budget document review	Class test, budget analysis assignment, written assignment	CLO1 CLO3 CLO6
Week 11–14	Monetary Management and Financial Market Development: monetary policy, money and credit situation, the banking and non-banking financial sector, interest rate movements, financing of agriculture, industry and SMEs, and capital market development.	Interactive lectures, group discussion, guided reading assignments	Quiz, analytical assignment, class presentation	CLO3 CLO6
Week 15–18	The External Sector: world trade scenario, export and import policy, tariff	Interactive lectures, group discussion,	Class test, thematic	CLO2 CLO5

	structure, Bangladesh's position in the WTO and regional trade arrangements, balance of payments, exchange rate policy, and foreign exchange reserves.	thematic assignments	assignment, presentation	CLO6
Week 19–21	Agriculture, Industry and State-Owned Enterprises: management of food grain production and agricultural credit; growth and performance of the manufacturing sector and SMEs; the production, financial performance, and reform of state-owned enterprises.	Interactive lectures, sector case studies, group presentations	Case-study assignment, group presentation, class test	CLO2
Week 22–24	Power, Energy, Transport, Communication and Human Development: power generation and transmission, transport and communication infrastructure, and human development outlays covering education, health, women and children's affairs, and social welfare.	Interactive lectures, documentary screening, group discussion	Short quiz, thematic assignment, group presentation	CLO2 CLO4
Week 25–28	Poverty Alleviation, Private Sector Development and Environment: poverty trends and reduction strategies, employment generation programs, a private-investment-friendly environment, privatization and public-private partnership, and environmental and climate change challenges facing Bangladesh.	Interactive lectures, thematic assignments, policy debate	Policy analysis assignment, class presentation, final examination	CLO4 CLO5 CLO6

Course Assessment Framework:

Total Course Marks: 100

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course 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

- Bangladesh Bank. (Current issue). Annual report. Dhaka, Bangladesh: Bangladesh Bank.
- Islam, Nurul. (2003). Making of a nation, Bangladesh: An economist's tale. Dhaka, Bangladesh: University Press Limited.
- Islam, S. M. Mujahidul. (Latest edition). Bangladesh economy. Dhaka, Bangladesh: Bangladesh Publishers.
- Khan, Akbar Ali. (1996). Discovery of Bangladesh. Dhaka, Bangladesh: University Press Limited.
- Mahmud, Wahiduddin (Ed.). (n.d.). Bangladesh's development experience: Some selected issues. Dhaka, Bangladesh: University Press Limited.
- Ministry of Finance, Government of Bangladesh. (Latest edition). Bangladesh economic review. Dhaka, Bangladesh: Finance Division.
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