NATIONAL UNIVERSITY

BANGLADESH

First Year Syllabus

Department of Mathematics

Four-Year B.Sc. (Honours) Program

Effective from the Session: 2024-2025

Mission: 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.

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

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

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

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

Program Educational Objectives (PEOs): After graduation, our students will be able to

PEO 1: Help others understand basic concepts of mathematics and science, and support learning at the school and college level.

PEO 2: Work together with teachers, students, and others to understand how mathematics builds thinking and problem-solving skills throughout the program.

PEO 3: Use mathematical and scientific knowledge in study and work, and develop leadership, communication, and teamwork abilities.

PEO 4: Contribute to making the Department of Mathematics a centre of quality education and research.

Program Learning Outcomes (PLOs): At the time of graduation, B.Sc. (Honours) in Mathematics students will have achieved the ability to

PLO 1: Mathematical Knowledge: Understand and use basic to advanced mathematics, and apply this acquired knowledge to solve real-life, academic, and professional problems.

PLO 2: Problem-Solving Ability: Recognize, formulate, and solve mathematical problems using logic, formulas, and mathematical techniques; and draw accurate conclusions in both pure and applied mathematics.

PLO 3: Designing Solutions: Design and conduct individual research or develop models and solutions in areas such as human welfare, technology, environmental issues, pollution, water use, climate change, and sustainable living.

PLO 4: Research Skills: Collect, analyze, and interpret data using mathematical methods; perform calculations, draw graphs, and present results confidently with logical conclusions.

PLO 5: Use of Modern Tools: Utilize modern tools, including scientific calculators, computers, and standard mathematical software (e.g., Mathematica, Fortran, C, C++), to solve mathematical problems effectively.

PLO 6: Health and Society: Apply mathematical knowledge to practical activities, societal functions, health, and overall development.

PLO 7: Career and Academic Readiness: Demonstrate readiness for careers in industry, teaching, or government, and qualify for admission to advanced studies in mathematics and related fields such as engineering, medical sciences, statistics, physics, economics, and education.

PLO 8: Ethics and Responsibility: Follow moral values in learning and research, be an honest professional, and avoid copying or using incorrect information.

PLO 9: Teamwork and Leadership: Function effectively as an individual, and also as a member or leader in teams. Be able to lead a group when needed in academic, research, or job settings.

PLO 10: Communication Skills: Share mathematical ideas clearly through writing, speaking, and presenting. Be able to write reports, give presentations, and explain concepts.

PLO 11: Project and Time Management: Plan and manage time, tasks, and projects well. Use mathematics in real situations while working alone or in a team.

PLO 12: Lifelong Learning: Keep learning new mathematics, tools, and skills beyond graduation for personal and professional growth in an ever-evolving technological world.

Mapping PEOs with 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				√

First Year Courses and Marks Distribution:

FIRST YEAR			
Course Code	**Course Title**	**Marks**	**Credits**
213701	Fundamentals of Mathematics	100	4
213703	Calculus I	100	4
213705	Linear Algebra and Analytic Geometry	100	4
213706	Math Lab-Practical I (Mathematica)	100	4
Any Two of the following:			
212707	Physics I (Mechanics, Properties of Matter, Waves and Optics)	100	4
212709	Physics-II (Heat, Thermodynamics, and Radiation)	50	2
213607	Fundamentals of Statistics	100	4
213610	Lab-1: Fundamentals of Statistics	50	2
212209	Principles of Economics	100	4
212211	Bangladesh Agricultural Economics	50	2
212807	Chemistry-I	100	4
212810	Chemistry-I Practical	50	2
Compulsory			
219901	History of Bangladesh: Language, Culture and Identity	100	4
219903	Information and Communication Technology	75	3
219904	Lab: Information and Communication Technology	25	1
	Total	**900**	**36**

Matrix of Courses with Program Learning Outcomes (Curriculum map):

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO9	PLO10	PLO11	PLO12
213701	√	√										
213703	√	√										
213705	√	√										
213706	√	√										
212707	√	√										
212709	√	√										
213607	√	√		√	√				√			
213610	√	√									√	
212209	√	√		√	√							
212211	√	√										
212807	√											
212810		√										
219901	√			√								
219903	√				√							
219904	√					√						

Detailed Syllabus of All Courses:

Course Code	213701	Marks: 100	Credits: 4	Class Hours: 60
Course Title:	Fundamentals of Mathematics			

Course Description: Fundamentals of mathematics are the foundations of all mathematics courses. The course is very productive. Understanding this course will enable everyone to learn other areas of mathematics. Upon completing this course, students will gain valuable and practical insights into mathematical logic, proof methods, real and complex number systems, relations and functions with graphs, equations, and various types of series.

Course Objectives: To provide students with knowledge and a detailed idea of some basic mathematical concepts like mathematical logic, relations and functions, real and complex number systems, polynomial and polynomial equations, algebraic and geometric series.

Course Learning Outcomes (CLOs):

After completing this course, students will be able to

CLO1	Describe fundamental concepts of mathematical logic, including statements, propositions, logical connectives, truth tables, and methods of proof such as direct, indirect, and mathematical induction.
CLO2	Apply knowledge of matrices, determinants, and systems of linear equations to solve real-life and physical problems.
CLO3	Identify the basic properties of the real number system and solve standard inequalities, including those involving means, powers, and classical inequalities (Cauchy, Chebyshev, Weierstrass).
CLO4	Explain relations and functions, describe their interrelationships, and illustrate various types of functions and their inverses.
CLO5	Analyze graphs of functions using different tests and properties to interpret mathematical behavior.
CLO6	Recognize and apply the structure and properties of the complex number system, including De Moivre's theorem, to solve polynomial equations and construct new equations based on conditions.
CLO7	Compute and apply summations of algebraic and trigonometric series using standard techniques such as the method of differences and successive differences.

Mapping of CLOs with PLOs:

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

Course Contents:

Topics	Teaching Learning Strategy	CLOs
Elements of Logic: Mathematical statements; Logical connectives; Conditional and bi-conditional statements; Truth tables and tautologies; Quantifiers; Logical implication and equivalence; Deductive reasoning; Methods of proof (direct, indirect), method of induction.	•Interactive lecture using examples •Group problem-solving in class •Use of real-life logic puzzles	CLO1
Set Theory: Sets and subsets, Set operations, Cartesian product of two sets, Operations on a family of sets, De Morgan's laws.	• Whiteboard-based lecture • Assignment	CLO1 CLO4
Relations and Functions: Relations; Order relation; Equivalence relations; Functions; Images and inverse images of sets; Injective, surjective, and bijective functions; Inverse functions.	•Whiteboard-based lecture •Assignment •Short presentations by students	CLO4
Real Number System: Field and order properties; Prime numbers; Natural numbers; Integers and rational numbers; Absolute value and its properties; Basic inequalities (including inequalities of means and powers); Inequalities of Cauchy, Chebyshev, Weierstrass.	• Whiteboard-based lecture •Assignment	CLO3
Complex Number System: Field of Complex numbers; De Moivre's theorem and its applications.	• Whiteboard-based lecture •Assignment	CLO6
Matrices and Determinants: Notion of matrix; Algebra of matrices; Different types of matrices; Invertible matrices; Elementary row and column operations and row-reduced echelon matrices; Determinant function; Properties of determinants; Minors, Cofactors, expansion, and evaluation of determinants.	• Whiteboard-based lecture •Assignment	CLO2
Summation of Series: Arithmetic and geometric series; Method of difference; Successive differences; Summation of algebraic and trigonometric series.	• Whiteboard-based lecture •Assignment	CLO7
Theory of Equations: Relations between roots and coefficients; Symmetric functions of roots; Sum of the powers of roots; Synthetic division; Descartes' rule of signs; Multiplicity of roots; Transformation of equation.	• Whiteboard-based lecture •Assignment	CLO6
Elementary Number Theory: Divisibility. Fundamental theorem of arithmetic. Congruences (basic properties only).	• Whiteboard-based lecture • Assignment	CLO1 CLO3

List of Books:

Barnard, S., & Child, J. M. (1959). *Higher algebra*. Macmillan.

Hall, H. S., & Knight, S. R. (2008). *Higher algebra*. Arihant Publications.

Lipschutz, S. (2009). *Schaum's outline of theory and problems of set theory and related topics* (2nd ed.). McGraw-Hill.

Rahman, M. A. (2000). *Basic algebra*. Nahar Book Depot and Publications.

Course Code	**213703**	**Marks: 100**	**Credits: 4**	**Class Hours: 60**
Course Title:	**Calculus I**			

Course Description: Calculus is one of the most fundamental courses in Mathematics, which consists of two parts (Differential and Integral). The course is designed to develop the topics of Differential and Integral calculus. Understanding this course will lead everyone to learn the other mathematical courses that require the fundamentals of differentiation and integration.

Course Objectives: Enable students to

- Develop the basic ideas of functions and their graphs.
- Learn the basic properties of limits and continuity, and analyze them both mathematically and graphically.
- Understand the ideas and applications in solving real-life, life-oriented problems of differentiation and integration.

Course Learning Outcomes (CLOs):

After completing this course, students will be able to

CLO1	Identify and graph various types of functions, including polynomial, rational, exponential, logarithmic, trigonometric, and hyperbolic functions, and describe their key properties.
CLO2	Explain the concepts of limits and continuity, and apply relevant theorems to compute limits, including indeterminate forms using L'Hospital's Rule.
CLO3	Apply techniques of differentiation, including rules and theorems (e.g., Leibniz's rule), to solve problems related to rates of change, related rates, and approximations in mathematical and real-life contexts.
CLO4	Analyze functions using derivative-based tools, such as the Mean Value Theorem, to determine maximum and minimum values, and concavity, to solve optimization and curve analysis problems.
CLO5	Apply techniques of integration (definite and indefinite) and related theorems to solve problems involving area, volume, arc length, and surface area.
CLO6	Interpret and compute properties of parametric and polar curves, including arc length, area, and surface volume in polar coordinates.
CLO7	Evaluate improper integrals and infinite series using convergence tests, Taylor polynomials and expansions, and apply Gamma and Beta functions where appropriate.

Mapping of CLOs with PLOs:

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

Course Contents:

Topics	Teaching Learning Strategy	CLOs
Functions and Their Graphs: Polynomial and rational functions; logarithmic and exponential functions; trigonometric functions and their inverses; hyperbolic functions and their inverses; combinations of such functions.	• Whiteboard-based lecture •Assignment	CLO1
Limit and Continuity: Definitions and basic theorems on limit and continuity; Limit at infinity and infinite limits; Computation of limits; Indeterminate form (L'Hospital's rules).	• Whiteboard-based lecture •Assignment	CLO2
Differentiation: Tangent lines and rates of change; Definition of derivative; One-sided derivatives; Rules of differentiation (proofs and applications); Successive differentiation; Leibnitz's theorem (proof and application); Rates of change in Natural and Social Sciences; Related rates; Linear approximations and differentials; Indeterminate forms; L'Hospital's rules.	• Whiteboard-based lecture • Assignment •Tutorial	CLO3
Applications of Differentiation: Mean value theorem; Maximum and minimum values of functions; Concavity and points of inflection; Optimization problems.	• Whiteboard-based lecture •Assignment	CLO4
Integration: Antiderivatives and indefinite integrals; Techniques of integration; Definite integration using antiderivatives; Fundamental theorems of calculus (proofs and applications); Basic properties of integration; Integration by reduction.	• Whiteboard-based lecture •Assignment	CLO5

Applications of Integration: Arc length; Plane areas; Surfaces of revolution; Volumes of solids of revolution; Volumes by cylindrical shells; Volumes by cross sections.	• Whiteboard-based lecture •Assignment	CLO5
Parametric and Polar Curves: Arc length for parametric curves; Graphing in polar coordinates; Tangent lines, arc length, and area for Polar Curves; Area and volume of surface by revolving in Polar coordinates.	• Whiteboard-based lecture •Assignment	CLO6
Improper Integrals: Tests of convergence and their applications; Gamma and Beta functions.	• Whiteboard-based lecture •Assignment	CLO7
Approximation and Series: Taylor polynomials and series; Convergence of series; Taylor's series; Taylor's theorem and remainders; Differentiation and integration of series; Validity of Taylor expansions and computations with series.	• Whiteboard-based lecture •Assignment	CLO7

List of Books:

Anton, H., Bivens, I. C., & Davis, S. (2016). *Calculus: Early transcendentals* (11th ed.). Wiley.

Das, B. C., & Mukherjee, B. N. (1938). *Integral calculus*. U. N. Dhur & Sons Pvt. Ltd.

Das, B. C., & Mukherjee, B. N. (1949). *Differential calculus*. U. N. Dhur & Sons Pvt. Ltd.

Matin, M. A., & Chakraboty, B. (1994). *Differential calculus*. Dhaka: Standard Publications.

Mohammad, K., Bhattacharjee, P. K., & Latif, M. A. (1968). *Differential calculus* (1st ed.). Chittagong: S. Tripaty.

Mohammad, K., & Bhattacharjee, P. K. (1987). *Integral calculus* (6th ed.). H. Bhattacharjee.

Stewart, J. (2015). *Calculus: Early transcendentals* (8th ed.). Cengage Learning.

Swokowski, E. W. (1988). *Calculus with analytic geometry* (6th ed.). Brooks/Cole.

Thomas, G. B., & Finney, R. L. (1996). *Calculus and analytic geometry* (9th ed.). Addison-Wesley.

Course Code	213705	Marks: 100	Credits: 4	Class Hours: 60
Course Title:	Linear Algebra and Analytic Geometry			

Course Description: This course combines essential topics from Linear Algebra and Analytic Geometry. It includes systems of linear equations, vector spaces, linear transformations, matrices, and inner product spaces, along with coordinate geometry in two and three dimensions, covering lines, planes, conics, and conicoids. The course develops both theoretical understanding and practical problem-solving skills.

Course Objectives: Enable students to

- Understand and apply the concepts of linear equations, vectors, vector spaces, linear transformations, eigenvalues, eigenvectors, and inner products.
- Analyze and interpret geometric objects such as points, lines, planes, and second-order curves and surfaces, including conic sections.
- Model, solve, and interpret real-world problems using the tools of linear algebra and analytic geometry.

Course Learning Outcomes (CLOs):
After completing this course, students will be able to

CLO1	Solve systems of linear equations using various methods and apply them to real-life problems such as networks and modeling.
CLO2	Work with vectors in 2D and 3D spaces, as well as in general R^n and C^n, including inner products, norms, and distances, and apply these concepts using appropriate digital tools.
CLO3	Understand vector spaces, basis, dimension, linear transformations, and matrices, and apply these concepts to analyze and interpret linear systems.
CLO4	Compute eigenvalues and eigenvectors, diagonalize matrices, and apply related results such as the Cayley-Hamilton theorem in problem-solving.
CLO5	Analyze geometric objects, such as lines, planes, and conic sections, in 2D and 3D, and interpret their properties through mathematical equations.
CLO6	Solve problems involving distances, angles, and intersections in space, and sketch standard geometric surfaces like spheres and conicoids.
CLO7	Communicate mathematical ideas effectively and use software tools (e.g., Mathematica) to model and visualize linear algebra and geometry problems.

Mapping of CLOs with PLOs:

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

Course Contents:

Topics	Teaching Learning Strategy	CLOs
System of Linear Equations: Linear equations; System of linear equations (homogeneous and non-homogeneous) and their solutions using different methods. Application to Network Flow and Electrical Networks; Balancing chemical equations; Polynomial interpolation.	•Problem discussion • Whiteboard-based lecture • Assignment	CLO1
Vectors in R_n and C_n: Review of geometric vectors in IR^2 and IR^3 spaces; Vectors in R^n and C^n, Inner product, Norm and distance in R^n and C^n, respectively	• Whiteboard-based lecture • Assignment •Visual illustration software use (Mathematica)	CLO2
Vector Spaces: Notion of groups and fields; Vector spaces; Subspaces; Linear combination of vectors; Linear dependence of vectors; Basis and dimension of vector spaces; Change of bases; Row and column space of a matrix; Rank of matrices; Solution spaces of systems of linear equations; Application to Polynomials.	• Pair practice • Whiteboard-based lecture • Assignment	CLO3
Linear Transformation: Linear transformations; Examples and illustrations with applications; Kernel and image of a linear transformation and their properties; Matrix representation of linear transformations.	• Lecture • Assignment	CLO5
Eigenvalues and Eigenvectors: Eigenvalues and Eigenvectors; Diagonalization; Cayley-Hamilton theorem; Application to Least Squares approximation.	• Lecture • Whiteboard derivation • Assignment	CLO6 CLO7
Two-dimensional Geometry: Transformation of coordinates; Pair of straight lines (homogeneous second-degree equations, general second-degree equations representing a pair of straight lines, angle between pair of straight lines, bisectors of angle between pair of straight lines); General equations of second degree (reduction to standard forms, identifications, properties, and tracing of conics).	•Lecture using whiteboard and visual aids •Example-solving and student participation •Assignment	CLO1 CLO2 CLO5
Three-dimensional Geometry: Coordinates, Distance, Direction cosines and direction ratios, Planes (equation of plane, angle between two planes, distance of a point from a plane), Straight lines (equations of lines, relationship between planes and lines, shortest distance); Spheres; Conicoid (Sphere, paraboloid, ellipsoid, hyperboloid of one-sheet and two sheets with sketches).	• Whiteboard-based lecture • Peer explanation and class practice	CLO1 CLO2 CLO3 CLO4 CLO5 CLO6 CLO7

List of Books:

Anton, H., & Rorres, C. (2013). *Linear algebra with applications* (10th ed.). Wiley.
Askwith, H. H. (1908). *Analytic geometry of conic sections*. Cambridge University Press.
Bhattacharjee, S. K. (1971). *Analytic geometry*. New Smart Prakashan.
Kolman, B., & Hill, D. R. (2007). *Elementary linear algebra with applications* (9th ed.). Pearson Education.
Lipschutz, S. (2001). *Linear algebra*. Schaum's outline series. McGraw-Hill.
Loney, S. L. (2005). *The elements of coordinate geometry*. AITBS Publishers.
Mohammad, K. (1975). *Analytic geometry and vector analysis*.
Nicholson, W. K. (2003). *Linear algebra with applications* (3rd ed.). McGraw-Hill.
Rahman, M. A. (2015). *Linear algebra.* Dhaka: Nahar book depot & publications.

Course Code	213706	Marks: 100	Credits: 4	Class Hours: 60
Course Title:	Math Lab-Practical I (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 objective of the course is as follows:

- Familiarize students with Mathematica software.
- Teach students how to use Mathematica for symbolic and numerical calculations, data analysis, visualization, and problem-solving in mathematics and scientific research.
- Enhance students' proficiency in utilizing Mathematica to improve their understanding and problem-solving abilities in various mathematical domains.

Course Learning Outcomes (CLOs):

After completing this course, students will be able to

CLO1	Demonstrate fundamental skills in operating the Mathematica software interface and executing basic commands.
CLO2	Apply Mathematica for symbolic and numerical computation, including operations with expressions, equations, and matrices.
CLO3	Use Mathematica to compute derivatives, integrals, limits, and series from courses like Calculus and Linear Algebra.
CLO4	Create 2D and 3D graphical representations of mathematical functions and data using Mathematica's visualization tools.
CLO5	Solve problems from first-year core math courses (e.g., Fundamentals, Linear Algebra, Analytic Geometry, Calculus I) using Mathematica's built-in functions and packages.
CLO6	Utilize Mathematica to explore mathematical patterns, test conjectures, and support experimental mathematics.
CLO7	Integrate Mathematica into scientific or mathematical reporting, presentations, and research-oriented tasks.

Mapping of CLOs with PLOs:

	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 Fundamental of Mathematics, Linear Algebra, Analytic Geometry, and Calculus I studied in the first year.

Teaching Learning Strategy:

Class Lecture Lab-based	30 (Each 2-hour lab covers first-year core Math problems)
Class Test	1
Lab Notebook	1 (Instructors will assign at least 30 lab tasks)

Assessment Strategy:

Type of evaluation	Time	Marks	Guideline
Final Exam	3 hours	70	Seven questions have to be answered out of the ten questions
Class Test	1 hour	20	Internal Assessment: Two questions have to be answered out of the three questions
Lab Notebook	-----	5	Internal Assessment: Throughout the whole course content (at least 30 lab tasks)
Class attendance	-----	5	Internal Assessment

List of Books:

Don, E. (2009). *Schaum's Outlines 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, Inc.

Course Code	212707	Marks: 100	Credits: 4	Class Hours: 60
Course Title:	Physics-I (Mechanics, Properties of Matter, Waves, and Optics)			

Course Objectives: This course reviews the concepts of mechanics learnt at colleges from a more advanced perspective and goes on to build new concepts. It begins with Newton's Laws of Motion and ends with Gravitation and Optics. Students will be taught the concept of Work, Energy, Power, Elasticity, Rotational Motion, and Surface Tension. The students will be able to apply the concepts learnt to several real-world problems.

Course Learning Outcomes (CLOs):
After going through the course, the student should be able to

CLO1 Understand the concept of Vector quantities and units
CLO2 Calculate work, energy, and power
CLO3 Understand rotational motion

CLO4 Understand analyze gravitation
CLO5 Understand the laws of fluid dynamics

CLO6 Understand physical properties of matter
CLO7 Understand the concept of waves and optics

Mapping of CLOs with PLOs:

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

Course Contents:

	Topics	Teaching Learning Strategy	CLOs
1	**Vector Analysis:** Vectors and scalars, Addition and multiplication of vectors, Triple scalar & vector products, Derivatives of vectors, Gradient, divergence and curl-their physical significance, Theorems of Gauss, Green & Stoke's	Lecture, and Assignment	CLO1
2	**Work, Energy, and Power:** Work energy theorem, Conservation of energy and linear momentum, Conservative and non-conservative forces and	Lecture, Group Discussion	CLO2

	systems, Conservation of energy and momentum, Centre of mass, Collision problems	and Assignment	
3	**Rotational Motions:** Rotational variables, Rotation with constant angular acceleration, Relation between linear and angular kinematics, Torque on a particle, Angular momentum of a particle, kinetic energy of rotation, and moment of inertia. Combined translational and rotational motion of a rigid body, Conservation of angular momentum.	Lecture, Group Discussion and Assignment	CLO3
4	**Gravitation:** Centre of gravity of extended bodies, Gravitational field and potential, their calculations, Determination of gravitation constant and gravity, Compound and kater's pendulums, Motion of planets and satellites, Escape velocity	Lecture, Group Discussion and Assignment	CLO4
5	**Fluid Dynamics:** Viscosity and coefficient of viscosity, Poiseulle's equation, Determination of the coefficient of viscosity of liquid by Stoke's method, Bernoulli's theorem and its applications, Torricelli's theorem, Venturimeter	Lecture, Group Discussion and Assignment	CLO5
6	**Elasticity:** Moduli of elasticity, Poisson's ratio, Relations between elastic constants and their determination, Cantilever	Lecture, and Assignment	CLO6
7	**Surface Tension:** Surface tension as a molecular phenomenon, Surface tension and surface energy, Capillary rise or fall of liquids, Pressure on a curved membrane due to surface tension, Determination of surface tension of water, mercury, and soap solution, Effect of temperature	Lecture, and Assignment	CLO6
8	**Waves:** Mechanical waves, types of waves, travelling waves. The superposition principle. Wave speed, Power, and intensity in wave motion. Interference of waves, Standing Waves, and resonance	Lecture, Group Discussion and Assignment	CLO7
9	**Oscillatory Motions:** Simple harmonic motion, Combination of harmonic motions, Damped harmonic motion, Forced oscillations, and resonance	Lecture and Assignment	CLO7
10	**Optics:** Fresnel's and Fraunhofer types, Diffraction through single slit and double slit, diffraction grating, Dispersive and resolving powers of gratings. Plane, Elliptical, and circular Polarizations, Optical, Rotatory	Lecture, Group Discussion and Assignment	CLO7

List of Books:

Khan A. H., & Ishaq. M. (2017). *B.Sc. Hons. Physics 1st Part (Bengali Version).* Ideal Books.

Halliday, D., Resnick, R. & Walker, J. (2001). *Fundamentals of physics.* 6th Edition John Willey and Sons, Inc.

Sears, F. W., & Zemansky, M. W. (2015). *University physics: Vol. 1. Mechanics* (12th ed.). Pearson.

Spiegel, M. R. (1959). *Vector analysis*. McGraw-Hill.

Course Code	212709	Marks: 50	Credits: 2	Class Hours: 30
Course Title:	Physics-II (Heat, Thermodynamics and Radiation)			

Course Learning Outcomes (CLOs):

After completing the course, the student will be able to

CLO1: Understand basic concepts of heat, temperature, and thermal equilibrium

CLO2: Calculate thermal energy by applying knowledge of calorimetry

CLO3: Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics and 2nd laws of thermodynamics.

CLO4: the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations

CLO5: Understand the basic aspects of the kinetic theory of gases, the Maxwell-Boltzmann distribution law.

CLO6: Describe the concept of black body radiation, Emissive and absorptive powers, Rayleigh-Jeans' law, and applications of radiation laws.

Mapping of CLOs with PLOs:

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

Course Contents:

	Topics	Teaching Learning Strategy	CLOs
1	**Thermometry:** Temperature, concepts of thermal equilibrium, measurement of low and high temperature: Gas thermometers, Resistance thermometer, Thermocouple, Pyrometry, International temperature scale	Lecture and Assignment	CLO1
2	**Calorimetry:** Specific heats of solids, liquids and gases by	Lecture	CLO2

	method of mixture with radiation corrections: Newton's Law of cooling, Variations of specific heats, Atomic and molecular heats	and Assignment	
3	**Thermodynamic Systems:** Concept of internal energy: The first law of thermodynamics, Work and specific heats, Isothermal and adiabatic processes	Lecture and Assignment	CLO3
4	**The Second Law of Thermodynamics:** Reversible and irreversible processes: Carnot cycle, Efficiency of reversible engines, Absolute thermodynamic temperature scale, Change of phase: Clausius and Clapeyron equation, Porous plug experiment	Lecture, Group Discussion, and Assignment	CLO3
5	**Entropy:** Entropy of an ideal gas, Temperature-entropy diagram, Increase of entropy.	Lecture	CLO4
6	**Thermodynamic Functions:** Maxwell's relations, Specific heat equations.	Lecture	CLO5
7	**Radiation:** Concept of black body radiation, Kirchhoff's law, Stefan–Boltzmann law, Wien's displacement Law, Rayleigh-Jeans law, Planck's Radiation law, Temperature of the sun	Lecture and Assignment	CLO6

List of Books:

Halliday, D., Resnick, R., & Walker, J. (2001). *Fundamentals of physics* (6th ed.). John Wiley & Sons, Inc.

Hossain, T. (1975). *Textbook of heat*. Variety Books.

Khan, A. H., & Ishaq, M. (2017). *B.Sc. Hons physics 3rd part* (Bengali version). Ideal Books.

Saha, M. N., & Srivastava, B. N. A. (1958). *Treatise on heat*. The Indian Press Private Ltd.

Sears, F. W. (1950). *An introduction to thermodynamics*. Addison-Wesley Press.

Zemansky, M. W. (1997). *Heat and thermodynamics* (7th ed.). The McGraw-Hill Co., Inc.

Course Code	**213607**	**Marks: 100**	**Credits: 4**	**Class Hours: 60**
Course Title:	**Fundamentals of Statistics**			

Course Objectives: To be able to understand the nature, characteristics, scope, application, and abuse of statistics. To make oneself familiar with data, the nature of data, how to process and condense the data, sources of data, and graphical presentation of data, and to apply appropriate statistical tools and techniques to analyze the data. To acquaint students with the necessary skills for solving probability-related problems using appropriate laws. To provide knowledge on time series and statistical indices.

Course Learning Outcomes (CLOs):

After going through the course, students will be able to

CLO1	Understand the nature, characteristics, scope, application, and abuse of statistics. Knowledge of sources of data and how to process, condense, and present data. Understand different characteristics of statistical data, such as measures of location, dispersion, moments, skewness, kurtosis, and their properties.
CLO2	Understand the relationship between variables such as simple correlation, rank correlation, correlation ratio, and simple regression analysis. standard error of estimators of regression coefficients & their properties, and fitting of regression lines.
CLO3	Comprehend different approaches to defining probability and useful laws of probability to solve problems. Also, learn some commonly used probability distributions.
CLO4	Gain knowledge about the meaning and application of statistical indices.
CLO5	Identify the patterns and trends and isolate the influencing factors of the time series data for future planning and control.
CLO6	Understand the concept of numerical methods, including interpolation and the use of numerical methods in applications to real problems.

Mapping of CLOs with PLOs:

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

Course Contents:

Topics	Teaching Learning Strategy	CLOs
Descriptive Statistics: Statistics–Its nature and some important uses, Qualitative and quantitative data, Classification, Tabulation and frequency distribution, Graphical representation of data, Measures of location, Measures of Dispersion, Skewness and Kurtosis, Mathematical relationship among different measures of location, dispersion, Skewness and kurtosis.	Lecture, Assignment	CLO1
Bivariate Data: Correlation coefficient, Correlation analysis, The purpose and uses of regression analysis, Simple regression and methods of least squares and estimation of parameters, Correlation ratio, Rank correlation, Partial and multiple correlation.	Lecture, Assignment	CLO2

Elementary Probability: Meaning of Probability, Classical and empirical definitions of Probability, Axiomatic approach of defining probability, Event, Sample space, and simple problems on probability, Addition rule, Conditional probability, Multiplication rule, and Bayes' Theorems, The concept of a random variable, Probability function and probability density function, Joint probability function. Marginal and conditional distributions, Statistical independence, Expected value and related theorems, Moment generating function, Common probability distributions, Binomial, Poisson, and Normal.	Lecture, Group Discussion, Assignment	CLO3
Index Number: Concept of an index number and problems in the construction of index numbers, Types of indices (Price, Quantity, Value, and cost of living indices) and their uses, Tests for index numbers.	Lecture, Group Discussion, Workshop, and Assignment	CLO4
Time Series Analysis: Elements of time-series analysis, Measurement of trend by moving average, By least square method, Trend curve, Determination of seasonal indices, Cyclical movements.	Lecture, Group Discussion, and Assignment	CLO5
Numerical Mathematics: Differences of a polynomial, Finite difference operator, Difference table, Newton's formula, and starling's central difference formula, Inverse interpolation, Numerical integration.	Lecture, Group Discussion, Workshop, and Assignment	CLO6

List of Books:

Hoel, P. G. (n.d.). *Introduction to statistics* (4th ed.). Wiley and Sons.

Islam, M. N. (2015). *An introduction to statistics and probability* (4th ed.). Mullick, & Brothers.

Jalil, M. A., & Ferdous, R. (1999). *Basic statistics: Methods and applications*. Robi Publications.

Mostafa, M. G. (1989). *Method of statistics* (4th ed.). Karim Press and Publications.

Shil, R. N., & Debnath, S. C. (2016). *An introduction to the theory of statistics*. Star Publications.

Simpson, G., & Kafka, F. (n.d.). *Basic statistics*. Oxford & IBH Publishing Co.

Weiss, N. A., & Weiss, C. A. (2012). *Introductory statistics*. Pearson Education.

Course Code	213610	Marks: 50	Credits: 2	Class Hours: 30
Course Title:	Lab-1: Fundamentals of Statistics			

Data condensation and tabulation. Formation of frequency distribution from both qualitative and quantitative data. Construction of a bivariate table. Graphical representation of data. Measures of location and dispersion, Calculation of moments, Measures of skewness and kurtosis. Simple correlation coefficient and fitting of regression lines. Computation of the rank correlation coefficient. Fitting of Binomial, Normal, and Poisson's distributions, Finding trend values and seasonal variation from time series data by different methods, Calculation of Index numbers and test of index number, Use of Newton's forward and backward formula, Solution of numerical integration.

Course Code	212209	4 Credits	100 Marks
Course Title:	Principles of Economics		

Course Objectives: This course provides students with fundamental economic principles covering microeconomic and macroeconomic concepts, including supply and demand analysis, consumer behavior, production theory, market structures (perfect competition and monopoly), national income accounting, international trade, money and inflation, and government finance. Students will develop analytical skills to understand economic decision-making at the individual, firm, and national levels, while examining contemporary economic issues and Bangladesh's economic context.

Course Learning Outcomes (CLOs):

CLOs	Learning Outcomes
CLO1	Explain core economic concepts, including scarcity, opportunity cost, and production possibilities
CLO2	Analyze market forces using supply-demand models and elasticity concepts
CLO3	Apply utility theory to explain consumer choice and calculate consumer surplus
CLO4	Differentiate between short-run and long-run production costs and analyze production functions
CLO5	Compare market structures (perfect competition vs monopoly) and their equilibrium outcomes
CLO6	Calculate key macroeconomic indicators (GDP, GNP) and explain national income accounting
CLO7	Evaluate arguments for free trade vs protectionism using comparative advantage theory
CLO8	Distinguish between economic growth and development, identifying measurement challenges
CLO9	Explain monetary concepts (money supply measures, inflation) and their economic impacts
CLO10	Analyze government budgets, tax systems, and fiscal policy implications

Mapping of CLOs with PLOs:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	✓	✓				✓						
CLO2	✓	✓	✓	✓								
CLO3	✓	✓		✓	✓							
CLO4	✓	✓	✓									
CLO5	✓	✓					✓					
CLO6	✓	✓		✓						✓		
CLO7	✓	✓				✓						
CLO8	✓	✓		✓								✓
CLO9	✓	✓				✓	✓					
CLO10	✓	✓	✓								✓	

Course Contents:

Topics	Teaching Learning Method	CLOs
1. Fundamentals of Economics: Definition, Nature and Scope of Economics, Scarcity of Resources, Various forms of Economic Organization, Three Fundamental Problems of Economics, Production Possibility Frontier, Opportunity Cost, Efficiency and Equity, Informal Economics,	Lecture and Assignment	CLO1
2. Supply and Demand: Demand and Quantity Demanded, Determinants of Quantity Demanded, Demand Schedule, Demand Curve, Supply and stock, Quantity Supplied, Determinants of Supply, Supply Schedule, Supply Curve, Equilibrium of Supply and Demand, Movement along the Supply and Demand Curve and Shift of Supply and Demand Curve and Its Effects on Equilibrium Price and Quantity. Elasticity of Supply and Demand; Determinants of Elasticity of Demand, Cross Elasticity of Demand.	Lecture, Group Discussion, Problem Solving, and Assignment	CLO2 CLO5
3. The Theory of Consumer Behavior: Cardinal and Ordinal Utility Analyses, Total and Marginal Utility; Law of Diminishing Marginal Utility, Equi-Marginal Utility; Consumer Surplus.	Lecture, Problem Solving, Tutorial, and Assignment	CLO3
4. Production and Cost: Production Function and Technology; Production with One Variable Input; Production with Two Variable Inputs; Returns to Scale; Costs in the Short-run; Costs in the Long-run, LAC, SAC, LMC, SMC.	Lecture, Group Discussion, and Tutorial	CLO4
5. Market Analysis: **i) Perfect Competition:** Definition of Market, Characteristics of Perfect Competition; Average and Marginal Revenue; Short-run equilibrium of a competitive	Lecture, Problem Solving, Group Discussion, and Assignment	CLO2 CLO5

firm, Long-run Equilibrium under a Perfectly Competitive Market, Causes of Disequilibrium Condition. **ii) Monopoly:** Characteristics of Monopoly Market, Average and Marginal Revenue; Supply Curve of the Monopolist; Equilibrium Position of a Monopolist. Compare between a Perfect Competitive Market and a Monopoly Market.		
6. Overview of Macroeconomics: Objective and Instruments of Macroeconomics, Methods of National Income Accounting, Gross Domestic Product (GDP), Problem of Double Counting, Net Domestic Product, Gross National Product (GNP), From GDP to Disposable Income.	Lecture, Practical Example, and Assignment	CLO6
7. International Trade: Domestic Vs. International Trade-Balance of Trade Vs. Balance of Payment-Trend of Changes in International Trade of Bangladesh. Free Trade Vs. Protection, Absolute Advantage Theory, Comparative Advantage Theory.	Lecture, Group Discussion, and Assignment	CLO7
8. Growth and Development: Economic Development and Economic Growth, Measurement of Economic Development, Obstacles to Economic Development, Contemporary Concept of Development.	Lecture, Group Discussion and Assignment	CLO8
9. Money: Definition and Functions of Money-Importance of Money in Modern Economy-Different Concepts of Money (M1, M2, M3)-Value of Money. Concept, Causes, and Effects of Inflation and Deflation.	Lecture, Group Discussion and Assignment	CLO9
10. Government Revenue and Expenditure: Difference between Public Sector and Private Sector finance, Different Sources of Govt. Revenues, Taxation and Different Kinds of Taxes, Direct and Indirect Taxation, Definition of Revenue Budget, Development Budget, Revenue Budget Vs. Development Budget, Surplus, Deficit, and Balanced Budget.	Lecture, Group Discussion, Practical Example, and Assignment	CLO10

List of Books:

Case, K. E., & Fair, R. C. (2020). *Principles of economics* (13th ed.). Pearson.
Mankiw, N. G. (2021). *Principles of economics* (9th ed.). Cengage Learning.
Parkin, M. (2022). *Economics* (13th ed.). Pearson.
Samuelson, P. A., & Nordhaus, W. D. (2021). *Economics* (20th ed.). McGraw-Hill.

Course Code	212211	Marks: 50	Credits: 2	Class Hours: 30
Course Title:	Bangladesh Agricultural Economics			

Course Objectives: This course aims to provide graduate students with a comprehensive insight into agricultural economics in the context of Bangladesh, covering fundamental concepts, the structure of traditional and modern agriculture, and the sector's contributions to economic development through product, factor, and market linkages. It examines different farming systems (subsistence, commercial, cooperative, and sharecropping), agricultural finance mechanisms, land reform policies, and marketing systems, including challenges such as market imperfections. Additionally, the course critically evaluates government interventions like price support and input subsidies, equipping students with analytical skills to assess agricultural policies and their socio-economic impacts, ultimately preparing them for careers in agricultural policy, rural development, and agribusiness.

Course Learning Outcomes (CLOs):

After going through the course, the students will be able to

CLOs	Learning Outcomes
CLO1	Define and explain the fundamental concepts of agricultural economics, including its subject matter and justification as a specialized field of study.
CLO2	Analyze the structural characteristics of traditional agriculture and evaluate development processes within traditional farming systems.
CLO3	Assess agriculture's contributions to economic development through product, factor, and market dimensions, and examine the impact of agricultural mechanization.
CLO4	Differentiate between various farming systems (commercial, cooperative, collective, sharecropping, subsistence, capitalist) and analyze their socio-economic implications.
CLO5	Evaluate the importance of agricultural finance, compare institutional and non-institutional credit sources, and analyze rural money markets, considering gestation periods for different crops.
CLO6	Examine land reform concepts, objectives, and implementation challenges, and conduct comparative policy analysis of land reforms in Bangladesh.
CLO7	Analyze agricultural marketing systems, market imperfections, and value chain management while developing strategies to reduce producer-consumer gaps.
CLO8	Critically assess government interventions (price supports, subsidies, sustainability policies) and evaluate their effectiveness in Bangladesh's agricultural sector.
CLO9	Synthesize course knowledge to formulate policy recommendations for enhancing agricultural productivity, marketing efficiency, and rural development.
CLO10	Apply theoretical concepts to analyze real-world agricultural economic challenges through case studies and research projects.

Mapping of CLOs with PLOs:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	✓					✓	✓					
CLO2	✓	✓	✓			✓						
CLO3	✓	✓	✓			✓						
CLO4	✓	✓				✓	✓					
CLO5	✓	✓		✓	✓							
CLO6	✓	✓	✓								✓	
CLO7	✓	✓	✓			✓				✓		
CLO8	✓	✓	✓			✓				✓		
CLO9	✓	✓		✓						✓		✓
CLO10	✓	✓		✓					✓			✓

Course Contents:

	Topics	Teaching Learning Strategy	CLOs
1.	**Introduction:** Definition of Agricultural Economics, subject matter of agricultural economics, need for a separate study.	Knowledge Sharing and Lecture	CLO1
2.	**Structure and Characteristics of Traditional Agriculture**: Basic features of traditional agriculture, development in traditional agriculture.	Lecture, Group Discussion, Assignment	CLO2
3.	**Contribution of Agriculture to Economic Development:** Product contribution; factor contribution, market contribution, and their relative importance; Importance of agriculture for industrial development; role of mechanization of agriculture mode of production.	Lecture, Field Work, and Assignment	CLO3 CLO9
4.	**Types of Farming:** Commercial, cooperative, and collective farming; share cropping, subsistence farming Vs. Capitalist farming;	Lecture, Group Discussion	CLO4 CLO9
5.	**Agricultural Finance:** Importance of agricultural credit, sources of agricultural credit, institutional and non-institutional; functions of rural money markets: proper management of financing considering gestation gaps for different varieties of agricultural products.	Lecture, Field Work, Problem Solving, and Assignment	CLO5 CLO9
6.	**Land Reform:** Definition, objectives of land reform, features of past and modern land reform, difficulties of implementing land reform; tenancy arrangement practices and prospects in rural economy; comparative analyses of land reform policies in Bangladesh.	Lecture, Group Discussion and Assignment	CLO6 CLO10

7.	**Marketing:** Role of agricultural marketing, marketing functions and market structure, market intelligence, imperfections of agricultural marketing in Bangladesh and LDCs; Value chain in the agriculture sector; proper management of value chain and the strategies of gap manage between peasant and consumer.	Lecture, Problem Solving, Group Discussion, and Assignment	CLO7 CLO9 CLO10
8.	**Role of Government:** Rationale for government intervention in agriculture, protection of farmers' income, price support and input subsidy, price policy in the agriculture sector in Bangladesh; government role for sustainability issues in rural Bangladesh.	Lecture, Group Discussion, Field Work, and Assignment	CLO8 CLO10

List of Books:

Barkat, A., Zaman, S., & Raihan, S. (2001). *Political economy of khas land in Bangladesh*. Association for Land Reform and Development (ALRD).

Ghatak, S., & Ingersent, K. (1984). *Agriculture and economic development*. Wheatsheaf Books.

Hill, B., & Ingersent, K. (1982). *Economic analysis of agriculture* (2nd ed.). Heinemann Educational.

Mellor, J. W. (1966). *The economics of agricultural development*. Cornell University Press.

Southworth, H. M., & Johnston, B. F. (Eds.). (1967). *Agricultural development and economic growth*. Cornell University Press.

Course Code	Course Title	Marks	Credits	Class Hours
212807	**Chemistry-I**	**100**	**4**	**60**

Course Objectives:

- The course is designed for the student to impart and improve fundamental knowledge and aspects related to understanding the fundamental physical, Organic, and Inorganic chemistry topics.

- To develop and extend students' knowledge on the state of matter, structure of atom, radiochemistry, chemical bonding, Liquid and Solution, chemical equilibrium, pH, aliphatic and aromatic hydrocarbons.

Course Learning Outcomes (CLOs):

	Upon completion of this course, the students will be able to:		Mapping with PLOs
Course Learning Outcomes (CLOs)	CLO1	explain the historical background, fundamental concept, and scope and aim of concepts of physical, Organic, and inorganic chemistry.	A1, B1
	CLO2	clarify the state of matter, structure of the atom, and radiochemistry	A2
	CLO3	explain about the chemical bonding, Liquid, and Solution	A1, B1, D2
	CLO4	explain the chemical equilibrium, pH, aliphatic and aromatic hydrocarbons	A1, A3, B1
	CLO5	explain the chemical equilibrium, pH, aliphatic and aromatic hydrocarbons, bonding, synthesis, nomenclature, and properties.	A2, A3

Mapping of CLOs with PLOs:

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

	Topics	Teaching Learning Strategy	CLOs
1	**State of Matter in Chemistry:** Nature and classification of matter. Classical states of solid, liquid, gas, and liquid crystals, states of aggregation of matter. Changes of state of matter. Intramolecular and intermolecular forces and their role for the determination of the state of matter. Modern state as plasma. Avogadro's number with application, Concept of mole: calculation and importance. Stoichiometry.	Lecture, Group Discussion, Assignment	1, 2, 3

2	**Structure of Atom:** Fundamental particles of atoms, Nucleus and discovery of nucleus, atomic model of Rutherford, Bohr atom model: postulates, limitations and success, Spectrum of atomic hydrogen, Dual nature of electron, Heisenberg uncertainty principle, Quantum numbers, atomic orbitals, Aufbau principle, Pauli exclusion principle, Hund's rule of maximum multiplicity, electronic configuration of atoms.	Lecture, Group Discussion, Assignment	3, 4, 5
3	**Radiochemistry:** Atomic number and mass number, atomic mass unit, atomic nucleus, Isotopes, Nuclear stability, natural and artificial radioactivity, half-life and average life of radioelements, radioactive decay, nuclear reactions.	Lecture, Group Discussion, Assignment	3, 4, 5
4	**Periodic Table:** Periodic law, Periodic table, Periodic properties of the elements such as ionization energies, Electron affinity, Electro negativity, Atomic/ionic radius along a period and down a group, Diagonal relationship.	Lecture, Group Discussion, Assignment	2, 3, 4
5	**Chemical Bond:** Definition and casues chemical bonds, octet rule and duplet rule, types of chemical bonds: ionic, covalent bond, polar and non-polar bond, Ionic character of covalent compound and covalent character of ionic compounds VSEPR theory, Valence bond theory, Hybridization, σ and π-bonding in compounds, Molecular orbital theory, coordination, metallic, hydrogen bonds.	Lecture, Group Discussion, Assignment	2, 3, 4, 5
6	**Chemical Reactions:** Physical change and Chemical change, Methods of bringing about chemical reaction, Redox reactions, oxidizing and reducing agents, oxidation state and oxidation number, redox half reactions, rules for balancing redox reactions, acid-base reactions.	Lecture, Group Discussion, Assignment	2, 3, 4
7	**Gaseous State:** Vapour and gas, measurable properties of gases, determination of gas pressure, the gas laws: derivation, molecular explanation and practical applications, effusion, diffusion, osmosis, ideal and real gases, ideal gas equation with applications, kinetic theory of gas, deviation from ideal behaviour, Van der Waals equation, critical constants. Dalton's law of partial pressure.	Lecture, Group Discussion, Assignment	1, 3
8	**Liquids and Solutions:** Liquids and their characteristics, evaporation, measurement of vapour pressure, dependence of vapour pressure on	Lecture, Group Discussion,	4, 5

	temperature variation, boiling, distillation, Types of solution, solubility and solubility curve, units of concentration for solution, Raoult's law, ideal and non-ideal solutions. Henry's law. a brief treatment of colligative properties.	Assignment	
9	**Chemical Equilibrium:** Equilibrium in chemical reactions. Stoichiometry, law of mass action, concentration versus time curves, equilibrium law and equilibrium constant: Kp, Kc, and Kx, effects of temperature, pressure, and concentration changes of equilibrium, principle and applications of Le Chatelier and Braun, reaction quotient, extent of reaction, thermodynamic equilibrium constant.	Lecture, Group Discussion, Assignment	1, 6
10	**pH and Buffer:** Ostwald dilution law, solubility product with principle and applications, common ion effect, ionic product of water (K_W), pH with applications, buffer solution, buffer mechanism, Henderson-Hasselbach equation. Acid-base titrations, Acid-base indicators. Theories of acids and bases, conjugate acids and bases, neutralization reactions, acid-base strength, Salts: Classification and their applications, neutralization reactions.	Lecture, Group Discussion, Assignment	1, 2
11	**Aliphatic Hydrocarbons:** Organic compounds, homologous series, the causes of diversity of organic compounds, Hydrocarbons: classifications and IUPAC nomenclature. Formation of carbocations, carbanion, free radicals, and their stabilities. Sources, properties, and general methods of preparation of the following hydrocarbons: Alkane, Alkene, and Alkynes. Classification of organic compounds based on their functional groups.	Lecture, Group Discussion, Assignment	5, 6
12	**Aromatic Hydrocarbons:** Definition and classification, nucleus and side chain, Structure, preparation, and uses of benzene. Aromaticity, Electrophilic aromatic substitution reactions with reference to nitration, halogenation, sulphonation, and alkylation. Orientation of substituents in the benzene ring, activating and deactivating groups.	Lecture, Group Discussion, Assignment	5, 6

List of Books:

Bahl, B. S., & Bahl, A. (2024). *Textbook of organic chemistry*. S. Chand & Company Ltd.

English, J., Cassidy, H. G., & Baird, R. I. (1949). *Principles of organic chemistry: An introductory text in organic chemistry*. McGraw-Hill.

Finar, I. L. (1973). *Organic chemistry* (Vol. 1). Pearson Education India.

Griffin, R. W. (2024). *Modern organic chemistry*. McGraw-Hill.

Morrison, R. T., & Boyd, R. N. (1992). *Organic chemistry*. Benjamin-Cummings Publishing Co.

Muny, J. Mc. (2010). *Organic chemistry*. Thomson Brooks/Cole.

Robert, J. D., & Caserio, M. C. (1977). *Basic principles of organic chemistry*. W. A. Benjamin, Inc.

Solomons, T. W. G. (2008). *Fundamentals of organic chemistry*. Wiley.

Course Code	Course Title	Marks	Credits	Class Hours
212810	**Chemistry-I Practical**	**50**	**2**	**30**

Course Objectives: To gain a fundamental knowledge of laboratory safety policy, some inorganic salts, and radical analysis, preparation of solutions with standardization, titration, and precipitation.

Course Learning Outcomes (CLOs):

	Upon completion of this course, the students will be able to:		**Mapping with PLOs**
Course Learning Outcomes (CLOs)	CLO1	discuss the general laboratory safety policy, rules and regulations, and chemical management process.	A1, B1, D1, D2
	CLO2	explain the applications of apparatus and reagents in various experiments, different laboratory glassware, and chemicals.	B1, D1, D2
	CLO3	prepare a standard solution and pH- pH-neutralization curves	A4, B1, C3, D1, D2
	CLO4	Qualitative analysis of mixtures of inorganic salts consisting of up to five different radicals	A4, B1, C3, D1, D2
	CLO5	explain to determination of Fe^{2+}, copper (II), and nickel as Ni (HDMG) 2 complex 7 using different methods.	A4, D1, D2

Mapping of CLOs with PLOs:

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

	Topics	Teaching Learning Strategy	CLOs
1	**Safety:** Introduction of chemicals, equipment's and safety in the laboratory.	Lecture, Group Discussion, Experimental, Assignment	1-5
2	**Preparation:** Preparation of $FeSO_4.7H_2O$ Mohr's salt, and potash alum.	Lecture, Group Discussion, Experimental, Assignment	1-5
3	**Separation and Identification:** Separation and identification of four radicals from a mixture of anions and cations The cations are Pb^{2+}, Cu^{2+}, Cd^{2+} , Al^{3+} , Fe^{2+} , Fe^{3+}, Co^{2+}, Ni^{2+}, Zn^{2+} Ca^{2+}, Ba^{2+}, Na^{+}, K^{+} , and NH_4^{+} , the anions are NO_3^{-}, CO_3^{2-}, S^{2-}, SO_4^{2-}, Cl^{-} , Br^{-} and I^{-}.	Lecture, Group Discussion, Experimental, Assignment	1-5
4	**Standardization:** Standardization of NaOH solution using standard oxalic acid solution.	Lecture, Group Discussion, Experimental, Assignment	1-5
5	**Determination:** Determination of Fe^{2+} using standard permanganate solution.	Lecture, Group Discussion, Experimental, Assignment	1-5
6	**Iodometric Method:** Iodometric determination of copper (II) using standard Na_2SO_3 solution.	Lecture, Group Discussion, Experimental, Assignment	1-5
7	**Gravimetric Method:** Gravimetric determination of nickel as Ni $(HDMG)_2$ complex.	Lecture, Group Discussion, Experimental, Assignment	1-5
8	**pH-Neutralization Curves:** Determination of the pH-neutralization curves of a strong acid by a strong base.	Lecture, Group Discussion, Experimental, and Assignment.	1-5

List of Books:

Alexeyev, V. (2024). *Qualitative Analysis*. Mir Publishers.

Braun, D. R. (2024). *Introduction to Chemical Analysis*. McGraw-Hill International,

Christian, G. D. (2023). *Analytical chemistry*. John Wiley & Sons.

Fifield, F. W., & Kealey, D. (2000). *Principles & practice of analytical chemistry*. Wiley.

Skoog, D. A., & West, M. D. (2022). *Fundamentals of analytical chemistry*. Publisher, Cengage Learning.

Vogel, A. I. (2017). *A Text-Book of Macro and Semimicro Qualitative Inorganic Analysis*. Longman, Green and Co. Ltd.

Welcher, F. J., & Hahn, R. B. (2024). *Semimicro Qualitative Analysis*. D. Van Nostrand Co., Inc.

Wulfsberg, G. (1987). *Principles of Descriptive Inorganic Chemistry*. University Science Books, Mill Valley.

Course Code:	**219901**	**Marks: 100**	**Credits: 4**
Course Title:	**History of Bangladesh: Language, Culture, and Identity**		**Hours: 60**

Course Objectives: This course is designed to help undergraduate students from diverse academic backgrounds develop a comprehensive and nuanced understanding of the historical development of Bangladesh, with a particular focus on its language, culture, and identity. By critically examining a variety of historical events, socio-political movements, and cultural shifts from ancient times to the contemporary period, students will have the opportunity to trace the evolution of the Bengali nation. The course aims to foster informed citizenship through an exploration of the Liberation War, identity formation processes, cultural heritage, the lives and contributions of key political figures, and the roles of ethnic minorities. Ultimately, the objective is to equip learners with the intellectual tools necessary to contextualize current national debates and to recognize the role of youth and globalization in shaping the future of Bangladesh.

Course Learning Outcomes (CLOs): At the end of the course, learners will be able to

CLO 1: Recall key historical events, dates, movements, personalities, and cultural developments that contributed to the emergence of Bangladesh from the pre-colonial period to the present day.

CLO 2: Demonstrate an understanding of the socio-political, linguistic, and cultural influences that shaped Bengali identity and nationalism, emphasizing the Language Movement, Liberation War, and subsequent democratic uprisings.

CLO 3: Apply their historical and cultural understanding to interpret contemporary national issues and debates relating to identity, political reform, and cultural transformation in Bangladesh.

CLO 4: Analyze how historical events, political ideologies, and social changes are interconnected in shaping the current socio-political landscape of Bangladesh, with a particular emphasis on the roles of movements, minorities, and the youth.

Course Contents:

Course contents	Teaching Learning Strategy	CLOs
1. Pre-colonial Era • Life and Culture of the People in Ancient Bengal • Bengal Under Muslim Rulers: Society, Culture, and Religion • Role of the Sufis in Preaching Islam and Impacts of • Sufism on the Bengali Society • Bengali Society and Culture in the Writings of Foreigners	Interactive lectures	CLO 1-2
2. Colonial Era (18th and 19th Century) • The Battle of Plassey (1757) and the Beginning of British Colonialism • Bengal Renaissance • Reforms in Hindu Society • New Forms in Bengali Literature and Culture • The Muslim Response to Western Education	Interactive lectures, reading, and assignments	CLO 1-2
3. Colonial Era (First Half of the 20th Century) • Partition of Bengal (1905) • Hindu-Muslim Disagreements • Formation of the All India Muslim League (AIML) • Muslim Shahitya Samaj • Buddhir Mukti Andolan: The Urge for Rational Thinking in Bengali Muslim Society • Growth of Religion-based Identity • Politics of Hindutva and the Two-Nation Theory • Spread of Communalism in Society • The Partition of India and Bengal	Interactive lectures and group discussions	CLO 2-3
4. Post-Partition Era (1947-1971) • Language Movement • Political, Economic, and Cultural Aspects • Growth of Vernacular Nationalism • Cultural Activism	Interactive lectures and group discussion	CLO 2-3
5. Changing Bengali Identity • The Evolution of Bengali Identity in the Context of Language, Culture, and Religion • From Ancient Times to the Present • The Role of the Bengali Language in Shaping Identity • The Language Movement of 1952 and Its Long-term Impact on National • Consciousness • The Influence of Religion on Bengali Identity • The Impact of Socio-political Movements on Identity Formation • The Liberation War of 1971	Interactive lectures and thematic assignments	CLO 2-3

• Contemporary Debates on Bengali Identity • The Role of Youth in Redefining Identity • The Influence of Globalization		
6. Liberation Movement of 1971 and Mass Uprising till 2024 • The Political and Economic Exploitation of East Pakistan by West Pakistan • Six (6) Points Movement, Uprising of 1969 • The 1970 General Elections • The Non-cooperation Movement and the Declaration of Independence • The Role of AK Fazlul Haque, Huseyn Shaheed Suhrawardy, Maulana Bhashani, Sheikh Mujibur Rahman, and Ziaur Rahman • The Liberation War of 1971 • Genocide and Resistance • The Role of the Mukti Bahini • Post-independence Challenges • Nation-building • Political Instability • Mass Uprisings and Democratic Movements • The Anti-autocracy Movement of the 1980s • The 1990s Movement for Democracy and Afterwards • The 2024 Movements for Political and Social Reforms	Interactive lectures, group discussions, and thematic assignments	CLO 1 CLO 3-4
7. History of Other Ethnic Groups • The Indigenous Communities of Bangladesh • Historical Presence • Cultural Practices • Land Rights and Cultural Assimilation • Contributions and Sacrifices • Political Representation of Ethnic Minorities	Interactive lectures and group discussions	CLO 4
8. Cultural Heritage and Modern Transformations • The Evolution of Bengali Culture • From Ancient Traditions to Modern Expressions • The Role of Literature, Music, and Art in Shaping Bengali Identity • Contributions of Rabindranath Tagore, Kazi Nazrul Islam, and Other Cultural Icons • The Impact of Globalization on Bengali Culture • The Revival of Traditional Arts • The Role of Youth in Cultural Innovation Urbanization • Environmental Changes • The Commodification of Culture	Interactive lectures, documentary screening, and thematic assignments	CLO 1-4

List of Books:

Ahmed, M. (1979). *Bangladesh: The constitutional quest for autonomy*. University Press Limited.

Ahmed, R. (1981). *The Bengal Muslims 1871–1906: A quest for identity*. Oxford University Press.

Alavi, H. (1972). The state in post-colonial societies: Pakistan and Bangladesh. In K. Gough & H. P. Sharma (Eds.), *Imperialism and revolution in South Asia* (pp. 145–178). Monthly Review Press.

Bernier, F. (2023). *Travels in the Mogul Empire: A.D. 1656–1668*. Atlantic Publishers.

Bleie, T. (2005). *Tribal peoples, nationalism, and the human rights challenge: The Adivasis of Bangladesh*. University Press Limited.

Bose, S. (2011). *Dead reckoning: Memories of the 1971 Bangladesh war*. Hurst & Company.

Eaton, R. M. (1996). *The rise of Islam and the Bengal frontier, 1204–1760*. University of California Press.

Gilmour, D. (2019). *The British in India: Three centuries of ambition and experience*. Penguin.

Habib, L. (1982). *The Cambridge economic history of India*. Cambridge University Press.

Halim, S., Amanullah, A. S. M., & Nasir, R. I. (Eds.). (2024). *Society and sociology in Bangladesh: A South Asian perspective*. University Press Limited.

Hashmi, T. (2021). *Fifty years of Bangladesh, 1971–2021: Crises of culture, development, governance and identity*. Palgrave Macmillan.

Huq, M. E. (1975). *History of Sufism in Bengal*. Bangladesh Asiatic Society.

Husain, I. (2014). *Karl Marx on India*. Tulika Books.

Jahan, R. (1972). *Pakistan: Failure in national integration*. Columbia University Press.

Maniruzzaman, T. (1988). *The Bangladesh revolution and its aftermath* (2nd ed.). University Press Limited. (Original work published 1980)

Mascarenhas, A. (1986). *Bangladesh: A legacy of blood*. Hodder and Stoughton.

Rashid, H. O. (2015). *The foreshadowing of Bangladesh: Bengal Muslim League and Muslim politics* (3rd ed.). University Press Limited.

Roy, A. (1984). *The Islamic syncretistic tradition in Bengal*. Princeton University Press.

Sen, A. (2006). *Identity and violence: The illusion of destiny*. W. W. Norton & Company.

Umar, B. (2022). *The emergency of Bangladesh: A history of East Pakistan*. Bangla Gobeshona.

Course Code	**219903**	**Marks: 75**	**Credits: 3**	**Class Hours: 45**
Course Title:	**Information and Communication Technology**			

Course Objectives: The main objective of the course is to develop students' understanding and skills in using, managing, and applying technology to solve problems and enhance various aspects of life and work. Key areas of focus include understanding ICT systems, software, hardware, networks, and their applications.

Course Learning Outcomes: The student will be able to

CLO 1	Explain foundational ICT concepts, including the information processing cycle.
CLO 2	Operate standard computer hardware and software systems effectively.
CLO 3	Use office productivity tools (Word, Excel, PowerPoint) for academic and professional tasks.

CLO 4	Apply safe internet practices and use internet tools for communication and information retrieval.
CLO 5	Understand and explain the concepts of Data Analytics, Artificial Intelligence (AI), and Machine Learning (ML)

Course Contents:

Unit	Specific Objectives	Content	Teaching and Learning Approach
Unit1: Introduction to Information and Communications Technology (ICT) and Computer System	The student will be able to: • Explain the concept of ICT and its related terminologies. • Describe the information processing cycle. • Analyze the impact of ICT on educational, social, and economic development. • Identify career opportunities in ICT education. • Differentiate among the classes of computers and their uses. • Identify the vital components of the Systems Unit.	Definition of ICT, basic concepts, and terminologies. Data, Information Application of ICT, Advantages and Disadvantages of ICT, Impact of ICT, Career opportunities in ICT education Information Processing Cycle. Classification of Computers The Vital Components of the Systems Unit.	Classroom Lectures
Unit 2: Computer Hardware and Software	The student will be able to: • Describe the categories of Computer Hardware. • Describe the commonly used Input and Output devices • Identify the main processing devices, storage devices, and media. Identify the main communication devices. • Identify types of Software packages. • Distinguish between an Operating System and Application software. • Identify different types, examples and uses of Operating Systems and Application software • Distinguish between Open Source and Proprietary	Categories of Computer Hardware: Input devices, Processing devices, Output devices, Storage devices. Communication devices, Main Processing Devices: The Processor, Control Unit, and Arithmetic and Logic Unit. Software Packages, Operating Systems, Types and uses of Operating Systems, Types and uses Application Software: Educational software, Games software, Graphics software. Browsers: Internet explorer, Google chrome, Mozilla Firefox,	Classroom lectures and Lab

Unit	Specific Objectives	Content	Teaching and Learning Approach
	Software.	Opera, Internet explorer, Mozilla Firefox; Proprietary and Open Source Software	
Unit 3: Introduction to Word Processing Application	The student will be able to: • Identify Word Processing packages. • Create and save a document using the Word Processor. • Format a Word document using formatting tools. Demonstrate the ability to perform collaborative editing. • Insert tables in a Word Processing document. • Insert symbols and pictures in Word Processing documents. • Use layout techniques in document creation. • Inserting headers and footers. • Print documents using the various print options.	Word Processing Packages and Their Uses Creating a Document Using a Word Processor Saving a Document Using the 'Save As' command Editing a Word Document Using Common Editing Tools: Copy/cut, paste, Undo and redo, find, replace, clipboard. Creating a Document with More Sub-Headings and Paragraphs Text correction, Wrapping options, Text orientation. Formatting and saving a Word document using the formatting tools: font (style, size, color, etc.), bold, underline, italic, superscript, subscript, shadow, strikeout, font color. Paragraph Editing: alignment, bullet & numbering, indent, line spacing, table border. Collaborative Editing: Using the highlighting option to track changes in a document, accepting or rejecting changes Insert: Adding text comments, Inserting Tables in a Word Document and inserting Symbols and Pictures in a Word Document. Header, footer, page number, drop cap, word art. Page Design: watermark, page border.	Classroom Lectures, Lab, and Hands-on Practice

Unit	Specific Objectives	Content	Teaching and Learning Approach
		Layout: Page setup/print	
Unit 4: Spreadsheet Application	The student will be able to: • Identify Spreadsheet Packages. • Explain the importance of the Spreadsheet application in data management. • Explain related concepts and terminologies in the Spreadsheet. • Identify features in the Spreadsheet application window. • Create and save a Workbook. • Construct and insert simple formulae and functions. • Format the worksheet using formatting tools. • Printing a worksheet.	Spreadsheet Packages, e.g. Excel, Importance of Spreadsheet application in Data Management, Related Concepts and Terminologies (e.g., cell(s), rows, columns, worksheet, workbook) Features in the Spreadsheet Window Tool Bars: formatting bar, standard bar, formulae bar Types of Data and Their Uses (e.g., number, date, text, currency), Creating and Saving a Workbook, Constructing and Inserting Simple Formulae and Functions Formatting Worksheet Using Formatting Tools. Draw a Graph/chart Editing and Printing Worksheet	Classroom Lectures, Lab and Hands-on Practice
Unit 5: Presentation Application	The student will be able to: • State the importance of the Presentation application. • Identify the commonly used features of a Presentation application while prepare a presentation. • Create and save presentations using a template, Add new slide(s). Edit text , Format text, Insert objects, images and pictures , Run slide show, Apply transition, animation effects to slides • Select the print option for printing. • Prepare a presentation on a selected topic and present it.	Presentation Applications Packages, Devices used for Presenting, Importance of Presentation Application, Principles for Designing Presentations, Terminologies in Presentation Application (eg, Slide Layout, Slide transitions, Slide show, etc.), Identification of Commonly Used Features of Presentation Application Window: Toolbars, Different presentation view modes. Prepare a Presentation: Adding elements and	Classroom Lectures, Lab and Hands-on Practice

Unit	Specific Objectives	Content	Teaching and Learning Approach
		formatting slides, slide Show, slide transition, animation Effects. Selection of Print Option: Entire presentation, Specific slides, Handouts, Notes pages, outline view of slides, and Number of copies.	
Unit 6: Privacy and Security	The student will be able to: • Understand the basics of digital security • Use some security tools. • Understanding digital ethics.	Introduction to Information Security, cybercrime, DoS and DDoS attack, Key Management, Digital Signature and Certifications, privacy, data security, vulnerability, threat and risk, malware, social engineering, hacking, Plagiarism, Fishing, Software Piracy, Worms and Viruses, Spam, Adware, Malware, Spyware, antivirus software. Ethics in the digital world.	Classroom Lectures, Lab and Hands-on Practice
Unit 7: Using The Internet to Communicate and Accessing Information	The student will be able to: • Explain basic concepts, requirements, and terminologies of the Internet • Apply the rules and regulations in the use of the internet. • Using email • Use the internet social network to communicate. • Use Uniform Resource Locators (URLs) to access Information. Use search engines to access information • Upload files to virtual drives and work on it.	Internet, Intranet, Extranet, IP Address, Masking, MAC Address, Internet Services, OSI reference model, TCP/IP protocol stack, IPv4, IPv6, subnet Masking, MAC Address, Internet Services, Network Configuration and Troubleshooting, Wi-Fi, Broadband, Email Usage. Rules and regulations in the use of the internet: spam- unsolicited emails, people's privacy, intellectual property rights, etc. e-mail: Creating an email	Classroom Lectures, Lab and Hands-on Practice

Unit	Specific Objectives	Content	Teaching and Learning Approach
		account, sending, accessing email Messages, attaching documents to email messages, Using the Internet: Social networks to communicate, Uniform Resource Locators (URLs) to access Information, Using Search Engines, Downloading Information from the Internet. Transferring information from the Internet to a Different Application. Intellectual property rights, ICT policy, software piracy etc. Using Cloud Space: Google Drive, Google Workspace, OneDrive, Dropbox, etc.	
Unit8: Emerging Technologies: Data analytics, Artificial intelligence, Machine learning	• Define Data Analytics, Artificial Intelligence (AI), and Machine Learning (ML). • Understand how data is collected, processed, and used for decision-making. • Recognize the role of AI and ML in everyday life. • Explain basic differences between AI and ML. • Discuss benefits and challenges of these technologies. Recognize current trends and career opportunities in these fields.	Introduction to Data Analytics: What is Data? Types of Data, Basic Steps in Data Analytics, Simple Tools; Artificial Intelligence (AI): Making machines capable of performing tasks that require human-like thinking. Common Examples: Voice assistants, facial recognition, GPS route suggestions, chatbots.; AI Capabilities: Understanding language, recognizing patterns, making decisions; Machine Learning (ML): Define Machine Learning (ML), How It Works, Classification and	Class room Lectures, Lab and Hands-on Practice

Unit	Specific Objectives	Content	Teaching and Learning Approach
		Examples; Relationship Between Data Analytics, AI, and ML. Benefits & Challenges of Data Analytics, AI, and ML. Future Trends & Career Paths.	

List of Books:

Norton, P. (2008). *Introduction to computers* (9th ed.). The McGraw-Hill.

Comer, D. E. (2018). *The internet book: Everything you need to know about computer networking and how the internet works* (5th ed.). Chapman and Hall/CRC Press.

Lambert, J., & Frye, C. (2015). *Microsoft Office 2016 step by step*. Microsoft Press.

Hassan, N. A., & Hijazi, R. (2017). *Digital privacy and security using Windows: A practical guide*. Apress.

Maheshwari, A. (2024). *Data analytics made accessible*. Jay Cobb.

Russell, S. J., & Norvig, P. (2020). *Artificial intelligence: A modern approach* (4th ed.). Pearson.

Alpaydin, E. (2020). *Introduction to machine learning* (4th ed.). MIT Press.

Course Code	219904	Marks: 25	Credits: 1	Class Hours: 15
Course Title:	Lab: Information and Communication Technology			

Course Objectives: The main objective of the course is to teach the students' understanding and skills in using and applying technology to solve problems and enhance various aspects of life and work. It includes assembling hardware, installing software, preparing PPT slides, and producing Word and Excel documents.

Course Learning Outcomes (CLOs): The student will be able to

CLO 1	Learn assembling hardware
CLO 2	Prepare, edit, and print Word documents and Excel
CLO 3	Prepare a PowerPoint presentation.
CLO 4	Access information from email
CLO 5	Installation of anti-virus software
CLO 6	Data collection, Prediction using AI, ML, Data Analytics

List of Experiments

CLO Addressed	Unit	Experiments	Teaching Learning Approach
CLO1	1-4	• Assemble different hardware • Install different software • Operate the computer - Drive, folder, and file management • Maintenance	Lab and Hands-on Practice
CLO 2	3	**Word** • Prepare a Word document on a specific topic (e.g, routine, question paper, CV, reports, applications) • Formatting the document (Alignment, table, border, watermark, etc.), e.g., newspaper article, academic report, or documentation used in daily life, book, poster, etc. • Print documents with different paper and printers	Lab and Hands-on Practice
CLO 2	4	**Excel** • Prepare a grade sheet • Prepare a family expenditure • Prepare a business expenditure report • Prepare payroll management, with a report • Create graphs on the given data • Print Excel files	Lab and Hands-on Practice
CLO 3	5	**Power point** • Prepare an academic presentation on a specific topic. • Formatting the slides & using different tools. • Apply animation and transition • Print PPT files in different modes: Hand note, Slides shorter, outline	Lab and Hands-on Practice
CLO4	6	Install antivirus software, e.g., Norton Antivirus, McAfee, Kaspersky, Avast, etc.	Lab and Hands-on Practice
CLO5	7	• Use of email • Access information from the internet, use a search engine. • Use of virtual drive for collaboration • Google Meet, Zoom	Lab and Hands-on Practice
CLO6	8	• Data Collection and Visualization • Simple Prediction Using Trendlines	Lab and Hands-on Practice

List of Books:

Comer, D. E. (2018). *The internet book: Everything you need to know about computer networking and how the internet works* (5th ed.). Chapman and Hall/CRC Press.

Lambert, J., & Frye, C. (2015). *Microsoft Office 2016 step by step*. Microsoft Press.