NATIONAL UNIVERSITY

BANGLADESH

First Year Syllabus

Department of Physics

Four Year B.Sc. (Honours) Program

Effective from the Session: 2024-25

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.

Mission of the Program:

 The academic program is focused on the creation, translation, and dissemination of knowledge on the subject matter. The strategic goals of the department are to:

1. Support the aims and objectives of the University within the capacity of our Departmental program. Curriculum for BSc (Hons) in Physics,

2. Train and produce high-quality graduates to meet up national and international requirements in scientific sectors of the job market.

3. Enhance the teaching-learning and research capacities of the Department by retaining and recruiting outstanding faculty and staff.

Program Educational Objectives (PEO):

PEO-1: To prepare physics graduates to exhibit quality of excellence, critical thinking, creativity, inventiveness, and self-motivation for life-long learning to handle all kind of diverse situations in interdisciplinary and multidisciplinary environment.

PEO-2: To produce graduates who are globally acceptable professionals for government, corporate and research organizations along with skills for entrepreneurial pursuits in multidisciplinary areas.

PEO-3: To groom graduates who can demonstrate technical competence in the field of project and technology management.

PEO-4: To produce graduates who can ethically lead and work as a part of team towards the fulfillment of both individual and organizational goals.

Program Learning Outcomes (PLO):
On successful completion of these programs a student should able to learn the following outcomes:

Fundamental Skill:

PLO-1: Knowledge: Apply fundamental knowledge of physics along with specializations to solve scientific problems of material science, energy, mechanics, optics, communication, space, biomedical physics etc.

PLO-2: Problem analysis: Solve problems in Physics using appropriate mathematical tools.

PLO-3: Experimentation: An ability to execute and analyze the results of an experimental investigation or theoretical modeling and to draw valid conclusions with an estimate of the uncertainty in the result. An ability to compare experimental results with the predictions of relevant theories.

PLO-4: Conduct investigations of problems: Use research based methods including design of experiments, analysis and interpretation of data leading to logical conclusions.

PLO-5: Modern tool usage: Create, select, and apply appropriate techniques, resources, software and modern scientific and ICT tools to problem solving in different sectors of Physics.

Social skill:

PLO-6: Communication: An ability to communicate scientific information verbally and in the form of clear and accurate scientific reports.

PLO-7: Environment and sustainability: Understand the impact of the professional scientific solutions in the societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.

PLO-8: Ethics: Apply ethical principles and commit to professional ethics, responsibilities and norms of scientific practices.

Personal Skill:

PLO-9: Individual and teamwork: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PLO-10: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Thinking Skill:

PLO-11: Project management: Demonstrate knowledge and understanding of principles of physics and apply those to one's own work as a member and leader in a team, to manage projects and in multidisciplinary environments.

PLO-12: Technology management: Competence in using programming languages and in troubleshooting and solving basic problems in electronic equipment and circuits.

Mapping PEO with PLO:

Domain	PLO	PEO-1	PEO-2	PEO-3	PEO-4
Cognitive	PLO-1	√	√		
	PLO-2	√	√		
	PLO-3			√	
	PLO-4		√	√	
	PLO-5		√	√	
	PLO-6		√	√	
Affective	PLO-7				√
	PLO-8				√
	PLO-9				√
	PLO-10				√
Psychomotor	PLO-11			√	
	PLO-12			√	

Courses and Marks Distribution

First Year

Course Code	Course Title	Marks	Credits
212701	Mechanics	100	4
212703	Properties of Matter, Waves & Oscillations	100	4
212705	Heat, Thermodynamics and Radiation	100	4
212706	Practical-I (Properties of Matter, Waves & Oscillations, Heat, Thermodynamics and Radiation)	100	4
213709	Foundations of Mathematics	100	4
213711	Calculus-1	50	2
212807	Chemistry-I	100	4
212808	Chemistry-I Practical	50	2
	Or		
213607	Fundamentals of Statistics	100	4
213610	Lab-1: Fundamentals of Statistics	50	2
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	PLO-9	PLO10	PLO11	PLO12
212701	√	√										
212703	√	√										
212705	√	√										
212706	√	√	√	√	√				√			
213709	√	√										
213711	√	√										
212807	√	√										
212808	√	√		√	√				√			
212607	√	√									√	
212610	√	√		√	√							
219901	√	√						√				
219903	√				√	√	√	√	√	√		
219904	√				√					√		√

Detailed Syllabus

Course Code	212701	Marks: 100	Credits: 4	Class Hours: 60
Course Title:	Mechanics			

Course Objectives:

This course reviews the concepts of mechanics learnt at school from a more advanced perspective and goes on to build new concepts. It begins with Newton's Laws of Motion and ends with the Forces and Special Theory of Relativity. Students will also appreciate to learn the Collisions in CM Frame, Gravitation, Rotational Motion and Oscillations. The students will be able to apply the concepts learnt to several real world problems.

Course Learning Outcomes (CLO):

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

CLO1		Understand concept of quantities and units
CLO2		Grasp the knowledge of one- two- and three- dimensional motion and their applications in real life problems
CLO3	(i)	Understand laws of motion and their applications. He / she will learn the concept of momentum, angular momentum to apply them to basic problems
	(ii)	Describe how fictitious forces arise in a non-inertial frame
CLO4		Understand work, energy, power efficiency, conversion of energy and Law of conservation of energy
CLO5	**(i)**	Understand the phenomena of collisions and idea about center of mass and laboratory frames and their correlation. Write the expression for center of mass of a rigid body and about a given axis of symmetry for different uniform mass distributions and
	(ii)	Explain the concept of law of conservation of momentum and Elastic and non elastic collision
CLO6		Understand rotational kinematics
CLO7		Understand the analogy between translational and rotational dynamics, and application of both motions simultaneously in analyzing rolling with slipping

Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO10	PLO11	PLO12
CLO1	√	√										
CLO2	√	√										
CLO3	√	√										
CLO4	√	√										
CLO5	√	√										
CLO6	√	√										
CLO7	√	√										

Course Contents:

	Topic	Teaching Learning Strategy	CLOs
1	**Vector Algebra:** Vector and scalar quantities; Vectors and their components, Vector addition and subtraction, Scalar and vector triple products, scalar and vector fields, Vector differentiation and integration, Gradient, Divergence and Curl and their physical significance, Gauss's divergence theorem, Green's theorem and Stoke's theorem, Polar, Spherical and Cylindrical co-ordinates.	Lecture, Assignment	CLO1
2	**Concept of Measurement:** Different Measurement units, International system of units, Origin of Length mass and time, Conversion of units from one system to another.	Lecture, Assignment	CLO1
3	**Particles Motion in one dimension:** Concept of motion and frame of reference, Position and displacement, Average velocity and average speed, Instantaneous velocity and speed, Acceleration, Constant acceleration, Equations for motion with constant acceleration, Free-fall acceleration, Equation for free-fall acceleration, Particles of physics and basic structure of atoms and nuclear.	Lecture, Group Discussion, Assignment	CLO2
4	**Particles Motion in Two and Three Dimensions:** Position and displacement using vectors, Velocity and average velocity, Acceleration and average	Lecture, Group Discussion, Workshop and	CLO2

	acceleration, Equation of motion using vector, Projectile motion, Uniform circular motion.	Assignment	
5	**Force and Motion:** Newton's laws of motion and their applications, Concept of mass, Force and weight, Frictional forces and Properties of friction, Drag force and terminal speed, Forces of nature.	Lecture, Group Discussion, and Assignment	CLO3
6	**Work, Energy and Power:** Kinetic and Potential energy, Work done by constant and variable forces, Work-energy theorem, Hooke's law, Work done by a spring force, Work done by weight, Power, Gravitational potential energy, Conservation of energy.	Lecture, Group Discussion, and Assignment	CLO4
7	**System of Particles:** Center of mass of systems of particles, Center of mass of rigid bodies, Linear momentum of a particle, Linear momentum of a system of particles, Conservation of linear momentum for a system of particles.	Lecture, Assignment	CLO5
8	**Collisions of Bodies:** Collisions and its classification, Impulse and linear momentum, Elastic and inelastic collision in one dimension, Motions of the center of mass of colliding bodies.	Lecture, Group Discussion, and Assignment	CLO5
9	**Rotational Kinematics:** Translational and Rotational motion, Angular Position, Angular displacement, Angular Velocity and angular acceleration, Rotation with constant angular acceleration, Relation between linear and angular kinematics of a particles in circular motion.	Lecture, and Assignment	CLO6
10	**Rotational Dynamics:** Torque and angular momentum and their relation, Kinetic energy of rotation and rotational inertia (moment of inertia), Combined Translational and rotational motion of a rigid body, Parallel and perpendicular axes theorems of moment of inertia, calculation of moment of inertia for solids of different shapes, conservation of angular momentum. Relation between angular momentum and torque.	Lecture, and Assignment	CLO7

List of Books:

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

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

Sears, F.W., Zemansky, M.W., & Young, H.D. (2007). *University physics (*12 th ed.). Pearson Addison Wesley.

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

Course Code	212703	Marks: 100	Credits: 4	Class Hours: 60
Course Title:	Properties of Matter, Waves & Oscillations			

Course Objectives

This course reviews the concepts of mechanics learnt at school from a more advanced perspective and goes on to build new concepts. It includes Newton's Laws of gravitation, Kepler's laws of motion, Properties of matter and waves. Students will also appreciate the Collisions in CM Frame, Gravitation, Rotational Motion and Oscillations. The students will be able to apply the concepts learnt to several real world problems.

Course Learning Outcomes

After going through the course, the student should be able to

CLO1:   Understand Kepler's laws of planetary motion and their applications.

CLO2:   Demonstrate deformation of solids and to apply them to basic problems.

CLO3:   Apply molecular theory to explain surface tension, cohesive and adhesive forces

CLO4:   Understand fluid dynamics, Bernoulli's equation and its application.

CLO5:   Understand the basic properties of waves and sound waves.

CLO6:   Describe and analyze SHM and DHM

CLO7:   Understand and apply vibrational knowledge in longitudinal and transverse mode of vibration in rods and air columns

Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO10	PLO11	PLO12
CLO1	√	√										
CLO2	√	√										
CLO3	√	√										
CLO4	√	√										
CLO5	√	√										
CLO6	√	√										
CLO7	√	√										

Course Contents

		Topic	Teaching Learning Strategy	CLOs
1		**Gravitation:** Kepler's Laws, Law of universal gravitation, G and its determination, Inertial and gravitational mass, Acceleration due to gravity and its variation, Measurement of acceleration due to gravity by compound pendulum and Katter's pendulum, Gravitational potential and field in simple cases, Gravitational potential energy.	Lecture, Group Discussion, and Assignment	**CLO1**
2		**Elasticity:** Hooke's Law, Elastic constants of isotropic solids, Poisson's ratio and their interrelations, Internal elastic potential energy, Experimental determination of elastic constants, Torsion of a cylinder, Bending of beams, Cantilever, Variation of elasticity with temperature.	Lecture, Group Discussion, Workshop and Assignment	**CLO2**
3		**Surface Tension:** Surface tension and surface energy, Adhesive and cohesive forces, Molecular theory of surface tension, Pressure on a curved membrane of uniform tension, Soap bubble, Capillarity, Angle of contact and its measurement, Determination of surface tension of water and mercury drop, Variation of surface tension with temperature.	Lecture, Group Discussion, and Assignment	**CLO3**
4		**Fluid Dynamics:** General concepts of fluid flow, Streamlines, Equation of continuity, Bernoulli's equation, Application of Bernoulli's equation and equation of continuity. Coefficient of viscosity, Critical velocity and Reynold's number, Poiseuille's formula and its correction, Measurement of viscosity, Variation of viscosity with temperature.	Lecture, Group Discussion, and Assignment	**CLO4**
5		**Waves:** Waves and Particles, Types of waves, Transverse and Longitudinal waves, Wavelength and frequency, The Speed of a traveling Wave, Wave speed on a stretched string, Energy and power of a traveling string wave, The principle of superposition for waves,	Lecture, Group Discussion, and Assignment	**CLO5**

	Interference of waves, Complex waves, Standing waves and Resonance.		
6	**Sound Waves:** The Speed of Sound, Propagation and speed of longitudinal waves, Traveling longitudinal waves, Standing longitudinal waves, Beats, Doppler effect.	Lecture, Group Discussion, and Assignment	**CLO5**
7	**Oscillations:** Simple harmonic motion (SHM), Energy consideration in SHM, Applications of SHM, Relation between SHM and uniform circular motion, Combinations of two SHM's, Lissajous' figures, Two-body oscillations, Damped harmonic motion, Forced oscillations and resonance, Power and intensity of wave motion.	Lecture, Group Discussion, and Assignment	**CLO6**
8	**Vibrations:** Vibrations of string, Membranes, bars, plates and air-column, Sonometer, Melde's experiment, Rectangular and circular membranes, Transverse and longitudinal vibration of rod, Air-columns in cylindrical pipes, Organ pipes, Chladni's figure.	Lecture, Group Discussion, and Assignment	**CLO7**

List of Books:

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

Khan, A.H., & Ishaq, M. (2017). *Physics* 2nd Part (Bengali Version). Ideal Books.

Sears, F.W., Zemansky, M.W., & Young, H.D. (2007). *University physics* (12 th ed.). Pearson Addison Wesley.

Course Code	212705	Marks: 100	Credits: 4	Class Hours: 60
Course Title:	Heat, Thermodynamics & Radiation			

Course Objectives:

This course deals with the relationship between the macroscopic properties of physical systems in equilibrium. It reviews the concepts of thermodynamics learnt at school from a more advanced perspective and develops them further. The primary goal is to understand the fundamental laws of thermodynamics and their applications to various systems and processes. In addition, it will also give exposure to students about the Kinetic theory of gases, transport phenomena involved in ideal gases, phase transitions and behavior of real gases.

Course Learning Outcomes:

After completing the course student will be able to

CLO1: **Understand b**asic concept of heat, temperature, and thermal equilibrium
(ii) Construct different types of thermometer

CLO2: Understand kinetic theory of gas

CLO3: (i)Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations.

(ii) Learn about Maxwell's thermodynamic relations.

(iii) Understand the basic aspects of kinetic theory of gases, Maxwell-Boltzman distribution law, equitation of energies, mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion.

CLO4: Explain the mechanism of heat engine and Carnot's heat cycle.

CLO5: Understand real gas equations, Van der Waal equation of state, the Joule-Thompson effect.

CLO6: Describe the concept of black body radiation, Emissive and absorptive powers, Stefan- Boltzmann's Law, Wien's displacement law, Rayleigh-Jean's law, Planck's quantum hypothesis and applications of radiations laws.

Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO10	PLO11	PLO12
CLO1	√	√										
CLO2	√	√										
CLO3	√	√										
CLO4	√	√										
CLO5	√	√										
CLO6	√	√										

Course Contents

	Topics	Teaching Learning Strategy	CLOs
1	**Heat and Temperature**: Concept of temperature, Thermal equilibrium, Measurement of low and high temperatures, The Clausius & Fahrenheit scales, Thermal expansion, Gas Thermometers, Platinum resistance thermometer, Thermocouple	Lecture, Group Discussion, and Assignment	**CLO1**
2	**Kinetic Theory of Gases:** Equation of state of an ideal gas, Equipartition of energy, Translational kinetic energy, Mean free path, Maxwell's theory of distribution of velocities, Brownian motion, Degrees of freedom & Molar Specific Heats, Van der Waals' Equation of state, Transport phenomena.	Lecture, Group Discussion, and Assignment	**CLO2**
3	**Transmission of Heat:** Conduction, Convection, Radiation, Conduction of heat in solids, Measurement of thermal conductivity of a bad conductor, Heat conduction through composite walls.	Lecture, Group Discussion, and Assignment	**CLO3**
4	**First Law of Thermodynamics:** Internal Energy, Heat and work, Isothermal and adiabatic processes, Work done by expanding gases, Statement of first law of thermodynamics and applications.	Lecture, Group Discussion, and Assignment	**CLO3**

5	**Second Law of Thermodynamics and Entropy:** The Thermodynamic temperature scale, Concept of entropy, Calculation of 6entropy change in reversible and irreversible processes, Entropy and second law of thermodynamics, Entropy and disorder. The Carnot engine, Efficiency of heat engines, Carnot's theorem, Refrigerator and air-conditioner, Clausius theorem, Clausius-Clapeyron equation.	Lecture, Group Discussion, Assignment	CLO4
6	**Third Law of Thermodynamics:** Nernst heat theorem, Phase rule and its uses, Third law of thermodynamics.	Lecture, Group Discussion, and Assignment	CLO3
7	**Thermodynamic Functions:** Thermodynamic potentials at constant volume and pressure, Maxwell's thermodynamic relations, Specific heat equations, Joule-Thomson effect and its applications.	Lecture, Group Discussion, and Assignment	CLO5
8	**Radiation Laws:** Concept of black body and black body radiation, Emissive and absorptive powers, Kirchhoff's law, Stefan-Boltzmann's Law, Wien's displacement law, Rayleigh-Jean's law, Planck's quantum hypothesis, Planck's law, Applications of radiations laws.	Lecture, Group Discussion, and Assignment	CLO6

List of Books

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

Hossain, T. (1975) *Text Book 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 (*7 th ed.). The McGraw-Hill Co. Inc.

Course Code	212706	Marks: 100	Credits: 4	Class Hours: 60
Course Title:	Practical-I (Properties of Matter, Waves & Oscillations, Heat, Thermodynamics and Radiation)			

Course Objectives:

Students will able to be familiar with different physical concepts relating to the experiments with complete understanding, realize the applications of these concepts such as mechanics, properties of matter and become confident with the related theories. The aim of this Laboratory is to understand some of the basic phenomenon of mechanics through various experiment. Another prime objective of the course is to enhance the scientific data collection and analysis in Physics Laboratories.

Course Learning Outcomes: Students will be able to

CLO1: Understand different quantities and determination of g

CLO2: (i) Gain the concept Understand measurement techniques of modulus of rigidity.
(ii) Gain the concept of modulus of elasticity.

CLO3: (i)Understand and measure the surface tension of liquids which do wet the contact materials and understand the effect of capillarity.
(ii) Understand and measure the effect of surface tension of a liquid which does not wet the contact material and learn the concept about the effect of cohesive and adhesive forces.
(iii) Learn the concept of surface tension of water, how to form ripples on water surface, and know how to measure the wave length of ripples.

CLO4: Learn the concept of viscosity and capillary flow of water.

CLO5: Understand the techniques to determine specific heat capacity of solid and liquid

CLO6: Measure thermal conductivity of solid

CLO7: Grasp the clear knowledge of temperature coefficient of resistance

CLO8: Understand the laws of transverse vibration of a stretched string by experimentation

CLO9: Determine frequency of a tuning fork by Melde's experiment.

CLO10: Determination of latent heat of fusion of ice and latent heat of condensation of steam.

Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO10	PLO11	PLO12
CLO1			√	√								
CLO2			√	√								
CLO3			√	√								
CLO4			√	√								
CLO5			√	√								
CLO6			√	√								
CLO7			√	√								
CLO8			√	√								
CLO9			√	√								
CLO10			√	√								

To perform two experiments (one from each group) each of three hours duration.

   i)   Experiments (3 hours each)   2 x 35 =   70

   ii) Laboratory note book   20

   iii) Experimental Viva-voce   10

Total marks = 35 Marks for each experiment shall be distributed as follows:

  a) Theory   8
  b) Data collection and tabulation   12
  c) Calculation, graphs and result   10

  d) Discussion   5

                     Total marks = 35

Course Contents (List of Experiments):

Group – A

1.   Determination of acceleration due to gravity 'g' by compound pendulum.

2.   Determination of acceleration due to gravity 'g' by Katter's pendulum.

3.   Determination of Young's modulus and rigidity modulus by Searle's dynamic method.

4.   Determination of rigidity modulus of a wire/rod by static method.

5.   Determination of rigidity modulus of the material of a wire by dynamic method.

6.   Determination of the spring constant and effective mass of a given spiral spring and hence to calculate the rigidity modulus of the material of the spring.

7.   Determination of the Young's modulus by the flexure of a beam (bending method).

8.   Determination of the moment of inertia of a fly-wheel about its axis of rotation.

9.   Determination of the Young's modulus for the material of a wire by Searle's apparatus.

10.   Determination of Surface tension of water by capillary tube method.

11.   Determination of surface tension of mercury by Quicken's method.

Group – B

12. Determination of the specific heat of solid by method of mixture, with radiation correction.

13. Determination of the specific heat of a liquid by the method of cooling.

14. Determination of the thermal conductivity of a good conductor by Searle's apparatus.

15. Determination of the thermal conductivity of a bad conductor by Lee's method.

16. Determination of mechanical equivalent of heat 'J' with radiation correction.

17. Investigation of the variation of resistance of a copper wire with temperature and determination of its temperature coefficient of resistance.

18. Verify the laws of transverse vibration of a stretched string with a sonometer (n-l, and n – 1/l curves only)

19. Determination of the frequency of a tuning fork by Melde's experiment.

20. Determination of latent heat of fusion of ice with radiation correction.

21. Determination of latent heat of condensation of steam with radiation correction.

22. Determination of density of water at various temperature by specific gravity bottle and study the variation of density with temperature from the graph.

List of Books:

Ahamed, G.U., & Uddin, M.S. (1969). *Practical physics* (4th ed.). Hafiz Book Centre.

Din, K., & Matin, M.A. (1966). *Advanced practical physic.* Mallik Brothers.

Khan, A.H. (2019). *B.Sc. Hons. practical physics.* Ideal Books.

Worsnop B.I,. & Flint, H.T. (1957). *Advanced practical physics.* Methuen and Co. Ltd.

Course Code	213709	Marks: 100	Credits: 4	Class Hours: 60

Course Title:	Foundations of Mathematics

Course Objectives:

The emphasis of course is to equip students with the mathematical and critical skills required in solving problems of interest to physicists. The course will also expose students to fundamental computational physics skills enabling them to solve a wide range of physics problems. The skills developed during course will prepare them not only for doing fundamental and applied but also for a wide variety of careers.

Course Learning Outcomes

CLO1	Understand the number system and theory of equations which have applications in problems
CLO2	Describe relations between roots and coefficients, Symmetric functions of roots
CLO3	Learn the System of linear equations and basic properties of matrices, different types of matrices viz., Hermitian, skew Hermitian, orthogonal and unitary matrices and their correspondence to physical quantities.
CLO4	Vector Spaces, Linear transformations, Matrix representation of linear transformation, Kernel and image, Eigenvalues and Eigenvectors
CLO5	Explain vector spaces and 2D and 3D geometry.

Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO10	PLO11	PLO12
CLO1		√									√	√
CLO2		√									√	√
CLO3		√									√	√
CLO4		√									√	√
CLO5		√									√	√

Course Contents

Topic	Teaching Learning Strategy	CLOs
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	CLO1
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	CLO2
Complex Number System: Field of Complex numbers; De Moivre's theorem and its applications.	Whiteboard-based lecture Assignment	CLO2
Matrices and Determinants: Notion of matrix; Algebra of matrices; Different types of matrices; Invertible matrices; Determinant function; Properties of determinants; Minors, Cofactors, expansion, and evaluation of determinants. Elementary row and column operations and row-reduced echelon matrices, Invertible matrices, Diagonal, triangular, and Symmetric matrices.	Whiteboard-based lecture Assignment	CLO3
System of Linear Equations: Linear equations; System of linear equations (homogeneous and non-homogeneous) and their solutions using different methods. Gaussian elimination, Application of matrices and determinants for solving systems of linear equations, Applications of systems of equations in real-life problems.	Whiteboard-based lecture Assignment	CLO3
Summation of finite series: Arithmetic and geometric series; Method of difference; Successive differences; Summation of trigonometric series.	Whiteboard-based lecture Assignment	CLO4
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	CLO3
Two-dimensional Geometry: Transformation of coordinates, Pair of straight lines (homogeneous second-	Whiteboard-based lecture	CLO5

degree equations, General second-degree equations representing 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).	Assignment	
Three-dimensional Geometry: Three-dimensional coordinates, Distance, Direction cosines and direction ratios, Planes and straight lines.	Whiteboard-based lecture Assignment	CLO5
Vector Geometry: Vectors in plane and space; Algebra of vectors; Rectangular components; Scalar and Vector products; Coplanar vectors; Scalar triple product and vector triple product; Applications of vectors to geometry (vector equations of straight lines, planes, areas and volumes).	Whiteboard-based lecture Assignment	CLO6 CLO7
Vector Spaces: Euclidean n-space, Real vector spaces, Subspaces, Linear combination of vectors, Linear dependence of vectors, Basis and dimension, Linear transformations, Matrix representation of linear transformation, Kernel and image, Eigenvalues and Eigenvectors.	Whiteboard-based lecture Assignment	CLO6 CLO7

List of Books:

Anton, H., & Rorres, C. (2013). *Elementary linear algebra with applications* (11th ed.). Wiley.

Bernet, Cristofer T. (2017). *Geometry* (6 th ed.). Schaum's Out line, McGraw Hill .

Bernard, S., & Child, J. M. (2016). *Higher algebra* (6th ed.). Arihant Prakashan.

Hall, H. S., & Knight, S. R. (1992). *Higher algebra* (7th ed.). Macmillan.

Howard A., & Chris R., (2015). *Elementary linear algebra with supplemental application.* Wiley.

Hummel, J. A. (1994). *Vector geometry*. Prentice Hall.

Khosh M. (2010). *Analytic geometry and vector analysis*. Dhaka: Ideal Library.

Lipschutz, S. (1997). *Schaum's outline of set theory and related topics* (Schaum's Outline Series). McGraw-Hill.

Murrey, R., Spiegel, Seymore L., & Dennis S. (2009). *Vector analysis*, Schaum's Out line, Springer.

Rahman, M. A. (2015). *Basic algebra*. Dhaka: Nahar Book Depot and Publications.

Rahman, M. A. (2016). *Linear algebra*. Dhaka: Nahar Book Depot and Publications.

Spiegel, M. R. (1974). *Vector analysis* (Schaum's Outline Series). McGraw-Hill.

Course Code	213711	Marks: 50	Credits: 2	Class Hours: 30
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 enable everyone to learn other mathematical courses that require the fundamentals of differentiation and integration.

Objective of the Course

To develop the basic ideas of functions and their graphs. Learning the basic properties of limit and continuity and analyzing them both mathematically and graphically. To understand the ideas and applications in solving real-life-oriented problems of differentiation and integration.

Course Learning Outcomes

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.

CLO3 Apply techniques of differentiation, including rules and theorems (e.g., Leibniz's rule), to solve problems related to rates of change 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 Apply approximation techniques using Taylor polynomials and series to estimate function values and analyze convergence.

CLO7 Evaluate series expansions and perform differentiation and integration of series to solve complex calculus problems.

Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO10	PLO11	PLO12
CLO1		√									√	
CLO2		√									√	
CLO3		√									√	
CLO4		√									√	
CLO5		√									√	
CLO6		√									√	
CLO7		√									√	

Course Contents

Topic	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.	Whiteboard-based lecture, Assignment	CLO2
Differentiation: Tangent lines and rates of change; Definition of derivative; One-sided derivatives; Rules of differentiation; Successive differentiation; Leibnitz's theorem; Related rates; Linear approximations and differentials.	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; 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

Approximation and Series: Taylor polynomials and series; Convergence of series; Taylor's series; Taylor's theorem and remainders; Differentiation and integration of series.	Whiteboard-based lecture Assignment	CLO6 CLO7

List of Books

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

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

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

Matin, M. A., & Chakraborty, 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.). Chittagong: 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	**212807**	**Marks: 100**	**Credits: 4**	**Class Hours: 60**

Course Title	Chemistry-I

Course Objective

The course is designed for the student to impart and improve fundamental knowledge and aspects related to understand the fundamental physical, Organic and Inorganic chemistry topics. To develop and extend student's knowledge on state of matter, structure of atom, radiochemistry, chemical bonding, Liquid and Solution, chemical equilibrium, pH, aliphatic and aromatic hydrocarbons.

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

CLO1   Explain the historical background, fundamental concept, and scope and aim of concepts of physical, Organic and inorganic chemistry.

CLO2   Clarify the state of matter, structure of atom, radiochemistry

CLO3   Explain about the chemical bonding, Liquid and Solution

CLO4   explain the chemical equilibrium, pH, aliphatic and aromatic hydrocarbons

CLO5   Explain the chemical equilibrium, pH, aliphatic and aromatic hydrocarbons, bonding, synthesis, nomenclature and properties.

Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO10	PLO11	PLO12
CLO1	√	√										
CLO2	√	√										
CLO3	√	√										
CLO4	√	√										
CLO5	√	√										

Course Contents

	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, state of aggregation of matter. Changes of state of matter. Intramolecular and intermolecular force and their role for the determination of 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 causes 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:** Vapor 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 behavior, Van der Walls 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 vapor pressure, dependence of vapor pressure on 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.	Lecture, Group Discussion, Assignment	4, 5
9	**Chemical Equilibrium:** Equilibrium in chemical reactions. Stoichiometry, law of mass action, concentration versus time curves, equilibrium law and equilibrium constant: K_p, K_c, and K_x, 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
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 carbon cations, carbanion, free radicals and their stabilities. Sources, properties, general methods of preparation of following hydrocarbons: Alkane, Alkene and Alkynes. Classification of organic compounds based on their functional groups.	Lecture, Group Discussion, Assignment	5

| 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 benzene ring, activating and deactivating group. | Lecture, Group Discussion, Assignment | 5 |

List of Books:

Bahl, B. S., & Bahl, A. (2024). *Text- Book of organic chemistry.* S. Chand & Company Ltd Ram Nagar, New Delhi

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

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

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

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

Muny, J. Mc. (2010). *Organic chemistry.* Thomson Broks-Coole.

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

Solomons, T. W. G. (2008). *Fundamental 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 on laboratory safety policy, some inorganic salts and radical analysis, preparation of solution with standardization, titration and precipitation.

Course Learning Outcomes (CLOs)

CLO1   Discuss about the general laboratory safety policy, rules and regulations and chemical management process.

CLO2   Explain the applications of apparatus and reagents in various experiments, different laboratory glassware and chemicals.

CLO3   Prepare stander solution and pH- neutralization curves

CLO4   Qualitative analysis of   mixtures of inorganic salts consisting of up to five different radicals

CLO5   Explain to determination of Fe^{2+}, copper (II), nickel as Ni (HDMG) 2 complex 7 using different methods.

Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO10	PLO11	PLO12
CLO1			√	√	√						√	
CLO2			√	√	√						√	
CLO3			√	√	√						√	
CLO4			√	√	√						√	
CLO5			√	√	√						√	

Course Contents

	Topics	Teaching Learning Strategy	CLOs
1	**Safety:** Introduction of chemical, 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:** 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, 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). *Fundamental of analytical chemistry*. Publisher, Cengage Learning.

Vogel, A. I. (2017). *A Text-Book of macro and semi-micro qualitative inorganic analysis*. Longmans, Green and Co. Ltd.

Welcher, F. J., & Hahn, R. B. (2024). *Semi-micro qualitative analysis*. D. Van Nostrand Co. Inc.

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

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 familiar with data, 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 necessary skills for solving probability related problems using appropriate laws. To provide knowledge on time series and statistical indices.

Course Learning Outcomes

CLO1 Understand the nature, characteristics, scope, application and abuse of statistics. Knowledge on sources of data and how to process, condense and presentation of 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, simple regression analysis. standard error of estimators of regression coefficients & their properties and fitting of regression lines.

CLO3 Comprehend different approaches of defining probability and useful laws of probability to solve problems. Also learn some commonly used probability distributions.

CLO4 Gain knowledge about meaning and application of statistical indices.

CLO5 Identify the pattern 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 use of numerical methods in application to real problems.

Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO10	PLO11	PLO12
CLO1			√	√	√						√	
CLO2			√	√	√						√	
CLO3			√	√	√						√	
CLO4			√	√	√						√	
CLO5			√	√	√						√	
CLO6			√	√	√						√	
CLO7			√	√	√						√	

Course Contents

Topic	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 variables, 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 number, 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	Lecture, Group Discussion,	CLO6

	difference operator, Difference table, Newton's formula and starling's central difference formula, Inverse interpolation, Numerical integration.	Workshop and Assignment	

List of Books

Gupta, S.C., & Kapoor, V.K. (1994). *Fundamentals* of *applied statistics*. Sultan Chand & Sons.

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

Jalil, M. A. and Ferdous R. (1999). *Basic statistics: Methods and applications*, Robi Mostafa, M.G. (1989). *Method of statistics (4th ed.).* Karim press and Publications.

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

Weiss, N. A., & C. A. Weiss (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 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 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	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	Interactive lectures and thematic assignments	CLO 2-3

• The Liberation War of 1971 • 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	Interactive lectures, documentary screening, and thematic assignments	CLO 1-4

• The Commodification of Culture		

List of Books

Ahmed, M. (1979). *Bangladesh: The constitutional quest for autonomy.* Dhaka: 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 & 11. P. Sharma (Eds.), Imperialism and revolution in South Asia (pp. 145-178). New York, NY: Monthly Review Press.

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

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

Bosc, 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.* Berkeley: University of California Press.

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

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

Halim, S., Amanullah, A. S. M., & Nasir, R. 1. (Eds.). (2024). *Society and sociology in Bangladesh*: *A South Asian perspective.* The University Press Limited.

Hashmi, T. (2021). *Fifty Years of Bangladesh, 1971-2021 Crises of Culture, Development, Governance and Identity.* Switzerland: Palgrave Macmillan.

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

Husain, 1. (2014). *Karl Marx on India.* New Delhi: Tulika Books.

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

Maniruzzaman, T. (1988*). The Bangladesh revolution and its aftermath.* (2nd ed.). Dhaka: University Press Limited. (Original work published 19801

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

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

Roy, A. (1984). *The Islamic syncretistic tradition in Bengal. Princeton.* NJ: 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.* Dhaka: Bangla Gobeshona.

Course Code	**219903**	**Marks: 75**	**Credits: 3**
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

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
Unit 1: 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	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	Classroom Lectures

	Differentiate among the classes of computers and the usages of them • Identify the vital components of the Systems Unit	the Systems Unit.	
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 Software	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, Opera, Internet explorer, Mozilla Firefox; Proprietary and Open Source Software	Classroom lectures and Lab
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	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,	Classroom Lectures, Lab, and Hands-on Practice

| | 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. | 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

Layout: Page setup/print | |
| Unit 4: Spreadsheet Application | The student will be able to:

• Identify Spreadsheet Packages
• Explain the importance of the Spreadsheet | Spreadsheet Packages, e.g. Excel

Importance of Spreadsheet application in Data Management, Related Concepts and | Classroom Lectures, Lab and Hands-on Practice |

		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	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	
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) Identification of Commonly Used Features of Presentation Application Window: Toolbars, Different presentation view modes Prepare a Presentation: Adding elements and formatting slides, slide Show, slide transition, animation Effects	Classroom Lectures, Lab and Hands-on Practice

		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 E-mail: Creating an Email	Classroom Lectures, Lab and Hands-on Practice

		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	
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,	Classroom Lectures, Lab and Hands-on Practice

| | | Classification and 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: The student will be able to:

CLO 1	Learn assembling hardware
CLO 2	Prepare, edit and print word documents and excel
CLO 3	Prepare power point presentation.
CLO 4	Access information from e-mail
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 - 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.	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.

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

CLO1	Understand 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	Grasp the knowledge of physical properties of matter
CLO7	Understand the concept of waves and optics

	Topic	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 systems, Conservation of energy and momentum, Centre of mass,	Lecture, Group Discussion, and	CLO2

	Collision problems	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 Katter'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., and Ishaq. M. (2017). B.Sc. Hons. *Physics 1st Part* (Bengali Version). Ideal Books.

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

Sears, F.W., Zemansky, M.W., & Young, H.D. (2007). *University physics (*12 th ed.). Pearson Addison Wesley.

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

CLO1: Understand basic concept 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 law of thermodynamics.

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

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

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

Course Contents

	Topic	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 method of mixture with radiation corrections: Newton's Law of cooling, Variations of specific heats, Atomic and molecular heats	Lecture and Assignment	**CLO2**
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,	Lecture, Group Discussion, and	**CLO3**

	Porous plug experiment	Assignment	
5	**Entropy:** Entropy of an ideal gas, Temperature-entropy diagram, Increase of entropy.	Lecture	**CLO4**
6	**Thermodynamic Functions:** The 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-Jean's 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* (6 th ed.). John Willey and Sons, Inc.

Hossain, T. (1975). *Text book 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 Mc. GRAW-HILL Co. Inc.