

# DEPARTMENT OF PHYSICS

**Faculty of Science and Engineering  
University of Barishal.**



**Curriculum for the B.S. (Honors) Program  
for Session: 2023-24**

## **(Content for only 1<sup>st</sup> Semester)**

**Credits:19.5**

- 1. Title of the Program:** Bachelor of Science (B.S)
- 2. Name of the University:** University of Barishal.
- 3. Vision of the University:** The University of Barishal envisages being a centre of excellence for producing skilled human resources, outstanding researchers and forward-thinking leaders to ensure sustainable development of the country and to meet global challenges.
- 4. Mission of the University:**
  - UM1:** Nurturing a favorable academic environment by maintaining congenial interpersonal and professional relationships among academics, non-academic staffs and learners.
  - UM2:** Promoting a research based higher education by creating new knowledge complying with humanitarian and ethical values.
  - UM3:** Producing skilled manpower and resourceful intellectuals to ensure sustainable development of the country and to meet global challenges.
  - UM4:** Creating global leaders by ensuring a transformative educational experience which will foster creativity, life-long autonomous learning and entrepreneurship.
  - UM5:** Producing global citizens with moral and ethical values who will uphold national consciousness along with a liberal attitude towards diversities of the society.
  - UM6:** Expanding the frontiers of knowledge in collaboration with leading universities, research organizations and industries.
- 5. Name of the Program Offering Entity:** B.S. (Honors) in Physics
- 6. Vision of the Program Offering Entity:** To ensure skilled, qualified and innovative human resources; creating knowledge of technology based smart world.  
Quality Physics Education and Research to explore nature and to meet up the future scientific challenge.
- 7. Mission of the Program Offering Entity:** To build skilled human resources by creating and expanding opportunities for higher education, research, modern knowledge practice at the national level and to establish a fully technology-based University.
- 8. Objective of the Program Offering Entity:** Physics
- 9. Name of the Degree:** B.S. (Honor's) in Physics

**10. Description of the Program:** Bachelor of Science (Honors) in Physics is a 4 (four) academic year program where each academic year is divided into 2 (two) semesters i.e. the whole program is divided into eight semesters. A semester, conducted for a period of 6 (six) months, is named as either 1<sup>st</sup> semester or 2<sup>nd</sup> semester in each academic year. Examination shall be held at the end of each semester. A minimum requirement is set up by the university authority for the students for promoting from one year to another year. A credit system is used in this case where a student required clearing all 147-credits course for the program.

**11. Graduate Attributes (based on need assessment):**

**Enhanced Disciplinary Knowledge:** Students will be able to -

- a) Apply the fundamentals and applications of physics related concepts and theoretical knowledge.
- b) Exercise on good laboratory practice along with designing, executing and analyzing experimental and theoretical problems.
- c) Implement the experimental and computational methods software to analyze sophisticated problems and represent their findings.

**Creative Thinking and Problem Solving:** Students will be able to –

- a) Identify and evaluate scientific issues regarding the discipline and able to integrate concepts, ideas and skills learned to perform qualitative and quantitative analysis and reasoning to solve issues.
- b) Use their ability to think creatively to design and perform new to novel research individually and collaboratively as a team which contributes to make smart world.

**Communication and IT:** Students will be able to –

- a) Communicate and exchange relevant knowledge and ideas clearly and effectively to the scientific community.
- b) Prepare and present the rational and concise scientific articles or reports in oral, written and/or electronic visual formats.
- c) Use modern electronic devices and developed apps for communication.

**Independence, Integrity and Morality:** Students will be able to –

- a) Maintain the academic and professional integrity as well as be able to develop capacity to work independently and confidently.
- b) Develop understanding of moral and ethical values of scientific and professional works including research findings, intellectual property and company secrecy.
- c) Manage the interactions between one's personal and professional interests in the context of ethical point of view.

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| Course Title: <b>Mechanics</b>    | Credits: <b>3.0</b> |
| Course Code: <b>0533-PHY-1101</b> | Marks: <b>100</b>   |

### **Rationale of the Course:**

Mechanics is an important branch of physics. It is the ancient of all physics topics. It is the branch of physics dealing with the study of motion related or associated with the movement of objects when they are subjected to various forces causing the motion or displacements. No matter what we are interested in science or engineering, mechanics will be important because- motion is a fundamental idea in science. Most of the events of our everyday life can be explained by Newtonian Mechanics which is the subject area of the course.

### **Course Objectives**

The objectives of this course are:

- a) to develop a conceptual understanding of the core subjects, and an ability to apply the theoretical framework to describe and predict the motions of bodies. This understanding is a necessary prerequisite to study Electromagnetism, Quantum Mechanics and Statistical Mechanics.
- b) to introduce the main topics of Newtonian mechanics such as Vectors, Kinematics, Forces, Motion, Momentum, Energy, Angular Motion, Angular Momentum, Gravity, Planetary Motion and the Motion of Rigid Bodies.

### **Course Contents**

#### **1. Kinematics and Dynamics:**

Kinematics; Motion with constant acceleration; Force and Newton's laws of motion, Effects of friction on motion; Turning effect of forces and Moment of forces; Projectile motion; Circular motion, Centripetal and Centrifugal force and, its practical application; Applications of Newton's laws; Frictional and Pseudo forces; Limitation of Newton's laws; Collision; Impulse and linear momentum; Conservation of linear momentum; and Rocket motion.

#### **2. Rotational Motion:**

Kinetic energy of rotation; Energy conservation in rotational motion; Rotational inertia, Mass and inertia, Rotational invariance and its calculation; Parallel and perpendicular axes theorem; Angular momentum and Angular impulse; Conservation of angular momentum; Relation between linear and circular motion; Torque; and Radius of gyration; Carioles forces and other Geometrical effects.

#### **3. Work, Energy and Power:**

Work done by a constant force and a variable force; Conservative and non-conservative forces; Kinetic energy; The work-energy theorem; Work and kinetic energy in rotational motion; Kinetic energy in collisions; Potential energy, Store chemical and Elastic potential energy; Conversion and Conservation of mechanical energy and Efficiency; and Power.

#### 4. Gravitation:

Law of universal gravitation; Inertial and gravitational mass; Accelerations due to gravity and its variation; Shell theorems; Gravitational potential and field; Motion under a central force, Escape velocity; Motion of planets and satellites, Artificial satellite; and Kepler's laws of planetary motion.

#### Recommended Books:

- a. Halliday, D. Resnick, R. and Krane: Physics (Vol. I & II).
- b. K. R. Symon: Mechanics.
- c. Francis W. Sears, Mark W. Zemansky: University Physics.
- d. Wolfgang Nolting; Theoretical Physics 1, Classical Mechanics.
- e. Daniel Keppner, Robert J. Kolenkov: An Introduction to Mechanics.

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|---|---------------------|
| Course Title: <b>Properties of Matter</b> | Credits: <b>3.0</b> |
| Course Code: <b>0533-PHY-1102</b>         | Marks: <b>100</b>   |

#### 1. Elasticity:

Rigid body; Perfectly elastic body; Plastic body; Elastic properties of matter; Stress and strain; Hooke's law; Stress-strain diagram; Shearing and Compression stress; Types of Elasticity and Factors affecting elasticity: Elastic constants of isotropic solid; Relation between the moduli of elasticity; Internal elastic potential energy; Poisson's ratio, Twisting couple and Maxwell Kneedle; Variation of elasticity with temperature; Torsion of a cylinder; Theory of bending of beam; Shearing force and bending moment; and Cantilever: Loaded at the free and uniformly; Compression waves and impact: Loss of energy on impact, coefficient of restitution and Masses of colliding bodies .

#### 2. Surface Tension:

Molecular force, range and its influence of sphere; Adhesive and cohesive forces; Surface tension and surface energy; Molecular theory of surface tension; Pressure difference across a surface film; Soap bubble and Excess pressure; Factors affecting surface tension and Variation of surface tension with temperature, Evaporation and Condensation effect; Angle of contact; Capillarity; and Surface tension of water and mercury.

#### 3. Hydrostatics:

Hydrostatic pressure; Change of pressure with elevation; Pascal's law; Hydrostatic paradox; Thrust on an immersed plane; Center of pressure; Principle of Archimedes, Equilibrium of floating bodies, Stability of equilibrium, Rolling and pitching of a ship; and Force against a dam.

#### 4. Hydrodynamics:

General concepts of fluid flow; Streamline flow and turbulent flow; Critical velocity; Viscosity and coefficient of viscosity; Newton's law of viscosity; Variation of viscosity with temperature and

pressure; Stokes' law and Stokes Method; Terminal velocity for falling bodies; Poiseuille's method and formula; Bernoulli's Equation and its applications; Ostwald Viscometer and Equation of continuity; Pressure due to Compressible fluid and change with Altitude.

**Recommended Books:**

- a. D. Halliday, R. Resnick & K.S. Krane: Physics Vol. 1.
- b. F.W. Newman and V.H.L Searle: General Properties of Matter.
- c. D.S. Mathur: Properties of Matter.
- d. B. Brown: General Properties of Matter.
- e. FC Champion and N Davy: Properties of Matter.
- f. BrijLal and N. Subrahmanyam: Properties of Matter.

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| Course Title: <b>Waves &amp; Oscillations</b> | Credits: <b>3.0</b> |
| Course Code: <b>0533-PHY-1103</b>             | Marks: <b>100</b>   |

**1. Simple Harmonic Wave:**

Oscillations and Simple Harmonic Motion: Free oscillations, Simple harmonic motion (SHM); Average value of kinetic and potential energies of a harmonic oscillation, Superposition principle of SHM's, Lissajous figures and uses, Mass-spring system; Energy conservation in mass-spring system; Simple pendulum; Free, Damped and Forced vibrations; Resonance and sharpness of resonance; Damped oscillations and its types; Logarithmic decrement; Relaxation time and quality factor of oscillator; Damped harmonic oscillator; LCR circuit.

**2. Coupled Oscillators and Normal Modes of Continuous System:**

Coupled oscillators: Normal coordinates and normal modes; Forced vibration of a coupled oscillator.

**3. Fundamentals of Waves:**

Types of waves; Progressive and Stationary wave and its characteristics; Energy distribution due to progressive and stationary wave; Waves equation and its solution; Energy and power in waves; Interference of sound wave; Phase and group velocity and its significance; Plane and spherical wave.

**4. Superposition of Periodic Motions:**

Principle of superposition; Superimposed vibration of equal and different frequencies: Stationary waves; Huygens principles.

**5. Sound Waves:**

Audible, Ultrasonic, Infrasonic and Supersonic waves; Doppler's effects and its application; Application of ultrasonic sound; Sources of sound; Propagation and speed of sound in fluid; Transmission and Absorption of sound and solid media; Beat.

**6. Acoustics:**

Intensity of sound; Bel; Sound pressure level; Phon; Acoustic intensity; Architectural acoustics; Diffraction of sound and noises; speech; Noise Insulation and Reduction; Characteristic of musical sound; Building Acoustics: Reverberation; Sabine's reverberation formula; Growth and Decay intensity; Reverberation time and absorption coefficient and Requisites for good acoustic.

**Recommended Books:**

- a. C. A. Coulson: Waves.
- b. A. B. Wood: A Text book of Sound.
- c. A. P. French: Vibrations and Waves.
- d. M. W. Molechlan: Theory of Vibration.
- e. Brijlal and Subramanyam: Waves and Oscillations.
- f. H. R. K.: Physics.

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| Course Title: <b>Mathematics-I</b> | Credits: <b>3.0</b> |
| Course Code: <b>0541-PHY-1104</b>  | Marks: <b>100</b>   |

**Rationale of the Course**

Mathematics is the foundational language of physics and other scientific disciplines. This course equips students with essential mathematical tools such as set theory, calculus and complex numbers that are crucial for understanding advanced topics in physics. It also enhances logical reasoning and problem-solving abilities required for modeling and analyzing physical systems.

**Course Objectives**

1. To develop proficiency in fundamental mathematical concepts such as set theory and logic.
2. To understand and apply calculus and complex number theory to solve physical and engineering problems.
3. To cultivate analytical thinking through the use of differential and integral calculus in real-life applications.

**Course Learning Outcomes (CLOs)**

| CLO Code    | Statement   |
|-------------|---|
| <b>CLO1</b> | Describe basic concepts of sets, logic, and complex numbers.        |
| <b>CLO2</b> | Apply differentiation and integration techniques to solve problems. |

|             |   |
|-------------|---|
| <b>CLO3</b> | Analyze mathematical functions using limits, series expansion, and curvature.                       |
| <b>CLO4</b> | Evaluate definite integrals and apply them in determining physical quantities like area and volume. |

### Course Contents:

#### 1. Set Theory:

Algebra of sets; Union, Intersection and Cartesian product; Relations and functions; Elements of logic.

#### 2. Complex Numbers and Their Properties:

Complex numbers; De Moivre's theorem and its applications; Hyperbolic functions and their relations to trigonometric functions.

#### 3. Introduction to Elementary Calculus:

Limits; Continuity and related theories; Derivatives of elementary functions; Chain rule; Higher derivatives; Taylor series; Partial differentiation; Euler's rule for partial differentiation of homogeneous functions; Maxima; Minima; Asymptotic and tangent normal of curves, Arc length and radius of curvature of curves.

#### 4. Integral Calculus:

Definite integral as the limit of a sum; Indefinite integrals and different techniques of integration; Fundamental theorem of integral calculus; Determination of length and area of plane curves and volume obtained by revolution of plane curves.

### Recommended Books:

- a. H. M. Bacon: Differential and Integral Calculus.
- b. F. Ayers: Calculus (Schaum Series).
- c. M. Tinker and R. Lambourne: Further Mathematics for the Physical Sciences (Wiley).
- d. R. Lambourne and M. Tinker: Basic Mathematics for the Physics Sciences (Wiley).
- e. Barnard and Child: Higher Algebra; S. G. Wasani for Macmillan India Ltd.
- f. D. Jordan and P. Smith: Mathematical Techniques (OUP).

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| Course Title: <b>Chemistry-I</b>  | Credits: <b>2.0</b> |
| Course Code: <b>0531-PHY-1105</b> | Marks: <b>50</b>    |

### Rationale of the Course

This course provides fundamental knowledge of physical and inorganic chemistry essential for physics students. Understanding chemical bonding, reaction kinetics, electrochemistry, and chemical equilibria equips students with the tools to comprehend the microscopic properties of matter and interpret physical

systems at the molecular level. It lays the groundwork for interdisciplinary applications across physical sciences and engineering.

### Course Objectives

1. To understand the nature of chemical bonds and the principles of chemical kinetics and equilibrium.
2. To gain practical insights into chemical analysis and electrochemical systems.
3. To apply basic chemical principles in explaining physical properties and reactions.

### Course Learning Outcomes (CLOs)

| CLO Code | Statement  |
|----------|--|
| CLO1     | Describe the fundamental types of chemical bonds and bonding theories. |
| CLO2     | Perform and explain basic chemical analysis including titrations.      |
| CLO3     | Interpret the kinetics of chemical reactions using rate laws.          |
| CLO4     | Evaluate equilibrium states and electrochemical cell operations.       |

### Course Contents:

#### 1. Chemical Bonds:

Chemical bond; types of chemical bonds; ionic bond; covalent bond: sigma and pi bond, concept of hybridization, coordinate covalent bond; metallic bond; hydrogen bond; van der Waal's forces.

#### 2. Chemical Analysis:

Types of chemical analysis: Qualitative analysis, Quantitative analysis, Volumetric analysis; Types of titrations; Requirement of volumetric analysis; Acidimetry and alkalimetry; Primary and secondary standard substance; Equivalent weight of an acid, base, salt and oxidizing and reducing agents; Preparation of standard solution.

#### 3. Chemical Kinetics:

First and second-order reactions and their simple treatment; half-life of a reaction; order and molecularity; determination of order of reaction; collision theory.

#### 4. Electrochemistry:

Electrolytic and electrochemical cells; Electrodes; Half-cell reaction; Cell notation; Reduction potentials; electromotive force of cells, Standard hydrogen electrode. Applications of electrochemical and electrolytic cell.

#### 5. Chemical Equilibria:

Equilibrium in chemical reactions and the equilibrium law.  $K_p$  and  $K_c$  and their determination. Principle of Le Chatelier and its applications. Ostwald dilution law. Solubility product. Common ion effect. pH, pOH and buffer solution.

### Recommended Books:

- a. Daniels and Alberty: Physical Chemistry.

- b. S. Glasstone: Physical Chemistry.
- c. P.C. Rakshit: Physical Chemistry.
- d. M.M. Hoque and M.A. Nawab: Principles of Physical Chemistry.
- e. Bahl and Tuli: Essentials of Physical Chemistry.
- f. S.Z. Haider: Modern Inorganic Chemistry.
- g. T. Moeller: Modern Inorganic Chemistry.

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| Course Title: <b>Communicative English</b> | Credits: <b>3.0</b> |
| Course Code: <b>0231-PHY-1106</b>          | Marks: <b>100</b>   |

### 1. Grammar:

Parts of speech; Articles; Verb patterns; Tenses; Voice; Narration; Prepositions; Sentences and its classifications; Transformations of sentences; Group verbs; Idioms and phrases; Synonyms/antonyms; Subject and verb agreement; and Common errors.

### 2. Technical & Scientific Writing:

Spelling: Rules of spelling; Word formation; Punctuation; Common confusable; Writing definition of scientific terms; Designing posters; Writing Scientific project proposal; Technical report writing; and Writing research papers.

### 3. Reading:

Skimming; Scanning; Extracting main ideas; Summarizing.

### 4. Listening:

Strategies for listening; Summarizing listening, identifying main idea. text sequencing dictating.

### 5. Speaking:

Pronunciation; Difficult pronunciation; How to invite, ask questions, make request and give instructions; How to respond to queries, invitations and statements; How to thank, introduce; How to express different concepts: ability, possibility, futurity, necessity, obligation, assumption, regularity, continuity, arrangement, comparison etc.; Conversation with classmates, teachers, neighbors and people in bus, train, plane etc.

### Recommended Books:

- a. Hornby, A S: Oxford Advanced Learner's Dictionary. 8th Edition. Oxford: Oxford University Press, 2010.
- b. Leech, Geoffrey and Jan Svartvik: A Communicative Grammar of English. 2nd Edition. London and New York: Longman, 1996.
- c. Brown et al.: Houghton Mifflin English Grammar and Composition: First Course. Boston. Houghton Mifflin Company, 1984.

- d. Swan, Michael: Practical English Usage. 2nd Edition. Oxford University Press, 1995.
- e. Murphy, Raymond: Intermediate English Grammar. 2nd Edition. Cambridge: Cambridge University Press. 2003.
- f. Jonathon Law: Oxford English Language References; Oxford University Press, 2001.
- g. Thompson and Martinet: Practical English Grammar. Oxford; Fourth Edition.
- h. Michael Alley: The Craft of Scientific Presentations: Critical Steps to Succeed and Critical Errors to Avoid 2nd ed. 2013 Edition, Springer.
- i. Barbara Gastel and Robert A. Day: How to Write and Publish a Scientific Paper, 8th Edition, Greenwood.
- j. Joshua Schimel: Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded 1st Edition, Oxford University Press.
- k. Sharon J. Gerson & Steven M. Gerson: Technical Writing- Process and Product, 3rd edition, Pearson Education Asia, 2000.
- l. Hargie, Owen: Ed. The Handbook of Communication Skills. New York: Routledge, 2006.
- m. Baker, Joanna and Heather Westrup: Essential Speaking Skills. London: VSO Books, 2003.
- n. Bygate, Martin: Speaking. New York: OUP, 2003.
- o. Francois Grellar: Developing Reading Skills. Cambridge University Press.

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|------------------------------------|---------------------|
| Course Title: <b>Physics Lab-I</b> | Credits: <b>1.5</b> |
| Course Code: <b>0533-PHY-1107</b>  | Marks: <b>50</b>    |

**List of Experiments:**

1. To Determine the moment of inertia of a Flywheel about its axis of rotation.
2. To determine the spring constant and effective mass of a Spiral Spring and hence to calculate the rigidity modulus of the material of the spring.
3. To determine the value of 'g', acceleration due to gravity, by means of a Compound Pendulum.
4. To determine the rigidity modulus of a short wire by Dynamical Method.
5. Determination of elastic constants (Y, n, K,  $\sigma$ ) of the material of a wire by Searle's Method.
6. Determination of surface tension of water at room temperature by Capillary Tube Method.
7. Determination of the unknown frequency of a tuning fork by Melde's Method.
8. Verification of the laws of transverse vibration of a stretched string by Sonometer.

**Recommended Books:**

- a. Ahmed, G and Uddin, MS: Practical Physics.
- b. Din, K and Matin, MA: Practical Physics.

- c. Squires, GL: Practical Physics.
- d. C.L. Arora: B.Sc. Practical Physics.
- e. Harnam Singh: B.Sc. Practical Physics.
- f. Kalimuddin: B.Sc. Practical Physics.

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| Course Title: <b>VIVA-I</b>       | Credits: <b>1.0</b> |
| Course Code: <b>0533-PHY-1108</b> | Marks: <b>50</b>    |