

# Syllabus for Bangladesh Physics Olympiad

## Category – C

### 1. Mathematics:

#### (a) Vector:

Definition of Vectors, Difference between Vector and Scalar quantities, Representation of Vectors in Cartesian co-ordinate system, Position Vector, Triangle and Parallelogram rule for Vector addition and its formula, Dot product and Cross product, Orthogonal Projection of a Vector on another Vector, polar coordinate system.

#### (b) Trigonometry:

Trigonometric angle, Relation between radius and arc length of a circle, Trigonometric identities, Sin rule, Cosine rule, Basic properties of inverse trigonometric functions using calculator.

#### (c) Calculus:

Basic idea of limits and differentiation, Differentiation of known algebraic-trigonometric-exponential functions, Determination of tangent of a curve or slope and maxima-minima using differentiation for simple algebraic functions, Very basic idea of definite and indefinite integral (area under the curve) and of common functions (polynomial, exponential functions), Fundamental theorem of Calculus.

#### (d) Algebra:

Simplifying algebraic expressions, plotting qualitative graphs of polynomials, solution of linear equations, Properties of Polynomial (number and types of roots), Solution of quadratic equation, Summation of arithmetic and geometric series, making first order approximation using Taylor expansion, probability and combinatorics.

#### (e) Statistics:

Average, median, calculating experimental error (standard deviation), plotting data and drawing best fit line of linear experimental data plot.

### 2. Measurement:

Concept of Measurement, Units of Measurement, Fundamental and Derived quantities, Fundamental and Derived units, International system of units – SI, Scientific notation, Dimensions and dimensional analysis, Measuring Instruments, Vernier scale and slide calipers, Screw gauge.

### 3. Mechanics:

#### (a) Motion:

Rest and motion, Distance and Displacement, Speed and Velocity, Distance – Time graph, Velocity – Time graph, Uniform and non-uniform velocity, Acceleration, Uniform and Nonuniform acceleration, Acceleration— Time graph, Inertia, Linear momentum, Unit of force – Newton, Newton's laws of motion, Equations of motion, center of mass and its calculation, drawing Force Diagrams, Law of conservation of momentum, elastic and inelastic collisions, Projectile Motion, Kinematics of uniform circular motion, centripetal acceleration and force, Moment of Inertia, Torque, conditions of equilibrium.

#### (b) Gravitation and gravity:

Gravitation and Gravity, Newton's law of gravitation, Universal gravitational constant (G), Acceleration due to gravity. Falling bodies, Difference between mass and weight, [Variation of weight at different places and its reasons \(i.e. lift, satellite, surface of earth\)](#), Center of gravity, Spring-balance, Gravitational Field and Potential, Gravitational Shell theorems, [gravity in the interior and exterior of a planet](#), [Kepler's Laws of planetary motion](#).

*(c) Oscillation:*

Periodic motion, Oscillatory or vibration motion, Simple harmonic motion, Energy in simple harmonic motion, Relation between uniform circular motion and simple harmonic motion, Hooke's Law, Simple pendulum, Time period, Frequency, Determination of the value of 'g' using simple pendulum.

*(d) Work, Power and Energy:*

Work, Work as dot product of force and displacement, Power, Energy, Forms of energy, Potential energy, Kinetic Energy, Efficiency, Work-energy Theorem, [work done by conservative and non-conservative forces](#).

#### **4. Fluid mechanics:**

Density, Pressure, Pressure at a point in liquid at equilibrium, [Thrust in rocket propulsion](#), Pascal's law. Archimedes' principle, [conditions for floating](#), Relative density or specific gravity.

#### **5. Wave and Acoustics:**

Types of waves, Transverse and longitudinal waves and their differences, Time period, Frequency, Amplitude, Phase, Wave length, Wave velocity,  $v = \text{frequency} \times \text{wavelength}$ , Mechanism of propagation of sound through Air, Speed of sound, Reflection of sound, Audible range – Ultrasonic and infrasonic wave, Doppler effect, [sonic boom](#), [Sound intensity and decibel unit](#).

#### **7. Heat:**

*(a) Effect of Heat on substance:*

Concept of heat and temperature, Difference between heat and temperature and their units, Relationship between different temperature scales, Thermal expansion of material: Linear, Surface, Volume expansion and coefficients of expansion.

*(b) Change of state:*

Fusion, Specific latent heat of fusion, Melting point, Vaporization, Specific latent heat of Vaporization, Boiling point, Effect of pressure on melting point and boiling points. Evaporation.

*(c) Calorimetry:*

Heat capacity and Specific heat and their relationship, Fundamental principle of Calorimetry, Calorimeter.

*(d) Transmission of heat:*

Conduction, Convection, Radiation and their differences, [Thermal conductivity and its formula](#).

*(e) Ideal gases:*

[Conditions for ideal gas behavior](#), [Ideal gas law](#), [Basic thermal processes: Isobaric, Isochoric, Isothermal, Adiabatic](#). First law of Thermodynamics and its applications.

#### **8. Optics:**

*(a) Nature of Light:*

Light, Different theories of Light, Ray of light and beam of light, Electromagnetic spectrum, Luminous intensity, Luminous flux, Illuminance, Inverse square law of illuminance.

*(b) Reflection of light:*

Reflection of light, Regular and diffused reflection, Laws of reflection, Plane and Spherical mirror, Image, Real and virtual image, Formation of image by plane mirror and its characteristics, Concave and convex mirror, Constructing image of an Extended object, Linear Magnification, Nature and Size of the image formed by spherical mirror for different positions of an object.

*c) Refraction of light:*

Laws of refraction, [Fermat's Principle](#), Relative and Absolute refractive index, Critical angle and Total internal reflection, Optical fibers. Convex and concave lens, Constructing image of an Extended object, Nature and Size of the image formed by a lens for different positions of an object, Sign Convention.

*d) Dispersion and Scattering of light:*

Prism and refraction of light through prism, Dispersion, Dispersion of light through prism, Spectrum, Primary and complementary color, Absorption and reflection of light and color of a body, Scattering of light and blue color of sky ( qualitative discussion).

**9 Electricity:**

*a) Electricity:*

[Charge, induced charge, Coulomb's Law](#), Electric field, field line and [electric flux, Gauss' Law \(Qualitative\)](#) Electric potential, Potential difference. Equipotential Surface. Capacitance, Different types of Capacitor ([spherical and parallel plate](#)), Energy stored in a capacitor.

*b) Current Electricity:*

Current, Category of current – direct current and alternating current, Electric circuit, Ohm's law, Battery and Electromotive force, Resistance, Series and parallel connection, Laws of resistance, Specific resistance/Resistivity, Ammeter, Voltmeter, Electrical Power, Electrical Energy.

**10 Magnetism:**

*a) Magnetism:*

Magnet and Magnetism, Magnetic field and Magnetic lines of force, [Magnetic flux Force on a moving charge in a magnetic field, force on a current carrying wire in a magnetic field.](#)

*b) Electromagnetism:*

Electromagnetic induction (qualitative), Transformer.

**11 Electronics:**

Semiconductor, P and N type Semiconductor, Semiconductor diode, [effect of an ideal diode in a circuit.](#)

**12 Modern Physics:**

X-ray, Radioactive decay law, Half-life, Energy and momentum of a Photon, Photoelectric effect, Bohr model of hydrogen atom (qualitative). De-Broglie Wave. Fundamental Particles, Baryon, Meson, Lepton, Gauge, Characteristics of Fundamental particles (theory).