

PUBLIC SERVICE COMMISSION, WEST BENGAL

Syllabus for recruitment to the post of Assistant Director of Industrial Training / Principal of Industrial Training Institutes in W.B.G.S under the Technical Education, Training and Skill Development Department, Government of West Bengal

**Measurement of small lengths:** Vernier constant and least count.

**Motion in a straight line and Motion in a Plane:** Uniform accelerated motion, velocity- time and position- time graphs. Average velocity and instantaneous velocity, elementary concepts of differentiation and integration for describing motion, Projectile motion and trajectory equation.

**Laws of Motion:** Force and Inertia, Newton's first law of motion, momentum, Newton's second law of motion, impulse. Newton's third law of motion. Law of conservation of linear momentum and it's applications.

**Uniform Circular motion:** Angular speed and angular velocity, centripetal acceleration, centrifugal force and their direction.

**Friction:** Static and kinetic friction, laws of friction.

**Work, Energy and Power:** Work done by a constant force and a variable force; kinetic energy, Potential energy, Elastic collision in one dimension.

**System of Particles and Rotational Motion:** Position vector of Centre of mass, Moment of force, Torque, Moment of Inertia, radius of gyration, Equation in rotational motion. Angular momentum,

**Gravitation:** The universal law of gravitation. Acceleration due to gravity, Gravitational potential energy and gravitational potential, escape velocity. Orbital velocity of a satellite, Geo-stationary satellites.

**Mechanical Properties of Solids:** Elastic behaviour, stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, shear modulus of rigidity. Poisson's ratio; elastic energy.

**Mechanical Properties of Fluids:** Pascal's law and it's applications. Viscosity, Stokes' law, terminal velocity, Reynolds's number, streamline and turbulent flow. Critical velocity, Bernoulli's theorem and it's applications. Surface energy and Surface tension. angle of contact, capillary rise.

**Thermal Properties of Matter:** Thermal expansion of solids, liquids and gases, Calorimetry, Latent heat capacity. Heat transfer- conduction. convection and radiation, thermal conductivity, qualitative ideas of blackbody radiation, Wein's displacement law, Stefan's Law.

**Kinetic Theory of gases:** Equation of state of a perfect gas. Assumptions; concept of pressure. Kinetic interpretation of temperature. RMS speed of gas molecules; degrees of freedom, concept of mean free path.

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**Thermodynamics:** Heat, work and internal energy. Work done in compressing a gas, First law of thermodynamics. Isothermal and adiabatic processes, two specific heats of gas and their relation. Second law of thermodynamics.

**Oscillations:** Simple harmonic motion ( S.H.M) and it's equation; phase; oscillations of a loaded spring – restoring force and force constant, energy in S.H.M. , kinetic and potential energies. simple pendulum -derivation of expression for its time period.

**Speed of wave motion:** Newton's law, Laplace's correction. Displacement relation for a progressive waves, Principle of superposition of waves, reflection of waves.

**Electric charges and Coulomb's Law:** Electric Charges; conservation of charges, Coulomb's law-force between two point charges, forces between multiple charges; superposition principle and continuous charge distribution.

**Electric field and Gauss's Theorem:** Electric field, electric field due to a point charge, electric field lines, electric dipole, electric field due to a dipole; torque on a electric dipole in uniform electric field.

Electric flux, statement of Gauss's theorem and its applications

**Electrostatic potential:** Electrostatic potential, electric potential due to a point charge, and two point charge, equipotential surfaces, electric potential energy in an electrostatic field.

**Capacitors and Dielectrics:** Conductors and insulators, Dielectrics and electric polarisation, capacitors and capacitance, combination of capacitors in series and in parallel, energy stored in a capacitor.

**Current Electricity:** Electric current, flow of electric charges in a metallic conductor, Ohm's law, electrical resistance, V-I characteristic, electrical energy and power, electrical resistivity and conductivity. Temperature dependence of resistance, internal resistance of a cell, potential difference and E.M.F. of a cell, combination of cells in series and in parallel.

**Electric network rules and electrical measurements:** Kirchhoff's laws and simple applications. Wheatstone bridge. Potentiometer and it's applications.

**Concept and laws of magnetic Field:** Concept of magnetic field, Biot-Savart law and it's application, Ampere's law and it's applications.

**Force on a Charge and current:** Force on a moving charge in uniform magnetic and electric fields. Force between two parallel current-carrying conductors, definition of ampere, moving coil

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galvanometer-its current sensitivity and conversion to ammeter and voltmeter.

**Electromagnetic Induction:** Electromagnetic Induction; Faraday's law. Induced emf and current; Lens's law, Eddy currents, Self and mutual inductance.

**Alternating Current:** Alternating currents, peak and RMS value of alternating current/voltage; reactance and impedance; LC oscillations(qualitative treatment only) ,LCR series circuit, resonance; power in AC circuits. AC generator and transformer.

**Refraction of light:** Refraction of light, total internal reflection and it's applications, optical fibres , refraction at spherical surfaces, lenses, Magnification power of a lens, Refraction of light through a prism.

**Particles Nature of Radiation:** Dual nature of radiation. Photoelectric effect, Einstein's photoelectric equation-particle nature of light.

**Atoms and Nuclei:** Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus , mass number, mass-energy relation, nuclear fission and fusion.

**Band theory of solids:** Energy bands in conductors , insulators and Semiconductors.

**Semiconductor Electronics:** semiconductor diode, I-V characteristics of diode in forward and reverse bias, diode as a rectifier. p-n junction diodes; LED, photodiode, solar cell and their Characteristics.

**Sets:** Empty set. Finite & Infinite sets. Equal sets. Subsets. Subsets of the set of real numbers, Power set, Universal Set. Venn diagrams. Union and Intersection of sets. Complement of a set.

**Relations & Functions:** Ordered pairs, Cartesian product of sets. Number of elements in the cartesian product of two finite sets. Definition of relation, pictorial diagrams, domain co-domain and range of a relation. Pictorial representation of a function, domain, co-domain & range of a function, domain and range of these functions, constant, identity, polynomial, rational, modulus, Sum, difference, product and quotients of functions.

**Trigonometric Functions:** Positive and negative angles. Measuring angles in radians and in degrees and conversion from one measure to another.

**Complex Numbers and Quadratic Equations:** Need for complex numbers,. Brief description of algebraic properties of complex numbers. Statement of Fundamental Theorem of Algebra, solution of quadratic equations in the complex number system. Square-root of a complex number, Cube roots of unity and their properties.

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**Linear Inequalities:** Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation on the number line, Inequalities involving modulus function.

**Permutations & Combinations:** Factorial  $n$ . ( $n!$ ) Permutations and combinations, derivation of formulae and their connections, simple applications.

**Sequence and Series:** Sequence and Series. Arithmetic progression (A.P.), arithmetic mean (A.M.), Geometric progression (G.P.), general term of G.P., sum of  $n$  terms of a G.P., geometric mean (G.M.), relation between A.M. and G.M. Arithmetic/geometric series, infinite G.P. and its sum, Sum to  $n$  terms of the special series  $\Sigma n$ ,  $\Sigma n^2$  and  $\Sigma n^3$ .

**Straight Lines:** Shifting of origin. Slope of a line and angle between two lines. Various forms of equations of a line : parallel to axes, point-slope form, slope-intercept form, two-point form, intercept form and normal form. General equation of a line. Equation of family of lines passing through the point of intersection of two lines. Distance of a point from a line.

**Conic Sections:** Sections of a cone: circle, ellipse, parabola, hyperbola, a point, a straight line and pair of intersecting lines Standard equation of a circle; General equation of a circle; Standard equations and simple properties of parabola, ellipse and hyperbola.

**Introduction to Three - dimensional Geometry:** Coordinate axes and coordinate planes in three dimensions. Coordinates of a point. Distance between two points and section formula.

**Limits and Derivatives:** Definition of derivative, relate it to slope of tangent of the curve, derivative of sum, difference, product and quotient of functions. Derivatives of polynomial and trigonometric functions.

**Statistics:** Measure of dispersion; mean deviation, variance and standard deviation of ungrouped/grouped data. Analysis of frequency distributions with equal means but different variances.

**Probability:** Random experiments outcomes, sample spaces (set representation). Events: occurrence of events, 'not', 'and' and 'or' events, exhaustive events, mutually exclusive events, Probability of an event, probability of 'not', 'and' & 'or' events.

**Mathematical Reasoning:** Mathematically acceptable statements. Connecting words / phrases consolidating the understanding of "if and only if (necessary and sufficient) condition", "implies", "and/or", "implied by", "and", "or", "there exists" and their use through variety of examples related to real life and Mathematics. Validating the statements involving the connecting words difference between contradiction, converse and contrapositive.

**Matrices:** Types of matrices, zero matrix, transpose of a matrix

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and symmetric and skew symmetric matrices, Addition, multiplication and scalar multiplication of matrices, simple properties of addition, multiplication and scalar multiplication

**Determinants:** Determinants of a square matrix, properties of determinants, minors and Cofactors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix.

**Continuity and Differentiability:** Continuity and differentiability, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit functions, Derivatives of logarithmic and exponential functions, Applications of derivatives, increasing/ decreasing functions, tangents and normals, maxima and minima Simple problems.

**Integrals and it's applications:** Integration as inverse process of differentiation. Integration of a variety of functions by substitution by partial fractions and by parts, only simple integrals of the type to be evaluated. Fundamental theorem of Calculus(without proof). Applications in finding the area under simple curves especially lines, areas of circles/ parabola/ ellipse (in standard form only)

**Differential Equations:** Definition, order and degree, general and particular solutions of a differential equation Formation of differential equation whose general solution is given. Solution of differential equation by method of separation of variables, homogenous differential equation of first order and first degree.

**Vectors:** Vectors and Scalars, magnitude and direction of a vector, Direction cosines/ ratios of vectors, types of vectors (equal, unit, zero, parallel and collinear vectors), Position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of vectors by a scalar, position vector of a point dividing a line segment in a given ratio. Scalar(dot)

**Probability:** Multiplication theorem on probability, Conditional probability, independent events, total probability, Bayes' Theorem, Random variable and its probability distribution.

Def.