

**DETAILED SYLLABUS/TOPICS OF WRITTEN EXAMINATION  
BEING HELD ON 25<sup>TH</sup> SEPT 2011 FOR OPEN RECRUITMENT FOR  
THE POST OF ASI/RM IN BSF COMN SETUP.**

**PHYSICS**

**Physical world and measurement**

Units of measurement, systems of units, SI units & fundamental and derived units.

**Kinematics**

Distance and displacement, velocity, acceleration, Motion in a straight line  
Uniform and non- uniform motion, average speed and instantaneous  
velocity, Uniformly accelerated motion, velocity-time, position-time graphs,  
Scalar and vector quantities, position and displacement vectors, general  
vectors Cases of uniform velocity and uniform acceleration-projectile,  
Uniform circular motion.

**Laws of motion**

Force and motion, Newton's first law of motion; momentum and Newton's  
second law of motion; inertia of a body, inertia and mass, momentum,  
elementary idea of conservation of momentum, action and reaction forces  
,Laws of friction ,Centripetal and centrifugal force.

**Work, energy and power**

Work done by a constant force and a variable force; kinetic energy, power.  
Conservative forces: conservation of mechanical energy (kinetic and  
potential energies)/ non-conservative forces: elastic and inelastic collisions  
in one and two dimensions. Elasticity – types.

**Motion of system of particles and rigid body**

Conservation and centre of mass motion, Torque, angular momentum  
,Moment of inertia, radius of gyration. Statement of parallel and  
perpendicular axis theorems and their applications.

## **Gravitation**

The universal law of gravitation, Acceleration due to gravity and its variation with altitude and depth. Gravitational potential energy, gravitational potential. Escape velocity, orbital velocity of a satellite, geo-stationary satellites.

## **Properties of bulk matter**

Stress-strain relationship, young's modulus, shear modulus of rigidity. Pascal's law and its applications, Viscosity, Bernoulli's theorem and its applications, Surface energy and surface tension, Heat transfer-conduction, convection and radiation

## **Behavior of perfect gas and kinetic theory**

Kinetic theory of gases- assumptions, concept of pressure, kinetic energy and temperature, RMS speed of gas molecules.

## **Oscillations and waves**

Periodic motion – period, frequency, displacement as a function of time. Simple harmonic motion (S.H.M) and its equation; Simple pendulum – derivation of expression for its time period; Longitudinal and transverse waves, speed of wave motion, Beats, Doppler effect.

## **Sound:**

Nature of sound and its propagation in various media, speed of sound, range of hearing in humans; ultrasound; reflection of sound; echo and SONAR

## **Electrostatics**

Electric charges; conservation of charge, coulomb's law-force between two point charges Electric field, electric field due to a point charge, electric field lines; electric dipole, electric field due to a dipole; torque on a dipole in uniform electric field .Electric flux, statement of gauss's theorem Electric potential. Potential difference, electric potential due to a point charge, Conductors and insulators, free charges and bound charges inside a conductor, dielectrics and electric Polarization, capacitors and capacitance,

combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor.

### **Current Electricity**

Flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity, carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance. Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in parallel. Kirchhoff's laws and simple applications. Wheatstone bridge, meter bridge. Potentiometer - principle and its applications to measure potential difference and for comparing emf of two cells; measurement of internal resistance of a cell.

### **Magnetic Effects of current and magnetism**

Concept of magnetic field, Oersted's experiment. Ampere's law and its applications to infinitely long straight wire, straight and toroidal solenoids. Fleming's left hand rule, Fleming's right hand rule, Force on a moving charge in uniform magnetic and electric fields. Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors-definition of ampere. Torque experienced by a current loop in uniform magnetic field; moving coil galvanometer- its current sensitivity and conversion to ammeter and voltmeter.

### **Electromagnetic induction and alternating currents**

Electromagnetic induction: Faraday's law. Induced emf and current: Lenz's law, Eddy currents, self and mutual inductance.

### **Optics**

Reflection of light, spherical mirrors, total internal reflection and its applications. Surfaces, lenses, thin lens formula, magnification, power of a lens, combination of thin lenses in contact, refraction and dispersion of light

through a prism. Scattering of light – blue colour of the sky and reddish appearance of the sun at sunrise and sunset. Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers. Wave optics; wave front and Huygens' principle, reflection and refraction of plane wave at a plane surface using wave fronts.

### **Dual Nature of matter and radiation**

Photoelectric effect

### **Atoms & Nuclei**

Composition and size of nucleus, atomic masses, isotopes, isobars; isotones, radioactivity- alpha; beta and gamma particles/rays and their properties; Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number nuclear fission and fusion.

### **Topics from ECE and computers**

#### **SEMICONDUCTOR PHYSICS:-**

Intrinsic semiconductor – conductivity, atomic and crystal structure of germanium and silicon, covalent bonds, generation and recombination , effect of temperature on conductivity of intrinsic semiconductor , energy level diagram of conductor , insulator and intrinsic semiconductors . Extrinsic semiconductor material – doping of impurity, P and N type semiconductor and their conductivity . Minority and majority carriers , drift and diffusion currents .

#### **SEMICONDUCTOR DIODE :**

P-N junction diode , mechanism of current flow in P-N junction , drift and diffusion current , depletion layer , potential barrier , behavior of P-N junction characteristics Zener and avalanche breakdown , concept of junction capacitance in forward and reverse bias conditions .

## **INTRODUCTION TO BIPOLAR TRANSISTOR :**

Concept of bipolar transistor as two junction three terminal device having two kinds of current carrier , PNP and NPN transistors , their symbols and mechanism of current flow explanation of fundamental current relation .

## **TRANSISTOR BIASING AND STABILISATION OF OPERATION POINT :**

Different transistors biasing circuits for fixing the operating point temperature and  $B_{dc}$  on operating point need for stabilization of operation point , effect of fixing operating point in cut off and saturation region on performance of the amplifier .

## **SINGLE STAGE TRANSISTOR AMPLIFIER:**

- Calculation of current CE current and voltage gain of single amplifier circuit.
- Explanation of phase reversal of the output voltage with respect to input voltage.

Transistor hybrid low frequency model in CE configuration, “ h” parameters and their physical significance, typical values of this parameters.

Expressions for voltage gain, current gain, input and output impedance for a single stage CE amplifier circuit in ‘h’ parameters, appropriate approximation.

## **FIELD EFFECT TRANSISTOR(FET)**

Construction, operation, characteristics and equivalent circuit of JFET and its circuit application. Construction, operation, characteristics and equivalent circuit of MOSFET in depletion, enhancement modes and its circuit applications.

## **COMS, ADVANTAGES AND APPLICATIONS**

Comparison of JFET, MOSFET, BJT, Simple FET amplifier circuit and its working principles (without analysis)

## **INTRODUCTION TO COMPUTERS:**

- (I) Block diagram of computer & overview of its working.
- (II) Interconnections of various peripherals with computers.
- (III) Input/output & secondary storages devices.
- (IV) Classification of programming languages.
- (V) Classification of computers

## **FAMILIARIZATION WITH OPERATING SYSTEM**

- (I) Introduction to computer operating system
- (II) Introduction to DOS structure, system files, batch files & configuration files.
- (III) Booting the system from floppy & hard disk.
- (IV) Brief introduction to DOS internal & external commands.
- (V) Familiarization with windows structures, its use & application.

## **PREPARATION OF DOCUMENTS THROUGH WORD PROCESSING**

- (I) Idea of text editors like Microsoft word, write etc.
- (II) Opening a document
- (III) Preparing documents inserting diagrams and table

## **EDITING DOCUMENTS**

- (I) Character, word and line editing
- (II) Margin setting, paragraph alignment
- (III) Block operations
- (IV) Spell checker
- (V) Saving a document

## **MEGNETIC MATERIALS**

- (I) Different magnetic materials, (Dia, Para, ferro) their properties
- (II) Ferromagnetism, ferrimagnetism, domains, permeability, hysteresis loop (including coercive force and residual magnetism and magnetic saturation)
- (III) Soft and hard magnetic materials, their examples and typical applications

## **BASIC OF MODULATION**

- (i) Amplitude Modulation
- (ii) Frequency Modulation
- (iii) Phase Modulation
- (iv) Pulse Modulation
  - (a) Statement of sampling theorem and elementary idea of sampling frequency for pulse modulation
  - (b) Basic concepts of time division multiplexing (TDM) and frequency division multiplexing (FDM)
  - (c) Basic ideas about PAM, PPM, PWM and their typical applications
  - (d) Pulse code modulation (PCM) basic scheme of PCM system. Quantization, quantization error, companding, block diagram of TDM-PCM communication system and function of each block, Advantages of PCM systems. Concepts of differential PCM(DPCM).

## **NUMBER SYSTEMS**

- (a) Binary and hexadecimal number system: conversion from decimal and hexadecimal to binary and vice – versa . BCD representation.
- (b) Binary addition, subtraction, multiplication and division including binary points. BCD addition. 1's and 2's complement method of addition/subtraction

## **LOGIC GATES**

- a) Concepts of negative and positive logic
- b) Definition, symbols and truth table of NOT, AND , OR NAND NOR , EXOR Gates. NAND and NOR as universal gates.

## **LOGIC SIMPLIFICATION**

- (a) Postulates of boolean algebra , DE Morgan's theorems. Various identities. Formulation of truth table and Boolean equation for simple problem. Implementation of Boolean (logic) equations with gates.
- (b) Karnaugh map (up to 4 variables) and simple applications in developing combinational logic circuits

## **LOGIC FAMILIES**

- (a) Logic family classification:
  - Definition of SSI, MSI, LSI, VLSI
  - TTL and MOS families & their sub classification
  - Characteristics of TTL and MOS digital gates delay, speed , noise margin, logic levels, power dissipation, fan-in, fan-out, power supply requirement and comparison between TTL and MOS families.
  - Interfacing TTL and MOS ICs.

## **LOGIC CIRCUITS**

- (a) Open collector, wired OR and totem pole output circuit operation (qualitative ) for a TTL NAND gate
- (b) MOS circuit operation for a standard gate (NOR)
- (c) Tristate Switch/Buffer

## **COUNTERS**

- (a) Binary counters
- (b) Divide by N ripple counters (including design), Decade counter
- (c) Resettable and programmable counters
- (d) Down counter , up/down counter
- (e) Synchronous counters (only introduction)
- (f) Difference between Asynchronous and Synchronous counters
- (g) Ring counter with timing diagram

## **MATHEMATICS**

### **Linear inequalities**

Linear inequalities, algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical solution of linear inequalities in two variables solution of system of linear inequalities in two variables – graphically.

### **Binomial Theorem**

statement and proof of the binomial theorem for positive integral indices, Pascal's triangle, general and middle term in binomial expansion, simple applications.

### **Sequence and series**

Sequence and series, arithmetic progression (AP). Arithmetic mean (AM) geometric progression (GP) general term of a GP sum of n terms of a GP geometric mean (GM) relation between AM and GM sum to n terms of the special series  $\sum N$ ,  $\sum n^2$  and  $\sum n^3$ .

### **Matrices:**

Addition, multiplication and scalar multiplication of matrices, simple properties of addition, multiplication and scalar multiplication.

### **Determinants:**

Square matrix (up to 3X3 matrices), properties of determinants. Minors, cofactors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix.

### **Integrals**

Integration as inverse process of differentiation.. Integration of a variety of functions by substitution, by partial fractions and by parts ,definite integrals as a limit of a sum.

## **Differential equations**

Definition, order and degree, general and particular solutions of a differential equation.

## **Real Numbers**

natural numbers, integers, rational numbers on the number line. terminating/non terminating recurring decimals, Rational numbers as recurring/terminating decimals. laws of exponents with integral powers.

## **Polynomials**

Definition of a polynomial in one variable, degree of a polynomial, constant, linear, quadratic, cubic polynomials, monomials, binomials. Trinomials, factors and multiples, zeros//roots of a polynomial/equation. remainder theorem , factor theorem. Zeros of a polynomial relationship between zeros and coefficients of quadratic polynomials statement and simple problems on division algorithm for polynomials with real coefficients.

## **Linear equations in two variables**

linear equations in one variable, two variables problems from real life, including problems on ratio and proportion and with algebraic and graphical solutions being done simultaneously.

## **Coordinate geometry**

Coordinates of a point names and terms associated with the coordinate plane, notations. Plotting points in the plane.

## **Lines and angles**

1. if a ray stand on a line. Then the sum of a two adjacent angles so formed is 180 degree and the converse.2. if two lines intersect, the vertically opposite angles are equal.3. result on corresponding angles. Alternate angles. Interior angles when a transversal intersects two parallel lines.4. lines. Which are parallel to a given line, are parallel.5. the sum of the angles of a

triangle is 180 degree.6. if a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interiors opposite angles.

### **Triangles**

1. two triangles are congruent if any two sides and the included angel of one triangle is equal to any two sides and the included angel of the other triangle (SAS congruence)2. two triangles are congruent if any two angles and the included side of one triangle is equal to any two angles and the included side of the other triangle (ASA congruence)3. two triangles are congruent if the three sides of one triangle are equal to three sides of the other triangle .4. two right triangles are congruent if the hypotenuse and a side of one triangle are equal (respectively) to the hypotenuse and a side of the other triangle.5. the angles opposite to equal sides of a triangle are equal.6. the sides opposite to equal angles of a triangle are equal.7. triangle inequalities and relation between angle and facing side inequalities in triangles. Pythagoras theorem

### **Quadrilaterals**

1. the diagonal divides a parallelogram into two congruent triangles.2. in a parallelogram opposite sides are equal and conversely.3. in a parallelogram opposite angles are equal and conversely.4. a quadrilateral is a parallelogram if a pair of its opposite sides is parallel and equal.5. in a parallelogram, the diagonal bisect each other and conversely.6. In a triangle, the line segment joining the mid points of any two sides is parallel to the third side and its converse.

### **Circles**

definitions of circle and related concepts, radius, circumference, diameter, chord, arc subtended angel, Tangents to a circle, area of a circle, area of sector and segments of a circle

### **Areas**

Area of a triangle using hero's formula (without proof) and its application in finding the area of quadrilateral. Area of rectangle .Surface areas and volumes of cubes, cuboids, spheres (including hemispheres) and right circular cylinders/ cones.

## **Statistics**

Introduction to statistics collection of data presentation of data tabular form, ungrouped/grouped, bar graphs, histograms (with varying base length), frequency polygons. qualitative analysis of data to choose the correct form of presentation for the collected data mean median mode of ungrouped data

## **Quadratic equations**

Standard form of a quadratic equation , solution of the quadratic equations . Relationship between discriminate and nature of roots.

## **Introduction to trigonometry**

Trigonometric ratios and relations of various angles. Trigonometric identities, trigonometric ratios of complementary angles. problems on Heights and distance

## **CHEMISTRY**

### **Structure of atom**

Discovery of electron, proton and neutron; atomic number, isotopes and isobars Thomson's model and its limitations, Rutherford's model and its limitations. Bohr's model and its limitations, concept of shells and subshells, dual nature of matter and light, De Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p and d orbitals, rules for filling electrons in orbitals – Aufbau principle, Pauli exclusion principle and Hund's rule electronic configuration of atoms, stability of half filled and completely filled orbitals.

### **Chemical bonding and molecular structure**

Valence electrons, ionic bond, covalent bond: bond parameters, Lewis structure, polar character of covalent bond, covalent character of ionic bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization, involving s, p and d orbital and shapes of some simple molecules, molecular orbital. Theory of homo nuclear diatomic molecules (qualitative idea only), hydrogen bond.

### **States of Matter: Gases and Liquids**

Type of bonding, melting and boiling points. Boyle's law.. Charles law, Liquid state – Vapour pressure, viscosity and surface tension

### **Hydrocarbons**

Alkanes, Alkenes, Alkynes & Aromatic hydrocarbons

### **Electrochemistry**

Electrolysis and laws of electrolysis (elementary idea), dry cell- electrolytic cells and galvanic cells, standard electrode potential, EMF of a cell

### **Alcohols, Phenols and Ethers**

Alcohols, Phenols and Ethers

### **Acid bases and salts**

Their definition in terms of furnishing of H and OH ions, general properties and uses, concept and importance of pH scale

### **Chemical equations**

Chemical equation, balanced chemical equation, implications of balanced chemical equations, types of chemical reactions: combination, decomposition, displacement, double displacement, precipitation, neutralization, oxidation and reduction, oxidation number.

### **Metals and non metals**

Properties of metals and non metals, reactivity series, formation and properties of ionic compounds, basic metallurgical processes, corrosion and its prevention.

### **Periodic classification of elements**

Need for classification, modern periodic table, gradation in properties, valency, atomic number, metallic and non metallic properties

## **GK & ENGLISH**

Current affairs, history, geography and general science Verbs, Tenses: present/past/future forms, Active and Passive voice, Types of sentences: affirmative/interrogative sentences, use of noun/adjectives/adverbs/pronouns and prepositions, direct and indirect speech and comprehension paragraph, antonyms and synonyms and idioms and phrases.

**DETAILED SYLLABUS/TOPICS OF WRITTEN EXAMINATION**  
**BEING HELD ON 25<sup>TH</sup> SEPT 2011 FOR OPEN RECRUITMENT FOR**  
**THE POST OF HC (RO) IN BSF COMN SETUP**

**PHYSICS**

**Physical world and measurement**

Units of measurement, systems of units, SI units & fundamental and derived units.

**Kinematics**

Distance and displacement, velocity, acceleration, Motion in a straight line Uniform and non- uniform motion, average speed and instantaneous velocity, Uniformly accelerated motion, velocity-time, position-time graphs, Scalar and vector quantities, position and displacement vectors, general vectors Cases of uniform velocity and uniform acceleration-projectile, Uniform circular motion.

**Laws of motion**

Force and motion, Newton's first law of motion; momentum and Newton's second law of motion; inertia of a body, inertia and mass, momentum, elementary idea of conservation of momentum, action and reaction forces ,Laws of friction ,Centripetal and centrifugal force.

**Work, energy and power**

Work done by a constant force and a variable force; kinetic energy, power. Conservative forces: conservation of mechanical energy (kinetic and potential energies)/ non-conservative forces: elastic and inelastic collisions in one and two dimensions. Elasticity – types.

**Motion of system of particles and rigid body**

Conservation and centre of mass motion, Torque, angular momentum ,Moment of inertia, radius of gyration. Statement of parallel and perpendicular axis theorems and their applications.

**Gravitation**

The universal law of gravitation, Acceleration due to gravity and its variation with altitude and depth. Gravitational potential energy,

gravitational potential. Escape velocity, orbital velocity of a satellite, geo-stationary satellites.

### **Properties of bulk matter**

Stress-strain relationship, young's modulus, shear modulus of rigidity. Pascal's law and its applications, Viscosity, Bernoulli's theorem and its applications, Surface energy and surface tension, Heat transfer-conduction, convection and radiation

### **Behavior of perfect gas and kinetic theory**

Kinetic theory of gases- assumptions, concept of pressure, kinetic energy and temperature, RMS speed of gas molecules.

### **Oscillations and waves**

Periodic motion – period, frequency, displacement as a function of time. Simple harmonic motion (S.H.M) and its equation; Simple pendulum – derivation of expression for its time period; Longitudinal and transverse waves, speed of wave motion, Beats, Doppler effect.

### **Sound:**

Nature of sound and its propagation in various media, speed of sound, range of hearing in humans; ultrasound; reflection of sound; echo and SONAR

### **Electrostatics**

Electric charges; conservation of charge, coulomb's law-force between two point charges Electric field, electric field due to a point charge, electric field lines; electric dipole, electric field due to a dipole; torque on a dipole in uniform electric field. Electric flux, statement of gauss's theorem Electric potential. Potential difference, electric potential due to a point charge, Conductors and insulators, free charges and bound charges inside a conductor, dielectrics and electric Polarization, capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor.

## **Current Electricity**

Flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity, carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance. Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in parallel. Kirchhoff's laws and simple applications. Wheatstone bridge, meter bridge. Potentiometer - principle and its applications to measure potential difference and for comparing emf of two cells; measurement of internal resistance of a cell.

## **Magnetic Effects of current and magnetism**

Concept of magnetic field, Oersted's experiment. Ampere's law and its applications to infinitely long straight wire, straight and toroidal solenoids. Fleming's left hand rule, Fleming's right hand rule, Force on a moving charge in uniform magnetic and electric fields. Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors-definition of ampere. Torque experienced by a current loop in uniform magnetic field; moving coil galvanometer- its current sensitivity and conversion to ammeter and voltmeter.

## **Electromagnetic induction and alternating currents**

Electromagnetic induction: Faraday's law. Induced emf and current: Lenz's law, Eddy currents, self and mutual inductance.

## **Optics**

Reflection of light, spherical mirrors, total internal reflection and its applications. Surfaces, lenses, thin lens formula, magnification, power of a lens, combination of thin lenses in contact, refraction and dispersion of light through a prism. Scattering of light – blue colour of the sky and reddish appearance of the sun at sunrise and sunset. Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers. Wave

optics; wave front and Huygens' principle, reflection and refraction of plane wave at a plane surface using wave fronts.

### **Dual Nature of matter and radiation**

Photoelectric effect

### **Atoms & Nuclei**

Composition and size of nucleus, atomic masses, isotopes, isobars; isotones, radioactivity- alpha; beta and gamma particles/rays and their properties; Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number nuclear fission and fusion.

## **MATHEMATICS**

### **Linear inequalities**

Linear inequalities, algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical solution of linear inequalities in two variables solution of system of linear inequalities in two variables – graphically.

### **Binomial Theorem**

statement and proof of the binomial theorem for positive integral indices, Pascal's triangle, general and middle term in binomial expansion, simple applications.

### **Sequence and series**

Sequence and series, arithmetic progression (AP). Arithmetic mean (AM) geometric progression (GP) general term of a GP sum of n terms of a GP geometric mean (GM) relation between AM and GM sum to n terms of the special series  $\sum N$ ,  $\sum n^2$  and  $\sum n^3$ .

### **Matrices:**

Addition, multiplication and scalar multiplication of matrices, simple properties of addition, multiplication and scalar multiplication.

### **Determinants:**

Square matrix (up to 3X3 matrices), properties of determinants. Minors, cofactors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix.

### **Integrals**

Integration as inverse process of differentiation.. Integration of a variety of functions by substitution, by partial fractions and by parts ,definite integrals as a limit of a sum.

## **Differential equations**

Definition, order and degree, general and particular solutions of a differential equation.

## **Real Numbers**

natural numbers, integers, rational numbers on the number line. terminating/non terminating recurring decimals, Rational numbers as recurring/terminating decimals. laws of exponents with integral powers.

## **Polynomials**

Definition of a polynomial in one variable, degree of a polynomial, constant, linear, quadratic, cubic polynomials, monomials, binomials. Trinomials, factors and multiples, zeros//roots of a polynomial/equation. remainder theorem , factor theorem. Zeros of a polynomial relationship between zeros and coefficients of quadratic polynomials statement and simple problems on division algorithm for polynomials with real coefficients.

## **Linear equations in two variables**

linear equations in one variable, two variables problems from real life, including problems on ratio and proportion and with algebraic and graphical solutions being done simultaneously.

## **Coordinate geometry**

Coordinates of a point names and terms associated with the coordinate plane, notations. Plotting points in the plane.

## **Lines and angles**

1. if a ray stand on a line. Then the sum of a two adjacent angles so formed is 180 degree and the converse.2. if two lines intersect, the vertically opposite angles are equal.3. result on corresponding angles. Alternate angles. Interior angles when a transversal intersects two parallel lines.4. lines. Which are parallel to a given line, are parallel.5. the sum of the angles of a

triangle is 180 degree.6. if a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interiors opposite angles.

### **Triangles**

1. two triangles are congruent if any two sides and the included angel of one triangle is equal to any two sides and the included angel of the other triangle (SAS congruence)2. two triangles are congruent if any two angles and the included side of one triangle is equal to any two angles and the included side of the other triangle (ASA congruence)3. two triangles are congruent if the three sides of one triangle are equal to three sides of the other triangle .4. two right triangles are congruent if the hypotenuse and a side of one triangle are equal (respectively) to the hypotenuse and a side of the other triangle.5. the angles opposite to equal sides of a triangle are equal.6. the sides opposite to equal angles of a triangle are equal.7. triangle inequalities and relation between angle and facing side inequalities in triangles. Pythagoras theorem

### **Quadrilaterals**

1. the diagonal divides a parallelogram into two congruent triangles.2. in a parallelogram opposite sides are equal and conversely.3. in a parallelogram opposite angles are equal and conversely.4. a quadrilateral is a parallelogram if a pair of its opposite sides is parallel and equal.5. in a parallelogram, the diagonal bisect each other and conversely.6. In a triangle, the line segment joining the mid points of any two sides is parallel to the third side and its converse.

### **Circles**

definitions of circle and related concepts, radius, circumference, diameter, chord, arc subtended angel, Tangents to a circle, area of a circle, area of sector and segments of a circle

#### **areas**

Area of a triangle using hero's formula (without proof) and its application in finding the area of quadrilateral. Area of rectangle .Surface areas and volumes of cubes, cuboids, spheres (including hemispheres) and right circular cylinders/ cones.

## **Statistics**

Introduction to statistics collection of data presentation of data tabular form, ungrouped/grouped, bar graphs, histograms (with varying base length), frequency polygons. qualitative analysis of data to choose the correct form of presentation for the collected data mean median mode of ungrouped data

## **Quadratic equations**

Standard form of a quadratic equation , solution of the quadratic equations . Relationship between discriminate and nature of roots.

## **Introduction to trigonometry**

Trigonometric ratios and relations of various angles. Trigonometric identities, trigonometric ratios of complementary angles. problems on Heights and distance

## CHEMISTRY

### Structure of atom

Discovery of electron, proton and neutron; atomic number, isotopes and isobars Thomson's model and its limitations, Rutherford's model and its limitations. Bohr's model and its limitations, concept of shells and subshells, dual nature of matter and light, De Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p and d orbitals, rules for filling electrons in orbitals – Aufbau principle, Pauli exclusion principle and Hund's rule electronic configuration of atoms, stability of half filled and completely filled orbitals.

### Chemical bonding and molecular structure

Valence electrons, ionic bond, covalent bond: bond parameters, Lewis structure, polar character of covalent bond, covalent character of ionic bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization, involving s, p and d orbitals and shapes of some simple molecules, molecular orbital. Theory of homo nuclear diatomic molecules (qualitative idea only), hydrogen bond.

### States of Matter: Gases and Liquids

Type of bonding, melting and boiling points. Boyle's law.. Charles law, Liquid state – Vapour pressure, viscosity and surface tension

### Hydrocarbons

Alkanes, Alkenes, Alkynes & Aromatic hydrocarbons

### Electrochemistry

Electrolysis and laws of electrolysis (elementary idea), dry cell- electrolytic cells and galvanic cells, standard electrode potential, EMF of a cell

### Alcohols, Phenols and Ethers

Alcohols, Phenols and Ethers

### **Acid bases and salts**

Their definition in terms of furnishing of H and OH ions, general properties and uses, concept and importance of pH scale

### **Chemical equations**

Chemical equation, balanced chemical equation, implications of balanced chemical equations, types of chemical reactions: combination, decomposition, displacement, double displacement, precipitation, neutralization, oxidation and reduction, oxidation number.

### **Metals and non metals**

Properties of metals and non metals, reactivity series, formation and properties of ionic compounds, basic metallurgical processes, corrosion and its prevention.

### **Periodic classification of elements**

Need for classification, modern periodic table, gradation in properties, valency, atomic number, metallic and non metallic properties

## **GK & ENGLISH**

Current affairs, history , geography and general science Verbs, Tenses:present/past/future forms,Active and Passive voice,Types of sentences: affirmative/interrogative sentences, use of noun/adjectives/adverbs/pronouns and prepositions, direct and indirect speech and comprehension paragraph, antonyms and synonyms and idioms and phrases.

**DETAILED SYLLABUS/TOPICS OF WRITTEN EXAMINATION  
BEING HELD ON 25<sup>TH</sup> SEPT 2011 FOR OPEN RECRUITMENT FOR  
THE POST OF HC (FITTER) IN BSF COMN SETUP**

**PHYSICS**

**Physical world and measurement**

Units of measurement, systems of units, SI units & fundamental and derived units.

**Kinematics**

Distance and displacement, velocity, acceleration, Motion in a straight line  
Uniform and non- uniform motion, average speed and instantaneous  
velocity, Uniformly accelerated motion, velocity-time, position-time graphs,  
Scalar and vector quantities, position and displacement vectors, general  
vectors Cases of uniform velocity and uniform acceleration-projectile,  
Uniform circular motion.

**Laws of motion**

Force and motion, Newton's first law of motion; momentum and Newton's  
second law of motion; inertia of a body, inertia and mass, momentum,  
elementary idea of conservation of momentum, action and reaction forces  
,Laws of friction ,Centripetal and centrifugal force.

**Work, energy and power**

Work done by a constant force and a variable force; kinetic energy, power.  
Conservative forces: conservation of mechanical energy (kinetic and  
potential energies)/ non-conservative forces: elastic and inelastic collisions  
in one and two dimensions. Elasticity – types.

**Motion of system of particles and rigid body**

Conservation and centre of mass motion, Torque, angular momentum  
,Moment of inertia, radius of gyration. Statement of parallel and  
perpendicular axis theorems and their applications.

## **Gravitation**

The universal law of gravitation, Acceleration due to gravity and its variation with altitude and depth. Gravitational potential energy, gravitational potential. Escape velocity, orbital velocity of a satellite, geo-stationary satellites.

## **Properties of bulk matter**

Stress-strain relationship, young's modulus, shear modulus of rigidity. Pascal's law and its applications, Viscosity, Bernoulli's theorem and its applications, Surface energy and surface tension, Heat transfer-conduction, convection and radiation

## **Behavior of perfect gas and kinetic theory**

Kinetic theory of gases- assumptions, concept of pressure, kinetic energy and temperature, rms speed of gas molecules.

## **Oscillations and waves**

Periodic motion – period, frequency, displacement as a function of time. Simple harmonic motion (S.H.M) and its equation; Simple pendulum – derivation of expression for its time period; Longitudinal and transverse waves, speed of wave motion, Beats, Doppler effect.

## **Sound:**

Nature of sound and its propagation in various media, speed of sound, range of hearing in humans; ultrasound; reflection of sound; echo and SONAR

## **Electrostatics**

Electric charges; conservation of charge, coulomb's law-force between two point charges Electric field, electric field due to a point charge, electric field lines; electric dipole, electric field due to a dipole; torque on a dipole in uniform electric field .Electric flux, statement of gauss's theorem Electric potential. Potential difference, electric potential due to a point charge, Conductors and insulators, free charges and bound charges inside a conductor, dielectrics and electric Polarization, capacitors and capacitance,

combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor.

### **Current Electricity**

Flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity, carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance. Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in parallel. Kirchhoff's laws and simple applications. Wheatstone bridge, meter bridge. Potentiometer - principle and its applications to measure potential difference and for comparing emf of two cells; measurement of internal resistance of a cell.

### **Magnetic Effects of current and magnetism**

Concept of magnetic field, Oersted's experiment. Ampere's law and its applications to infinitely long straight wire, straight and toroidal solenoids. Fleming's left hand rule, Fleming's right hand rule, Force on a moving charge in uniform magnetic and electric fields. Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors-definition of ampere. Torque experienced by a current loop in uniform magnetic field; moving coil galvanometer- its current sensitivity and conversion to ammeter and voltmeter.

### **Electromagnetic induction and alternating currents**

Electromagnetic induction: Faraday's law. Induced emf and current: Lenz's law, Eddy currents, self and mutual inductance.

### **Optics**

Reflection of light, spherical mirrors, total internal reflection and its applications. Surfaces, lenses, thin lens formula, magnification, power of a lens, combination of thin lenses in contact, refraction and dispersion of light

through a prism. Scattering of light – blue colour of the sky and reddish appearance of the sun at sunrise and sunset. Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers. Wave optics; wave front and Huygens' principle, reflection and refraction of plane wave at a plane surface using wave fronts.

### **Dual Nature of matter and radiation**

Photoelectric effect

### **Atoms & Nuclei**

Composition and size of nucleus, atomic masses, isotopes, isobars; isotones, radioactivity- alpha; beta and gamma particles/rays and their properties; Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number nuclear fission and fusion.

### **ADDITIONAL TOPICS**

1. Construction & method of reading micrometers (internal and external) and vernier calipers correct handling of micrometers and vernier calipers. Reading of vernier scale description and use of combination set care and maintenance of micrometers, vernier calipers, combination set.
2. Sheet metal worker's hand tools their description and use description of simple soldering and brazing. Fluxes used for common joints types of sheet metal joints their uses.
3. General description & construction of diesel engine diesel engine characteristics & classification working principles of 4 stroke cycle diesel engine comparison between petrol and diesel engine.
4. Two stroke cycle diesel engine types of scavenging uniflow and loop flow scavenger opposed piston engine differences between two stroke and 4 stroke cycle diesel engines.
5. Engine details cylinder materials cylinder arrangements cylinder liners and their advantages cylinder heads, description, function, care

- and maintenance – location combustion chamber in cylinder heads and also heater plugs and post & valve arrangements.
- 6 Combustion chambers pumps open and closed types, advantages and disadvantages, compression ration & compression pressures compression testing of cylinders and analysis of results & importance.
  - 7 Need for maintenance check up in diesel engine – preparation of maintenance schedule from charts of popular makes of engines.
  - 8 Valves, valve operations mechanism parts and function of each valve timing diagram-camshaft and timing gears-types of drives used in engines chain tension and its importance cylinder head and manifold construction and function-water jackets passages.
  - 9 Description and function of valve parts-maintenance materials used-necessity of valve clearance prescribed by makers of engine-effect of incorrect clearances-common troubles and remedy-reason for warping of cylinder head.
  - 10 Piston and piston rings function types and materials. Used recommended clearances for the rings and its necessity precautions while fitting rings connecting rods types function and material used methods of fixing gudgeon pin on small end method bearing failure & its causes care & maintenance.
  - 11 Crankshaft – construction & factions – materials used – arrangement of crank pins and main journals – balancing methods-flywheel-construction & its functions and material used rim marks and balancing. Elementary of clutch & coupling units attached to flywheel.
  - 12 Description & function of cylinder block-material used-cylinder liners & details crank case and oil pan and their construction water jacket passages & wail thickness bolt hole dimension got cylinder fixing provision for mounting accessories like oil pump, water pump filters oil flow passages and cleaning plugs.

- 13 Engine bearings classification and location materials used & composition of bearing materials shell bearing and their advantages special bearings material for diesel engine application bearing failure & its causes care & maintenance.
- 14 Friction its meaning and importance, methods to reduce friction in engines use of lubricants oil for diesel engine lubrication properties of lubricants.
- 15 Need for lubrication system for diesel engines types used and layout for the system by pass & full flow arrangement type of oil pumps oil filters, oil coolers, common troubles care and maintenance.
- 16 Engine assembly procedure need for cleanliness and special tools and gauges used for engine assembling, practice periods of decarburizing and overhauling engine in terms of hours of run or mileage running in procedure of overhauled engines.
- 17 Cylinder liner construction & purpose material used and finish provided types of liners in use method used to fir the same in cylinder bore, advantages of wet and dry liners wear pattern & allowable wear cylinder wear and its causes.
- 18 Need for cooling as engine general description & type of air and liquids cooling used in engine layout of cooling system and parts in the layout function of parts like radiator thermostat & water pump purpose of thermostat & need to maintain engine working temperature.
- 19 Need for cooling an engine general description & types of air and liquids cooling uses in engine layout of cooling system and parts in the layout function of parts like radiator thermostat & water pump purpose of thermostat & need to maintain engine working temperature.
- 20 Description of internal & external engines different types of IC engines parts of all IC engine 4 stroke OTTO cycle engine – 2 stroke

- petrol engine differences between of valve timing and parts of valve operation system description and operation.
- 21 Reasons for development of noises in the engine components rectification, methods of assembling practice to be followed during engine overhauling as per makers shop manual.
  - 22 Simple electrical circuit series & parallel circuits identification of alternating current and direct current meters insulators and conductors types of resistance ohm's law and its application common electrical terms and symbols primary and secondary cells lead acid battery description construction common troubles and remedy.
  - 23 Description of electrical circuits ignition system and the components purpose of induction coil, condenser, spark plugs common troubles in ignition circuit and remedy.
  - 24 Description of charging circuit operation of dynamo and regulator Unit-Ignition warning lamp troubles & remedy in charging system.
  - 25 Description of starter motor circuits constructional details of starter motor solenoid switches common troubles and remedy in starter circuits.

## **MATHEMATICS**

### **Linear inequalities**

Linear inequalities, algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical solution of linear inequalities in two variables solution of system of linear inequalities in two variables – graphically.

### **Binomial Theorem**

statement and proof of the binomial theorem for positive integral indices, Pascal's triangle, general and middle term in binomial expansion, simple applications.

### **Sequence and series**

Sequence and series, arithmetic progression (AP). Arithmetic mean (AM) geometric progression (GP) general term of a GP sum of n terms of a GP geometric mean (GM) relation between AM and GM sum to n terms of the special series  $\sum N$ ,  $\sum n^2$  and  $\sum n^3$ .

### **Matrices:**

Addition, multiplication and scalar multiplication of matrices, simple properties of addition, multiplication and scalar multiplication.

### **Determinants:**

Square matrix (up to 3X3 matrices), properties of determinants. Minors, cofactors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix.

### **Integrals**

Integration as inverse process of differentiation.. Integration of a variety of functions by substitution, by partial fractions and by parts ,definite integrals as a limit of a sum.

### **Differential equations**

Definition, order and degree, general and particular solutions of a differential equation.

### **Real Numbers**

natural numbers, integers, rational numbers on the number line. terminating/non terminating recurring decimals, Rational numbers as recurring/terminating decimals. laws of exponents with integral powers.

### **Polynomials**

Definition of a polynomial in one variable, degree of a polynomial, constant, linear, quadratic, cubic polynomials, monomials, binomials. Trinomials, factors and multiples, zeros//roots of a polynomial/equation. remainder theorem , factor theorem. Zeros of a polynomial relationship between zeros and coefficients of quadratic polynomials statement and simple problems on division algorithm for polynomials with real coefficients.

### **Linear equations in two variables**

linear equations in one variable, two variables problems from real life, including problems on ratio and proportion and with algebraic and graphical solutions being done simultaneously.

### **Coordinate geometry**

Coordinates of a point names and terms associated with the coordinate plane, notations. Plotting points in the plane.

### **Lines and angles**

1. if a ray stand on a line. Then the sum of a two adjacent angles so formed is 180 degree and the converse.2. if two lines intersect, the vertically opposite angles are equal.3. result on corresponding angles. Alternate angels. Interior angles when a transversal intersects two parallel lines.4. lines. Which are parallel to a given line, are parallel.5. the sum of the angles of a triangle is 180 degree.6. if a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interiors opposite angles.

## **Triangles**

1. two triangles are congruent if any two sides and the included angle of one triangle is equal to any two sides and the included angle of the other triangle (SAS congruence) 2. two triangles are congruent if any two angles and the included side of one triangle is equal to any two angles and the included side of the other triangle (ASA congruence) 3. two triangles are congruent if the three sides of one triangle are equal to three sides of the other triangle .4. two right triangles are congruent if the hypotenuse and a side of one triangle are equal (respectively) to the hypotenuse and a side of the other triangle.5. the angles opposite to equal sides of a triangle are equal.6. the sides opposite to equal angles of a triangle are equal.7. triangle inequalities and relation between angle and facing side inequalities in triangles. Pythagoras theorem

## **Quadrilaterals**

1. the diagonal divides a parallelogram into two congruent triangles.2. in a parallelogram opposite sides are equal and conversely.3. in a parallelogram opposite angles are equal and conversely.4. a quadrilateral is a parallelogram if a pair of its opposite sides is parallel and equal.5. in a parallelogram, the diagonal bisect each other and conversely.6. In a triangle, the line segment joining the mid points of any two sides is parallel to the third side and its converse.

## **Circles**

definitions of circle and related concepts, radius, circumference, diameter, chord, arc subtended angle, Tangents to a circle, area of a circle, area of sector and segments of a circle

### **areas**

Area of a triangle using heron's formula (without proof) and its application in finding the area of quadrilateral. Area of rectangle .Surface areas and volumes of cubes, cuboids, spheres (including hemispheres) and right circular cylinders/ cones.

## **Statistics**

Introduction to statistics collection of data presentation of data tabular form, ungrouped/grouped, bar graphs, histograms (with varying base length), frequency polygons. qualitative analysis of data to choose the correct form of presentation for the collected data mean median mode of ungrouped data

### **Quadratic equations**

Standard form of a quadratic equation , solution of the quadratic equations . Relationship between discriminate and nature of roots.

### **Introduction to trigonometry**

Trigonometric ratios and relations of various angles. Trigonometric identities, trigonometric ratios of complementary angles. problems on Heights and distance

## CHEMISTRY

### Structure of atom

Discovery of electron, proton and neutron; atomic number, isotopes and isobars Thomson's model and its limitations, Rutherford's model and its limitations. Bohr's model and its limitations, concept of shells and subshells, dual nature of matter and light, De Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p and d orbitals, rules for filling electrons in orbitals – Aufbau principle, Pauli exclusion principle and Hund's rule electronic configuration of atoms, stability of half filled and completely filled orbitals.

### Chemical bonding and molecular structure

Valence electrons, ionic bond, covalent bond: bond parameters, Lewis structure, polar character of covalent bond, covalent character of ionic bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization, involving s, p and d orbital and shapes of some simple molecules, molecular orbital. Theory of homo nuclear diatomic molecules (qualitative idea only), hydrogen bond.

### States of Matter: Gases and Liquids

Type of bonding, melting and boiling points. Boyle's law.. Charles law, Liquid state – Vapour pressure, viscosity and surface tension

### Hydrocarbons

Alkanes, Alkenes, Alkynes & Aromatic hydrocarbons

### Electrochemistry

Electrolysis and laws of electrolysis (elementary idea), dry cell- electrolytic cells and galvanic cells, standard electrode potential, EMF of a cell

### Alcohols, Phenols and Ethers

Alcohols, Phenols and Ethers

### **Acid bases and salts**

Their definition in terms of furnishing of H and OH ions, general properties and uses, concept and importance of pH scale

### **Chemical equations**

Chemical equation, balanced chemical equation, implications of balanced chemical equations, types of chemical reactions: combination, decomposition, displacement, double displacement, precipitation, neutralization, oxidation and reduction, oxidation number.

### **Metals and non metals**

Properties of metals and non metals, reactivity series, formation and properties of ionic compounds, basic metallurgical processes, corrosion and its prevention.

### **Periodic classification of elements**

Need for classification, modern periodic table, gradation in properties, valency, atomic number, metallic and non metallic properties

## **GK & ENGLISH**

Current affairs, history , geography and general science Verbs, Tenses:present/past/future forms,Active and Passive voice,Types of sentences: affirmative/interrogative sentences, use of noun/adjectives/adverbs/pronouns and prepositions, direct and indirect speech and comprehension paragraph, antonyms and synonyms and idioms and phrases.