Annexure - I
EAMCET AC 2016, SW-III
Syllabus

* In accordance to G.O.Ms.No: 16 Edn., (EC) Dept., Dt: 25th Feb' 04, EAMCET AC Committee has specified the syllabus of EAMCET AC-2016 as given hereunder.
* The syllabus is in tune with the syllabus introduced by the Board of Intermediate Education, A.P., for Intermediate course with effect from the academic year 2012-2013(Ist year) and 2013-2016 (2nd year) and is designed at the level of Intermediate Course and equivalent to (10+2) scheme of Examination conducted by Board of Intermediate Education, AP.
* The syllabus is designed to indicate the scope of subjects included for EAMCET AC. The topics mentioned therein are not to be regarded as exhaustive. Questions may be asked in EAMCET AC-2016 to test the student's knowledge and intelligent understanding of the subject.
* The syllabus is applicable to students of both the current and previous batches of Intermediate Course, who are desiring to appear for EAMCET AC-2016.

## Subject: MATHEMATICS

**I. ALGEBRA:** (a) Functions – Types of functions – Algebra of real valued functions (b) Mathematical induction and applications (c) Permutations and Combinations – linear and circular permutations – combinations. (d) Binomial theorem – for a positive integral index – for any rational index – applications – Binomial Coefficients. (e) Partial fractions (f) Exponential and logarithmic series (g) Quadratic expressions, equations and inequations in one variable. (h) Theory of equations – Relations between the roots and Coefficients in any equation – Transformation of equations – reciprocal equations. (i) Matrices and determinants – Types of matrices – Algebra of matrices – Properties of determinants – simultaneous linear equations in two and three variables – Consistency and inconsistency of simultaneous equations. (j) Complex numbers and their properties – De Moivre's theorem – Applications – Expansions of trigonometric functions.

**II. TRIGONOMETRY:** (a) Trigonometric functions – Graphs – periodicity (b) Trigonometric ratios of compound angles, multiple and sub-multiple angles, Transformations-sum and product rules (c) Trigonometric equations (d) Inverse trigonometric functions (e) Hyperbolic and inverse hyperbolic functions (f) Properties of Triangles (g) Heights and distances (in two-dimensional plane).

**III. VECTOR ALGEBRA :** (a) Algebra of vectors – angle between two non-zero vectors – linear combination of vectors – vector equation of line and plane (b) Scalar and vector product of two vectors and their applications c) Scalar and vector triple products, Scalar and vector products of four vectors.

**IV. PROBABILITY : (**a) Random experiments – Sample space – events – probability of an event – addition and multiplication theorems of probability – Conditional event and conditional probability - Baye's theorem (b) Random variables – Mean and variance of a random variable – Binomial and Poisson distributions

**V. COORDINATE GEOMETRY :** (a) Locus, Translation of axes, rotation of axes (b) Straight line (c) Pair of straight lines (d) Circles (e) System of circles (f) Conics – Parabola – Ellipse – Hyperbola – Equations of tangent, normal, chord of contact and polar at any point of these conics, asymptotes of hyperbola. (g) Polar Coordinates (h) Coordinates in three dimensions, distance between two points in the space, section formula, centroid of a triangle and tetrahedron. (i) Direction Cosines and direction ratios of a line – angle between two lines (j) Cartesian equation of a plane in (i) general form (ii) normal form and (iii) intercept form – angle between two planes (k) Sphere – Cartesian equation – Centre and radius

**VI. CALCULUS :** (a) Functions – limits – Continuity (b) Differentiation – Methods of differentiation (c) Successive differentia-tion – Leibnitz's theorem and its applications (d) Applications of differentiation (e) Partial differentiation including Euler's theo-rem on homogeneous functions (f) Integration – methods of integration (g) Definite integrals and their applications to areas – reduction formulae (h) Numerical integration – Trapezoidal and Simpson's rules (i) Differential equations – order and degree – Formation of differential equations – Solution of differential equation by variables seperable method – Solving homogeneous and linear differential equations of first order and first degree.

## Subject – PHYSICS

**I. MEASUREMENTS, UNITS AND DIMENSIONS :** Introduction- units and Dimensions, Accuracy, precision of measuring instruments, Constant errors, systematic errors, environmental errors (errors due to external causes). Error due to imperfec-tion, Random errors, Gross Errors, Absolute Errors, Mean absolute errors, Relative errors, percentage errors, Errors due to addition, subtraction, multiplication, division, powers of observed quantities, Significant figures, Fundamental and derived physical quantities / System of Units, definition of units in SI, Rules for writing units in SI, Derived units in SI, Multiple and submultiples of SI units, Dimensional formulae and dimensional equations, dimensional constants and dimensionless quan-tities. Principle of homogeneity of dimensions, Conversion of one system of units into another, to check correctness of an equation, to derive the relationship between different physical quantities.

**II. ELEMENTS OF VECTORS :** Classification of Physical quantities, geometrical representation of vectors, addition of vec-tors, equality of vectors, Resolution of a vector into components, null vector, unit vector in Cartesian co-ordinate system, position vector and its magnitude, Parallelogram law of addition of vectors, Derivation of expression for the magnitude and the direction of resultant vector, Special cases, Triangle law and polygon law of vectors, triangle law of addition of vectors, polygon law of addition of vectors, concept of relative velocity, application to relative motion of a boat in a river, motion of a boat across a river, shortest path, shortest time, Multiplication of vector with a scalar, product of two vectors, scalar product or dot product of two vectors, properties of scalar product, examples of scalar product, work done and energy, vector product of two vectors,

properties of vector product of two vectors, examples of vector product of two vectors - torque, angular velocity and angular momentum.

**III. KINEMATICS :** Introduction : Motion in a straight line – displacement, speed and velocity, Uniform and non-uniform motion, average speed and instantaneous velocity, Uniformly accelerated motion, velocity-time and position-time graphs, equations for uniformly accelerated motion (graphical treatment), acceleration due to gravity, equations of motion of a freely falling body, Equations of motion of an object vertically projected upwards from the ground, Maximum height (H), Time of ascent, time of descent, velocity of the body on returning to the point of projection, Vertical projection of an object from a tower, Projectiles – oblique projection from ground, equation of trajectory, maximum height, time of ascent, time of flight, horizontal range, two angles of projection for the same range, velocity of projection at any instant, horizontal projection from the top of a tower, equation of trajectory, time of descent, range, velocity of the projectile (at any instant).

**IV. DYNAMICS :** Introduction- Newton's laws of motion, applications of Newton's laws. Objects suspended by strings, Atwood machine, blocks placed in contact with each other on frictionless horizontal surface, apparent weight in a lift, Impulse, law of conservation of linear momentum, conservation of linear momentum during collision, work, power, energy, K.E. & P.E. defini-tion and derivation for both, Relation between KE and Linear momentum, conservative and non-conservative forces, work-energy theorem, Law of conservation of energy in case of freely falling body and vertically projected body.

**V. COLLISIONS:** Introduction – Elastic and inelastic collisions, Collisions in one dimension (Elastic collision only), body at rest, bodies moving in same direction and opposite directions, Co-efficient of restitution, definition, equation for height attained for freely falling body after number of rebounds on floor.

**VI. CENTRE OF MASS (CM)**: Introduction- Centre of mass, difference between centre of mass and centre of gravity, co-ordinates of centre of mass, centre of mass of particles along a line, centre of mass of system of particles in a plane, center of mass of system of particles in space, motion of centre of mass (Velocity and acceleration of CM), characteristics of centre of mass, laws of motion of the centre of mass, velocity and acceleration, explosion.

**VII. FRICTION :** Introduction - cause of friction, advantages of friction, disadvantages of friction, methods of reducing friction, types of friction, static friction, kinetic (or) dynamic friction, rolling friction, Distinction between static and dynamic friction. Normal reaction, laws of friction, static friction, kinetic friction or Dynamic friction, Rolling friction, Angle of friction, motion of body on rough horizontal plane, motion of bodies on an inclined plane, Body at rest on the plane-Angle of repose-when the body is just ready to slide, when the body is sliding down. Motion of a body on smooth and rough inclined plane, body sliding down the plane, body sliding up the plane, pushing and pulling of a lawn roller. A lawn roller on a horizontal surface pulled by an inclined force, a roller on horizontal surface pushed by an inclined force.

**VIII. ROTATORY MOTION :** Introduction, uniform circular motion, concept of angular displacement, angular velocity and angular acceleration, relation between linear velocity and angular velocity, centripetal acceleration and force, torque, couple (concepts, units, dimensional formula and examples), Vector representation of torque, Moment of Inertia(MI), definition, units, parallel and perpendicular axes theorems. Expressions for MI of a thin rod, uniform disc, rectangular lamina, solid and hollow spheres, circular ring and cylinder (no derivations needed), angular momentum, relation between angular momentum and torque, law of conservation of angular momentum with examples, Motion in vertical circle.

**IX. GRAVITATION:** Introduction- Basic forces in nature, Nature of gravity, law of universal gravitation, Relation between Univer-sal gravitational constant (G) and acceleration due to gravity (g), variation of 'g' with altitude, depth, latitude and shape of the earth, characteristics of gravitational force, limitations of Newton's third law, gravitational field, field strength, properties of gravitational fields, Origin of black holes, Chandrashekar limit, neutron star, Frames of reference, Inertial and Non- Inertial frames, Inertial and Gravitational mass & relation between them, Principle of equivalence, Escape and Orbital velocities, definition, derivation of expressions and relation between them, Geostationary satellites and their uses.

**X. SIMPLE HARMONIC MOTION (SHM):** Introduction- simple harmonic motion examples, SHM explanation by reference circle, expression for displacement, amplitude, velocity, acceleration, time period, frequency, phase, initial phase (epoch) - Simple pendulum, expression for time period, loaded spring, expression for time period, force constant, PE and KE of simple harmonic oscillator, Total Energy of Simple Harmonic Oscillator, Law of conservation of energy in the case of a simple pendulum.

**XI. ELASTICITY:** Introduction- Elasticity and plasticity, stress, strain, Hook's law, Moduli of elasticity, Poisson's ratio, defini-tion and its limit, Behavior of a wire under gradually increasing load- Elastic fatigue, strain energy - experimental determination of Young's modulus of wire.

**XII. SURFACE TENSION:** Introduction - surface tension, definition - Examples, molecular theory of surface tension. Surface energy, Angle of contact, capillarity-examples in daily life, Determination of surface tension by capillary rise method – theory and experiment. Effect of temperature on surface tension, excess pressure in liquid drops and soap bubbles.

**XIII. FLUID MECHANICS:** Introduction - Principle of Buoyancy- pressure in a fluid - Streamline flow – Bernoulli's theorem - equation with derivation – applications-aerodynamic lift, motion of a spinning ball, Illustrations of Bernoulli's theorem.

Viscosity – explanation, coefficient of viscosity, effect of temperature on viscosity, Poiseuille's equation, Motion of objects through fluids. Stokes formula, net force on the object, terminal velocity.

**XIV. TEMPERATURE AND THERMAL EXPANSION OF MATERIALS:** Introduction- concept of temperature, Measurement of temperature, Fahrenheit, Centigrade scales of temperature, their relation (only formulae)- Different types of thermometers (brief theoretical description). Vibration of atoms in a solid, PE curve, Anharmonicity of vibrations, explanation for expansion in solids. Coefficients of linear, areal and cubical expansion, definitions, Expressions & Relation between these coefficients of expansions, change of density with temperature, examples in daily life.

Introduction- coefficients of real and apparent expansion of liquids, relation between them with derivation, Determination of coefficient of apparent expansion of liquids by specific gravity bottle method, Anomalous expansion of water, its significance

in nature.

Introduction - volume and pressure coefficients of gases, relation between them and derivation. Determination of volume coefficient-Regnault's method. Determination of pressure coefficient-Jolly's bulb method. Kelvin scale of temperature, Boyle's and Charle's laws. Ideal gas equation, derivation, significance of Universal gas constant.

**XV. THERMODYNAMICS:** Introduction - Quasi-static and cyclic process, reversible and irreversible processes, Heat and Temperature, Zeroeth law of Thermodynamics, definition of Calorie, Joule's law and mechanical equivalent of heat, Internal energy, First law of thermodynamics, equation and explanation. Heat capacity, specific heat, experimental determination of specific heat by the method of mixtures. Specific heats of a gas ($C_p$ and $C_v$), External work done by a gas during its expansion. Relation between $C_p$ and $C_v$ derivation, Isothermal and adiabatic processes. Relation between P, V and T in these processes.

Expression for work done in Isothermal process (no derivation), expression of work done in adiabatic process (no derivation). Heat engines and refrigerators (only qualitative treatment). Three phases of matter, Triple point – Triple point of water. Latent heat, Determination of latent heat of vaporization of water, Second law of thermodynamics – different statements.

**XVI. TRANSMISSION OF HEAT:** Introduction - conduction of heat, coefficient of thermal conductivity, convection- Type of convections, Nature and properties of Thermal radiation, Prevost's theory of heat exchange - emission power and absorptive power - Black body radiation, Kirchoff's law and its applications – Stefan's law – Newton's law of cooling.

**XVII. WAVE MOTION:** Longitudinal and transverse waves, Equation for a progressive wave, principle of superposition of waves, reflection of waves, Formation of waves on a stretched string, laws of vibrating strings, experimental verification by Sonometer, Sound: Characteristics of sound, speed of sound in solids, liquids and gases (only formula to be given), Forced Vibrations, Free Vibrations, Resonance with examples, standing waves in Organ Pipes, Open Pipes, Closed Pipes, Funda-mental frequency-Overtones, Harmonics, definition and explanation, Beats definition and its importance. Doppler Effect, Definition, derivation of relation for apparent frequency of a sound note emitted by a source for the cases a) only source is moving, b) only listener is moving, c) both source and listener are moving. Applications and limitations of Doppler Effect-Echoes, Absorption of sound waves, Reverberation – Reverberation Time, Fundamentals of building Acoustics – Statement of Sabine's Law.

**XVIII. OPTICS:** Nature of Light, Newton's corpuscular Theory, Huygen's Wave Theory- Electromagnetic spectrum. Huygen's Explanation of Reflection and Refraction of plane waves at a plane surface. Refraction through prism, Derivation of Refractive index of material of prism for minimum deviation, critical angle, Total Internal Reflection, Relation between Critical angle and Refractive Index, application of total internal reflection to Optical fibers. Defects in Images: Spherical and Chromatic aberrations and reducing these defects, Different methods (qualitative treatment). Optical Instruments: Microscope, Telescope, Formula for magnification of Microscope, Astronomical and Terrestrial Telescopes. Construction of Ramsden's and Huygen's eye pieces with ray diagrams. Dispersion of light, dispersive power, pure and impure spectra, condition for obtaining pure spectrum, different kinds of spectra– Emission spectra, Line, Band and continuous spectra, absorption spectra, Fraunhofer lines and their significance.

**XIX. PHYSICAL OPTICS:** Interference – condition for interference, Young's double slit experiment – Derivation for Intensity and fringe width – Uses of interference, Diffraction: Fresnel and Fraunhofer diffraction (Qualitative only). Polarisation: Concepts of Polarisation. Plane Polarisation of Light by Reflection, Refraction and Double Refraction (Polaroids).

**XX. MAGNETISM:** Coulomb's Inverse Square Law, Definition of Magnetic Field, Magnetic Lines of Force- Uniform and Non – Uniform Magnetic Fields. Couple acting on a bar magnet placed in a uniform magnetic field, Definition of magnetic moment of magnet. Magnetic Induction due to a bar magnet on axial and equatorial lines. Superposition of magnetic fields, Tangent Law, Deflection Magnetometer. Comparison of Magnetic Moments in Tan A, Tan B positions by equal distance method and Null Method, Verification of Inverse Square Law. Vibration Magnetometer- Principle and Description, Experimental determination of M and $B_H$ (earth's horizontal component) using Vibration Magnetometer. Types of magnetic materials – Para, Dia, and Ferro Magnetism – Definition and properties.

**XXI. ELECTROSTATICS:** Charges – conservation of charge and additive property of charges. Coulomb's Law : Permittivity of Free Space and Permittivity of Medium, Force between two point charges. Force due to multiple charges – Principle of superposition with examples. Electric field, Electric lines of force, their properties, Electric field intensity definition, electric intensity due to isolated charge and due to multiple charges. Electrostatic Potential, Definition of Electrostatic Potential in an electric field- Potential due to single charge and multiple charges, Electrostatic potential energy- Relation between electro-static potential and electric intensity.

Electric Flux & Gauss Law: Electric Flux Definition, Gauss Law-Statement of Gauss Law, Application of Gauss Law to find electric intensity and electrostatic Potential due to continuous charge distribution of Infinite Long wire, Infinite Plane Sheet and Spherical Shell. Capacitance, Definition of Electrical Capacity of a Conductor, Capacitance, Dielectric constant, Definition of Condenser, its uses, Parallel plate Condenser, Formula for Capacitance of Parallel Plate Condenser, Dielectric, Dielectric Strength, Effect of dielectric on capacitance of capacitor. Capacitors in series and in parallel: derivation of the equivalent capacitance for the above cases. Energy stored in a Condenser, Effect of dielectric on Energy of Condenser, Types of capaci-tors, their uses.

**XXII. CURRENT ELECTRICITY:** Electric current – Flow of Electric charges in a metallic conductor, Drift velocity and mobility, Relation between electric current and drift velocity. Ohm's Law: Statement, Ohmic and Non-Ohmic elements with examples, Conductance, Specific resistance, Variation of resistivity with temperature, Variation of Resistance with temperature, Ther-mistor. E.M.F. of Cell – Internal resistance and back E.M.F., Difference between EMF of a Cell and potential difference. Electrical energy, Power definition of kWh. Kirchhoff's laws: Statement of Kirchhoff's voltage law, Kirchhoff's current law, their application to Wheatstone bridge, condition for balancing, Meter bridge, Determination of resistance of a conductor using meter bridge. Principle of Potentiometer determination of internal resistance and E.M.F. of a cell using potentiometer. Series and parallel combination of cells – Derivation of equivalent EMF for the above cases.

**XXIII. THERMOELECTRICITY:** Introduction- Seebeck effect, Peltier and Thomson effects and their coefficients. Variation of themo EMF with temperature, Neutral and Inversion Temperatures. Applications of Thermo- Couple.

**XXIV. ELECTROMAGNETICS:** Oersted's Experiment, Biot – Savart Law, Ampere's Law, Magnetic field near a long straight wire and magnetic field at the Center of a circular coil carrying current (with derivations). Field on the axis of circular coil carrying current (expression only). Tangent Galvanometer (TG), Principle and working, Definition of Reduction Factor. Force on a moving charge in a magnetic field, Force on a current carrying conductor placed in a magnetic field, Force between two long straight parallel conductors carrying current, Definition of Ampere, Fleming's Left Hand Rule, Current loop as a magnetic dipole, force and Torque on Current loop in an uniform magnetic field, magnetic dipole moment of a revolving electron. Prin-ciple, Construction and working of Moving Coil Galvanometer (MCG), Converting MCG into ammeter and voltmeter, compari-son of MCG with TG. Electromagnetic induction, Magnetic Flux, Induced EMF, Faraday's and Lenz's Laws. Fleming's Right Hand Rule, Self Inductance, Mutual Inductance, Principle of Transformer.

Growth & decay of current in L-R circuit with DC source, Growth and decay of charge in R.C. Circuit connected to DC source, Equations for charge on condenser – Current in inductor, Time constant, Definition and its significance. Alternating current (A.C), Introduction – Instantaneous, maximum and RMS value of A.C. current, Alternating Voltage applied to a pure resistor, pure inductor, pure capacitor, AC through C-R, L-R and L-C-R series circuits.

**XXV. ATOMIC PHYSICS:** Discovery of electron, e/m of electron by Thomson's method, Charge of the electron by Millikan's Oil Drop Method (Principle Only). Photo Electric Effect : Definition, Laws of Photoelectric Emission, Einstein's explanation of Photoelectric effect, Einstein's Photo electric equation and its experimental verification by Milikan's method. Photo Electric Cells, working and uses. X- Rays- Production of X- Rays, Coolidge tube, X- ray spectrum, Continuous X-Ray Spectra, Characteristic X – Ray Spectra, Moseley's Law and its importance. Compton effect (Statement only), Dual nature of matter, de Broglie's hypothesis (concept only).

**XXVI. NUCLEAR PHYSICS:** Composition and size of nucleus, mass defect and binding energy and their relation (Explanation with examples). Natural radio activity – alpha, beta and gamma radiations and their properties, radio active decay law, half life and average life of a radio active substance, Nuclear forces – Their Properties, Artificial Transmutation of elements, Discovery of Neutron, Radio Isotopes and their uses. Nuclear Fission, Chain Reaction, Principle and Working of a Nuclear Reactor, Nuclear Radiation Hazards, Protective shielding, Types of reactors – Breeder Reactor, Power Reactor and their uses. Nuclear Fusion, Energy of Sun and stars, Carbon – Nitrogen cycle and proton – proton cycle, Elementary particles.

**XXVI. SEMI CONDUCTOR DEVICES:** Introduction- Intrinsic and extrinsic semi conductors (n and p type). Junction diode, p -n junction, depletion layer and barrier potential, Forward and Reverse bias, and Current -voltage characteristics of junction diode, p –n Diode as half wave and full wave rectifier (only qualitative treatment), Zener Diode as a voltage regulator.Transistor Function of Emitter, Base and Collector, p-n-p and n-p-n Transistors, Biasing of Transistors, Current – Voltage Characteristics of Transistor in CE configuration, Transistor as common emitter amplifier (qualitative treatment), Logic Gates - OR, AND , NOT, NOR, NAND

**XXVII. COMMUNICATION SYSTEMS:** Elements of communication systems (block diagram only), Bandwidth of signals (Speech, TV and digital data), bandwidth of Transmission medium. Popagation of electromagnetic waves in the atmosphere, sky and space wave propagation, Modulation, Need for modulation.

## Subject: CHEMISTRY

**I. ATOMIC STRUCTURE:** Characteristics of electron, proton and neutron. Rutherford model of an atom. Nature of electro-magnetic radiation. Planck's quantum theory. Explanation of photo electric effect. Dual behavior of electromagnetic radiation. Features of atomic spectra – Emission and absorption spectra. Characteristics of hydrogen spectrum. Bohr's theory of the structure of atom – Postulates. Bohr's theory of hydrogen atom, Energy of an electron. Bohr's explanation of spectral lines. Failure of Bohr's theory. Wave-particle nature of electron. De Broglie's hypothesis, Heisenberg's uncertainty principle. Impor-tant features of the quantum mechanical model of an atom – Meaning and significance of wave function. Quantum numbers, concept of orbitals, definition of atomic orbital in terms of quantum numbers - shapes of s, p and d orbitals, Aufbau principle, Pauli's exclusion principle and Hund's rule of maximum multiplicity. Electronic configuration of atoms. Explanation of stability of half filled and completely filled orbitals.

**II. CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES:** Concept of grouping the elements in accor-dance to their properties – Mendeleef's Periodic Table. Periodic law – Mendeleef's classification of elements. Significance of atomic number and electronic configuration as the basis for periodic classification. Classification of elements into s, p, d, f blocks and their main characteristics. Periodic trends in physical and chemical properties of elements: Atomic radii, Ionic radii, Inert gas radii, Ionization energy, Electron gain energy, Electronegativity and Valency. Variation of oxidation states, Electropositivity – Metallic and Non-metallic nature, Nature of Oxides, Diagonal relationship. Variation of atomic radii in inner transition elements.

**III. CHEMICAL BONDING AND MOLECULAR STRUCTURE:** Kossel -Lewis approach to chemical bonding. Factors favor-able for the formation of ionic bond, energy changes in ionic bond formation. Crystal lattice energy - calculation of lattice energy – Born - Haber cycle. Crystal structure of sodium chloride and Caesium chloride, Coordination number. Properties of ionic compounds. Covalent bond - VSEPR theory – Lewis representation of covalent compounds, Formal charge, geometry of simple molecules. The valence bond approach for the formation of covalent bonds. Directional properties of covalent bond. Properties of covalent bond. Hybridization - different types of hybridization involving s, p and d orbitals. Shapes of simple covalent molecules. Definition of coordinate covalent bond with examples. Molecular orbital theory of homonuclear diatomic molecules. Symmetry and energy of sigma and pi bonding and antibonding molecular orbitals. Molecular orbital energy diagram of H , N and O . Concept of hydrogen bond and its types with examples. Effect of hydrogen bonding on properties

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of compounds.

**IV. STOICHIOMETRY:** Laws of chemical combination – Principles and examples. Molar mass, concept of equivalent weight with examples. Percentage composition of compounds and calculation of empirical and molecular formulae of compounds. Chemical reactions and Stoichiometric equations. Oxidation number concept. Balancing of redox reactions by ion electron method and oxidation number method. Types of redox reactions. Applications of redox reactions in titrimetric quanti-tative analysis. Redox reactions and electrode processes.

**V. STATES OF MATTER: GASES AND LIQUIDS :** Graham's law of diffusion, Dalton's law of partial pressures, Avogadro's law. Ideal behavior, empirical derivation of gas equation, ideal gas equation. Kinetic molecular theory of gases. Kinetic gas equation (No derivation) - deduction of gas laws. Distribution of molecular velocities and types of molecular velocities
– Average, Root Mean Square and Most Probable Velocity. Behavior of real gases, deviation from ideal behaviour, compressibility factor versus pressure diagrams of real gases. Conditions for liquification of gases, critical temperature. Liquid state – Properties of liquids in terms of intermolecular attractions. Vapour pressure, viscosity and surface tension
(qualitative idea only, no mathematical derivation)

**VI. SOLUTIONS:** Classification of solutions, molarity, normality, molality and mole fraction. Dilute solutions, vapour pressure, Raoult's law, Limitations of Raoult's law. Colligative properties – (i) Relative lowering of vapour pressure (ii) Elevation of B.P (iii) Depression in freezing point and their relation to molar mass. Osmosis and osmotic pressure - theory of dilute solutions. Determi- nation of molar mass using colligative properties: Ostwald's dynamic method, Cottrell's method, Rast's method and Berkeley Hartley's method. Abnormal molecular mass.

**VII. ELECTRO CHEMISTRY:** Conductance in electrolytic solutions. Specific, Equivalent and Molar conductance - variation of conductance with concentration, Kohlrausch's law and its application to calculation of equivalent conductance of weak electrolytes. Electrolytes and non-electrolytes, redox reactions. Electrolysis. Some typical examples of electrolysis viz; Fused Sodium hydroxide, Fused sodium chloride, Brine solution, Fused Magnesium chloride. Faraday's laws of electrolysis and applications. Galvanic and voltaic cells. Representation and notation of electrochemical cells with and without salt bridge. Standard hydrogen electrode, electrode potentials, electrochemical series.EMF of the cell, Nernst equation and its application to calculate EMF of electrochemical cells. Primary cell - dry cell / Lechlanche cell. Secondary cells - Fuel cells: Hydrogen - Oxygen fuel cell and Hydrocarbon - Oxygen fuel cell. Corrosion: mechanism, factors to promote corrosion and prevention of corrosion, passivity. Lead accumulator.

**VIII. SOLID STATE**: Classification of solids based on different binding forces as molecular, ionic, covalent, and metallic solids. Elementary treatment of metallic bond. Metallic solids, amorphous and crystalline solids. Unit cell in two dimensional and three dimensional lattices. Seven crystal systems, Bravais lattices.

Bragg's equation, X-ray study of crystal structure, Bragg's method. Calculation of density of unit cell, packing in solids, voids, number of atoms per cubic unit cell. Point defects - Schottky and Frenkel defects. Electrical and magnetic properties.

**IX. CHEMICAL KINETICS:** Concepts of reaction rate, factors affecting reaction rates. Rate law, Units of rate constant. Order and molecularity. Methods of determination of order of a reaction. Integrated rate equations and half lives for zero and first order reaction Collision theory of reaction rates (elementary ideas).

Concept of activation energy. **Equilibrium:** Equilibrium in physical and chemical processes, dynamic nature of equilibrium, Law of mass action, equilibrium constant. Factors affecting equilibrium. Relation between Kp and Kc. Le Chatelier's principle, application to industrial synthesis of (i) Ammonia (ii) Sulphur trioxide. **Acids and Bases:** Lowry-Bronsted acid base theory. Lewis theory, limitation of Lewis theory, Ionic equilibrium. Ionization of acids and bases, strong and weak electrolytes, degree of ionization. Ionic product of water. Concept of pH. Hydrolysis of salts (elementary idea), hydrolysis constant, buffer solutions. Solubility product and common ion effect with illustrative examples.

**X. THERMODYNAMICS:** Concept of system, types of systems, surroundings, work, heat, energy, extensive and intensive proper-ties, state functions. First law of thermodynamics - Internal energy and Enthalpy. Heat capacity and Specific heat, Exothermic and Endothermic reactions, measurement of $\Delta E$ and $\Delta H$, Enthalpy of bond dissociation, combustion, neutralization, formation, atomi- zation, sublimation, phase transition, ionization and dilution. Thermo chemical equations. Hess's law of constant heat summation. Driving force for a spontaneous process. Thermodynamic representation of criteria of spontaneity in terms of entropy, entropy as a state function. Gibbs free energy, Gibbs free energy change for spontaneous, non spontaneous and equilibrium processes.

**XI. SURFACE CHEMISTRY:** Adsorption: Physical and chemical adsorption, adsorption of gases on solids, factors affecting it - pressure (Langmuir and Freundlich Isotherms) and temperature. Catalysis - types of catalysis, autocatalysis. Colloidal state: colloidal solutions, classification of colloidal solutions, protective colloids and Gold number, Properties of colloids - Tyndall effect, Brownian movement. Coagulation. Emulsions, classification of emulsions, micelles, cleansing action of soap.

**XII. HYDROGEN AND ITS COMPOUNDS:** Position of hydrogen in periodic table. Occurrence, isotopes of hydrogen. Hydrogen - Preparation, properties and uses including as a fuel. Reactions of hydrogen leading to ionic, molecular and non - stoichiomet-ric hydrides. Physical and Chemical properties of water and heavy water. Hardness of water and its removal Hydrogen peroxide
– methods of preparation, physical and chemical properties - oxidation, reduction, decomposition, disproportionation and addition reactions. Detection, structure and uses of Hydrogen Peroxide.

**XIII. ALKALI AND ALKALINE EARTH METALS:** Electronic configuration, occurrence, Anomalous properties of the first element in each group. Diagonal relationship. Trends in properties like ionization enthalpy, atomic and ionic radii, reac-tivity with oxygen, hydrogen, halogens and water, uses of alkali and alkaline earth metals. Preparation, properties and uses of sodium hydroxide, salts of oxo acids, sodium carbonate, sodium hydrogen carbonate and sodium chloride. Preparation and uses of Calcium oxide, Calcium carbonate and Calcium sulphate. Biological importance of Na, K, Mg and Ca.

**XIV. p-BLOCK ELEMENTS: GROUP 13 ELEMENTS: (IIIA GROUP ELEMENTS):** Electronic configuration, occurrence. Variation of properties and oxidation states, trends in chemical reactivity. Anomalous properties of first element of the group. Boron- Physical

and chemical properties and uses of boron. Borax, boric acid and boron hydrides. Preparation, structure and properties of diborane. Aluminum: uses, reactions with acids and alkalis. Potash alum.

**XV. p-BLOCK ELEMENTS: GROUP 14 ELEMENTS: (IVA GROUP ELEMENTS):** Electronic configuration, occurrence. Variation of properties and oxidation states, trends in chemical reactivity. Anomalous behavior of first element. Carbon - catenation, allotropic forms, physical and chemical properties and uses.

Similarities between carbon and silicon, uses of oxides of carbon. Important compounds of Silicon - Silicon dioxide, Silicon tetrachloride, silicones, silicates and zeolites. Manufacture and uses of Producer gas and Water gas.

**XVI. p- BLOCK ELEMENTS: GROUP 15 ELEMENTS (VA GROUP ELEMENTS):** Occurrence - physical states of nitrogen and phosphorous, allotropy, catenation electronic configuration, oxidation states. General characteristics and structure of hydrides. General characteristics of oxides and halides. Oxoacids of nitrogen and phosphorous. Preparation and uses of nitric acid and Ammonia. Super phosphate of lime.

**XVII. p- BLOCK ELEMENTS: GROUP 16 ELEMENTS (VIA GROUP ELEMENTS):** Occurrence, electronic configuration, oxidation states, physical states of oxygen and sulphur, their structure and allotropy. General characteristics of hydrides, oxides and halides. Structural aspects of oxy acids of chalcogens. Preparation, properties and uses of Ozone and sodium thiosulphate. Industrial process for manufacture of sulphuric acid.

**XVIII. P- BLOCK ELEMENTS: GROUP 17 ELEMENTS (VIIA GROUP ELEMENTS):** Occurrence, electronic configuration and oxidation states. Physical states of halogens. Ionization Potential, Electro negativity, Electron affinity, bond energies, chemical reactivity, oxidizing power of fluorine and chlorine. Structural aspects of oxy acids of chlorine. Preparation, properties and uses of fluorine, chlorine and bleaching powder. Structures of Inter halogen compounds.

**XIX. GROUP 18 ELEMENTS: (ZERO GROUP ELEMENTS):** Electronic configuration, occurrence and isolation. Trends in physical and chemical properties and uses. Structures of Xenon oxides and halides.

**XX. TRANSITION ELEMENTS:** General introduction, electronic configuration, occurrence and characteristics of transition met- als. General trends in properties of first row transition elements - metallic character, ionization energy, variable oxidation states, atomic and ionic radii, color, catalytic property, magnetic property, interstitial compounds and alloy formation. **Lanthanides:** Elec- tronic configuration, variable oxidation states, chemical reactivity and lanthanide contraction. **Coordination compounds:** Introduc- tion, ligands, coordination number, Werner's theory of coordination compounds, shapes of coordination compounds - Valence bond theory, IUPAC nomenclature of mono nuclear coordination compounds, bonding, isomerism, EAN rule, importance of coordination compounds in qualitative analysis, extraction of metals and biological systems (chromo proteins, haemoglobin, chlorophyll: structures only).

**XXI. GENERAL PRINCIPLES OF METALLURGY:** Principles and methods of extraction - concentration, reduction by chemical and Electrolytic methods and refining. Occurrence and principles of extraction of Copper, Zinc, Iron and Silver. Molten electrolysis processes of Aluminium, Magnesium and Sodium.

**XXII. ENVIRONMENTAL CHEMISTRY:** Definition of terms, types of Pollution, Air, Water and Soil pollution. Oxides of carbon, carbon monoxide, oxides of nitrogen and sulphur, chloro fluoro carbons. Chemical reactions in atmosphere, smogs, major atmo- spheric pollutants, acid rain. Ozone and its reactions, effects of depletion of ozone layer. Green house effect and global warming. Pollution due to industrial wastes. Green chemistry as an alternative tool for reducing pollution with two examples.

**XXIII. BASIC PRINCIPLES AND TECHNIQUES IN ORGANIC CHEMISTRY:**

Methods of purification, qualitative and quantitative analysis of organic compounds. Classification and IUPAC nomenclature of organic compounds. Homolytic and heterolytic fission of covalent bond. Types of regents – electrophiles, nucleophiles and free radicals with examples. Reactive intermediates. Types of organic reactions - substitution, addition, elimination and rearrangement reactions with examples. Inductive effect, electromeric effect, resonance and hyperconjugation.

**XXIV. HYDROCARBONS:** Classification of hydrocarbons. **Alkanes** - Nomenclature, isomerism. Methods of preparation of ethane. Conformations of ethane. Physical properties, chemical reactions including free radical mechanism of halogenation, Combustion and Pyrolysis of ethane. **Cycloalkanes :** Preparation and properties of cyclohexane. **Alkenes** - Nomenclature, structure of ethene, geometrical isomerism and physical properties of geometrical isomers. Ethylene: Methods of preparation, physical properties and chemical reactions - addition of hydrogen, halogen, water, hydrogen halides (Markovnikov's addition and peroxide effect), Ozonoly-sis and oxidation. Mechanism of electrophilic addition.

**XXV: ALKYNES & AROMATIC HYDROCARBONS:** Nomenclature, structure of triple bond. Acetylene - Methods of preparation, Physical properties and chemical reactions: acidic character of acetylene, addition reaction of - hydrogen, halogens, hydrogen halides and water. **Aromatic hydrocarbons:** Introduction, IUPAC nomenclature; Benzene: resonance and aromaticity, Chemical properties: Mechanism of electrophilic substitution - Nitration, Sulphonation, Halogenation, Friedel Craft's alkylation and Acylation. Directive influence of functional group in mono substituted benzene. Carcinogenicity and toxicity of aromatic compounds.

**XXVI: STEREO CHEMISTRY:** Optical activity-discovery, determination using a polarimeter, specific rotation. Asymmetric carbon, elements of symmetry. Chirality - Chiral objects, Chiral molecules. Compounds containing one chiral centre, enantiomers, Fischer projections and Configuration. D-L and R-S nomenclature, racemic forms, racemisation and resolution. Compounds containing two chiral centers, diastereomers, meso form.

**XXVII : HALOALKANES & HALOARENES: Haloalkanes:** Nomenclature, nature of C-X bond, Preparation, physical and chemical properties of ethyl chloride and chloroform. Mechanism of $S_{N}1$, and $S_{N}2$ reactions. **Haloarenes:** Nature of C-X bond, Preparation and Substitution reactions of chlorobenzene (directive influence of halogen for mono substituted compounds only).

**XXVIII. ALCOHOLS , PHENOLS AND ETHERS: Alcohols**: Nomenclature, methods of preparation, physical and chemical properties of ethyl alcohol. Mechanism of dehydration. Identification of primary, secondary and tertiary alcohols. Uses of methanol and ethanol. **Phenols:** Nomenclature, methods of preparation and physical and chemical properties of phenol, acidic nature of phenol. Electrophilic substitution reactions and uses of phenol. **Ethers:** Nomenclature, methods of preparation, physical and chemical properties and uses of diethyl ether.

**XXIX: ALDEHYDES AND KETONES:** Nomenclature, and nature of carbonyl group. Methods of preparation, physical and chemical

properties and uses of acetaldehyde and acetone. Mechanism of nucleophilic addition. Aldol and crossed aldol condensation, Cannizzaro reaction.

**XXX. CARBOXYLIC ACIDS:** Nomenclature and acidity of carboxylic acids. Methods of preparation, Physical and chemical properties and uses of acetic acid.

**XXXI. ORGANIC COMPOUNDS CONTAINING NITROGEN: Nitrobenzene:** Preparation, properties and uses. **Amines:** Nomenclature and classification of amines. Structure, methods of preparation, physical and chemical properties and uses of Aniline. Identification of primary, secondary and tertiary amines. **Diazonium salts:** Preparation, chemical reactions and impor-tance of diazonium salts in synthetic organic chemistry. Azo dyes and their uses.

**XXXII. POLYMERS & BIOMOLECULES:** Classification of polymers. Addition and condensation polymerization. Copolymeriza-tion. Natural rubber, vulcanization of rubber, synthetic rubber – Neoprene and Buna- S. Molecular weights of polymers - Number average and weight average molecular weights (definition only) Biopolymers – Carbohydrates and Proteins. Biodegradable poly-mers and some commercially important polymers – Polythene, nylon, polyesters and bakelite. **Carbohydrates:** Importance. Classification into (a) aldoses and ketoses and (b) mono (glucose and fructose), oligo (sucrose, lactose, maltose) and polysaccha-rides (starch, cellulose, glycogen). Structure determination and properties of glucose. Structural features of oligo and polysaccha-rides mentioned above. **Proteins:** Elementary idea of Alpha amino acids, peptide bond, polypeptides and proteins. Primary, secondary, tertiary and quaternary structures of Proteins (Qualitative idea only). Denaturation of proteins; enzymes. **Vitamins:** Classification and functions of vitamins in biosystems. **Nucleic Acids:** Types of nucleic acids, primary building blocks of nucleic acids. Chemical composition of DNA & RNA, Primary structure of DNA and its double helix. Replication. Transcription, protein synthesis and genetic code. **Lipids:** Classification, structure and functions of lipids in biosystems. **Hormones:** Classifica-tion, structural features and functions of hormones in biosystems.

**XXXIII. CHEMISTRY IN EVERYDAY LIFE: Uses of Chemicals in medicine:** Analgesics : Narcotics (morphine, codeine). Non-narcotics (Aspirin, Ibuprofen). Antipyretics (Analgin, phenacetin and paracetamol). Tranquilizers (Barbituric acid, Luminal, seconal, valium). Antiseptics (Chloroxylenol, bithional), Disinfectants (formalin). Antimicrobials (lysozyme, lactic acid, hydrochloric acid in stomach). Antibiotics (pencillin, chloramphenicol, sulphadiazine). Chemicals in food preservatives (sodium benzoate, potassium metabisulphite). Artificial sweetening agents (Aspartame, alitame, sucralose).

## ANNEXURE -

## MODEL QUESTIONS – MATHEMATICS

1. If $y = \sin^{-1} x$ then $(1-x^2)\frac{d^2y}{dx^2} =$

(1) $-x\frac{dy}{dx}$ (2) 0 (3) $x\frac{dy}{dx}$ (4) $x\left(\frac{dy}{dx}\right)^2$

2. If $\alpha,\beta,\gamma$ are the roots of the equation $x^3-10x^2+7x+8 = 0$, then observe the following lists:

| | List A | List B |
|---|---|---|
| (I) | $\alpha + \beta + \gamma$ | (a) - 43/4 |
| (II) | $\alpha^2 + \beta^2 + \gamma^2$ | (b) – 7/8 |
| (III) | $\alpha^{1+} \beta^{\frac{1}{}} + \gamma^{\frac{1}{}}$ | (c) 86 |
| | | (d) 0 |
| (IV) | $\frac{\alpha}{\beta\gamma} + \frac{\beta}{\gamma\alpha} + \frac{\gamma}{\alpha\beta}$ | (e) 10 |

The correct matching of List (A) from List (B) is:

| | I | II | III | IV |
|---|---|---|---|---|
| (1) | e | c | a | b |
| (2) | e | c | b | a |
| (3) | d | c | a | b |
| (4) | e | b | c | a |

3. An aeroplane flying with uniform speed horizontally one kilometer above the ground is observed at an elevation of $60^0$. After 10 seconds if the elevation is observed to be $30^0$, then the speed of the plane (in km/hr) is

(1) $\frac{240}{\sqrt{3}}$ (2) $200\sqrt{3}$ (3) $240\sqrt{3}$ (4) $\frac{120}{\sqrt{3}}$

4. If $P_n$ is the probability of getting the sum 'n' when two unbiased dice are thrown simultaneously then

(1) $P_5 < P_8 < P_{10} < P_{11}$ (2) $P_{10} < P_5 < P_{11} < P_8$

(3) $P_{11} < P_{10} < P_5 < P_8$ (4) $P_{11} < P_{10} < P_8 < P_5$

5. If $\int \frac{dx}{(x+2009)\sqrt{x+2008}} = f(x)+c$ then f(x) =

(1) $2(x+2008)^{1/2}$ (2) $3(x+2008)^{1/2}$

(3) $2\tan^{-1}\sqrt{(x+2009)}$ (4) $2\tan^{-1}\sqrt{(x+2008)}$

## MODEL QUESTIONS - PHYSICS

1. If the force is given by $F=at+bt^2$ with 't' as time, then dimensions of 'a' and 'b' are: (1) $MLT^{-4}$, $MLT^{-2}$ (2) $MLT^{-3}$, $MLT^{-4}$

(3) $ML^2T^{-3}$, $ML^2T^{-2}$ (4) $ML^2T^{-3}$, $ML^3T^{-4}$

2. A bomb moving with velocity $(40\hat{i} + 50\hat{j})$ m/sec explodes into two pieces of mass ratio 1:4. After explosion the smaller piece moves away with velocity $(200\hat{i} + 70\hat{j} + 15\hat{k})$ m/sec. The velocity of larger piece after explosion is:

(1) $45\hat{j} - 35\hat{k}$ (2) $45\hat{i} - 35\hat{j}$

(3) $45\hat{k} - 35\hat{j}$ (4) $-35\hat{i} + 45\hat{k}$

3. A ray of light passes through an equilateral prism such that the angle of incidence is equal to the angle of emergence and each one is equal to $3/4^{th}$ the angle of prism. The angle of deviation is :

(1) $45^0$ (2) $39^0$ (3) $20^0$ (4) $30^0$

4. Four charges of magnitude –'Q' are placed at the four corners of a square and a charge 'q' is at its centre. If the system is in equilibrium the value of 'q' is :

(1) $-\frac{Q}{4}(1+2\sqrt{2})$ (2) $\frac{Q}{(1+2\sqrt{2})}$

(3) $-\frac{Q}{2}(1+2\sqrt{2})$ (4) $\frac{Q}{2}(1+2\sqrt{2})$

5. The intensity of the magnetic induction field at the center of a single turn circular coil of radius 5 cm carrying current of 0.9 A:

(1) $36\pi \times 10^{-7}$ T (2) $9\pi \times 10^{-7}$ T

(3) $36\pi \times 10^{-6}$ T (4) $9\pi \times 10^{-6}$ T

## MODEL QUESTIONS – CHEMISTRY

1. Which one of the following cannot be determined experimentally?

1) Order 2) Rate 3) Rate constant 4) Molecularity

2. Which one of the following elements exhibits highest oxidation state?

1) Zn 2) Fe 3) Cu 4) Mn

3. **Assertion (A):** At 300 K, Kinetic energy of 16 grams of methane is equal to the kinetic energy of 32 grams of oxygen. **Reason (R) :** At constant temperature, kinetic energy of one mole of all gases is equal.

The correct answer is:

1) Both (A) and (R) are true and (R) is the correct explanation of (A).

2) Both (A) and (R) are true and (R) is not the correct explanation of (A).

3) (A) is true but (R) is <u>not</u> true.

4) (A) is not true but (R) is true.

4. Match the following :

| List I | List II |
|---|---|
| A) Ethane | 1. 2 sp carbons |
| B) Ethylene | 2. 6 $sp^2$ carbons |
| C) Acetylene | 3. 2 $sp^3$ carbons |
| D) Benzene | 4. 2 $sp^2$ carbons |
| | 5. 1 sp and 1 $sp^2$ carbons |

The correct answer is:

| | (A) | (B) | (C) | (D) |
|---|---|---|---|---|
| 1) | 3 | 4 | 1 | 2 |
| 2) | 4 | 5 | 3 | 2 |
| 3) | 3 | 1 | 2 | 5 |
| 4) | 2 | 3 | 4 | 5 |