Appendix - A

SYLLABI FOR UPSEE-2016

PAPER – 1 (PHYSICS, CHEMISTRY & MATHEMATICS)

Section A, PHYSICS

Measurement: Dimensional analysis and error estimation, dimensional compatibility and significant figures.

Motion in one dimension: Average velocity, instantaneous velocity, one-dimensional motion with constant accelerations, freely falling bodies.

Laws of Motion: Force and inertia, Newton's laws of motion, and their significance.

Motion in two dimensions: Projectile motion, uniform circular motion, tangential and radial acceleration in curve-linear motion, relative motion and relative acceleration.

Work, Power and Energy: Work done by a constant and variable forces, kinetic and potential energy, power, Conservative and non conservative forces, conservation of energy, gravitational energy, work energy theorem, potential energy stored in a spring.

Linear Momentum & collisions: Linear momentum & impulse, conservation of linear momentum for two particle system, collisions, collision in one dimension, collision in two dimension, rocket propulsion.

Rotation of a rigid body about a fixed axis: Angular velocity and angular acceleration, rotational kinematics, rotational motion with constant angular acceleration relationship between angular and linear quantities, rotational energy, moment of inertia for a ring, rod, spherical shell, sphere and plane lamina, torque and angular acceleration, work and energy in rotational motion, rolling motion of a solid sphere and cylinder.

Gravitation: Gravitational field, Kepler's laws and motion of planets, planetary and satellite motion, geostationary satellite.

Oscillatory motion: Harmonic motion, oscillatory motion of mass attached to a spring, kinetic & potential energy, Time Period of a simple pendulum, comparing simple and harmonic motion with uniform circular motion, forced oscillations, damped oscillations and resonance.

Mechanics of solids and fluids: States of matter young's modulus, bulk modulus, shear modulus of rigidity, variations of pressure with depth, Buoyant forces and Archimedes principle, Pascal's law, Bernoulli's theorem and its application, surface energy, surface tension, angle of contact, capillary rise, coefficient of viscosity, viscous force, terminal velocity, Stoke's law, stream line motion, Reynold's numbers.

Heat and thermodynamics: First law of thermodynamics, specific heat of an ideal gas at constant volume and constant pressure, relation between them, thermodynamics process (reversible, irreversible, isothermal, adiabatic), second law of thermodynamics, concept of entropy and concept of absolute scale, efficiency of a Carnot engine, thermal conductivity, Newton's law of cooling, black body radiation, Wien's displacement law, Stefan's law.

Wave: Wave motion, phase, amplitude and velocity of wave, newton's formula for longitudinal waves, propagation of sound waves in air, effect of temperature and pressure on velocity of sound, Laplace's

correction, Principle of superposition, formation of standing waves, standing waves in strings and pipes, beats, Doppler's effect.

Electrostatics: Coulomb's law, electric field and potential due to point charge, dipole and its field along the axis and perpendicular to axis, electric flux, Gauss's theorem and its applications to find the field due to infinite sheet of charge, and inside the hallow conducting sphere, capacitance, parallel plate capacitor with air and dielectric medium between the Plates, series and parallel combination of capacitors, energy of a capacitor, displacement currents.

Current Electricity: Concept of free and bound electrons, drift velocity and mobility, electric current, Ohm's law, resistivity, conductivity, temperature dependency of resistance, resistance in series and parallel combination, Kirchoff's law and their application to network of resistances, principle of potentiometer, effect of temperature on resistance and its application.

Magnetic Effect of Current: Magnetic field due to current, Biot-Savart's law, magnetic field due to solenoid, motion of charge in a magnetic field, force on a current carrying conductors and torque on current loop in a magnetic field, magnetic flux, forces between two parallel current carrying conductors, moving coil galvanometer and its conversion into ammeter and voltmeter.

Magnetism in Matter: The magnetization of substance due to orbital and spin motions of electrons, magnetic moment of atoms, diamagnetism, paramagnetism, ferromagnetism, earth's magnetic field and its components and their measurement.

Electromagnetic induction: Induced e.m.f., Faraday's laws, Lenz's law, electromagnetic induction, self and mutual induction, B-H curve, hysisteresisloss and its importance, eddy currents.

Ray Optics and optical instruments: Sources of light, luminous intensity,luminous flux, illuminance, photometry, wave nature of light, Huygen's theory for propagation of light and rectilinear propagation of light, reflection of light , total internal reflection, reflection and refraction at spherical surfaces, focal length of a combination of lenses, spherical and chromatic aberration and their removal, refraction and dispersion of light due to a prism, simple and compound microscope, reflecting and refracting telescope, magnifying power and resolving power.

Wave Optics: Coherent and incoherent sources of light, interference, young's double slit experiment diffraction due to a single slit, linearly polarized light, Polaroid.

Modern Physics: Photo-electric equation, matter waves, quantization, Planck's hypothesis, Bohr's model of hydrogen atom and its spectra, ionisation potential, Rydberg constant, solar spectrum and Fraunhofer lines, fluorescence and phosphorescence, X-Rays and their productions, characteristic and continuous spectra.

Nuclear Instability, radioactive decay laws, Emission of α, β, γ rays, Mass - defect, Mass Energy equivalence, Nuclear Fission Nuclear Reactors, Nuclear Fusion.

Classification of conductors, Insulators and semiconductors on the basis of energy bands in solids, PN junction, PN Diode, junction Transistors, Transistor as an amplifier and Oscillator.

Principles of Logic Gates (AND, OR and NOT) Analog Vs Digital communication, Difference between Radio and television, Signal propagation, Principle of LASER and MASER, Population Inversion, Spontaneous and stimulated Emission.

Section B, CHEMISTRY

Atomic Structure: Bohr's concept. Quantum numbers, Electronic configuration, molecular orbital theory for homonuclear molecules, Pauli's exclusion principle.

Chemical Bonding: Electrovalency, co-valency, hybridization involving s,p and d orbitals hydrogen bonding.

Redox Reactions: Oxidation number, oxidising and reducing agents, balancing of equations.

Chemical Equilibrium and Kinetics: Equilibrium constant (for gaseous system only) Le Chaterlier's principle, ionic equilibrium, Ostwald's dilution law, hydrolysis, pH and buffer solution, solubility product, common-ion effect, rate constant and first order reaction.

Acid - Base Concepts: Bronsted Lowry & Lewis.

Electrochemistry: Electrode potential and electro-chemical series.

Catalysis: Types and applications.

Colloids: Types and preparation, Brownian movement, Tyndall effect, coagulation and peptization.

Colligative Properties of Solution: Lowering of vapour pressure, Osmotic pressure, depression of freezing point, elevation of boiling point, determination of molecular weight.

Periodic Table: Classification of elements on the basis of electronic configuration, properties of s,p and d block elements, ionization potential, electronegativity & electron affinity.

Preparation and Properties of the following: Hydrogen peroxide. copper sulphate, silver nitrate, plaster of paris, borax, Mohr's salt, alums, white and red lead, microcosmic salt and bleaching powder, sodium thiosulphate.

Thermochemistry: Exothermic & endothermic reactions Heat of reaction, Heat of combustion & formation, neutralisation, Hess's law.

General Organic Chemistry: Shape of organic compounds, Inductive effect, mesomeric effect, electrophiles & nucleophiles, Reaction intermediates: carboniumion, carbanions & free radical, Types of organic reactions, Cannizzaro Friedel Craft, Perkin, Aldol condensation.

Isomerism: Structural, Geometrical & Optical

IUPAC: Nomenclature of simple organic compounds.

Polymers: Addition & condensation polymers

Corbohydrates: Monosaccharides.

Preparation and Properties Of the Followings: Hydrocarbons, monohydric alcohols, aldehydes, ketones, monocarboxylic acids, primary amines, benzene, nitrobenzene, aniline, phenol, benzaldehyde, benzoic acid, Grignard Reagent.

Solid State: Structure of simple ionic compounds, Crystal imperfections (point defects only), Born-Haber cycle

Petroleum: Important industrial fractions, cracking, octane number, anti knocking compounds.

Section C, MATHEMATICS

Algebra: Sets relations & functions, De-Morgan's Law, Mapping Inverse relations, Equivalence relations, Peano's axioms, Definition of rationals and integers through equivalence relation, Indices and surds, Solutions of simultaneous and quadratic equations, A.P., G.P. and H.P., Special sums i.e. $\sum n^2$ and $\sum n^3$ ($n \sum N$), Partial fraction, Binomial theorem for any index, exponential series, Logarithm and Logarithmic

series. Determinants and their use in solving simultaneous linear equations, Matrices, Algebra of matrices, Inverse of a matrix, Use of matrix for solving equations.

Probability: Definition, Dependent and independent events, Numerical problem on addition and multiplication, theorem of probability**.**

Trigonometry: Identities, Trigonometric equations, properties of triangles, solution of triangles, heights and distances, Inverse function, Complex numbers and their properties, Cube roots of unity, De-Moivre's theorem.

Co-ordinate Geometry: Pair of straight lines, Circles, General equation of second degree, parabola, ellipse and hyperbola, tracing of conics.

Calculus: Limits & continuity of functions, Differentiation of function of function, tangents & normal, Simple examples of Maxima & Minima, Indeterminate forms, Integration of function by parts, by substitution and by partial fraction, definite integral, application to volumes and surfaces of frustums of sphere, cone and cylinder. Differential equations of first order and of first degree.

Vectors : Algebra of vectors, scalar and vector products of two and three vectors and their applications.

Dynamics : Velocity, composition of velocity, relative velocity, acceleration, composition of accelerations, Motion under gravity, Projectiles, Laws of motion, Principles of conservation of momentum and energy, direct impact of smooth bodies.

Statics: Composition of coplanar, concurrent and parallel forces moments and couples resultant of set of coplanar forces and condition of equilibrium, determination of centroid in simple cases, Problems involving friction.

PAPER – 2 (PHYSICS, CHEMISTRY & BIOLOGY)

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