Syllabus for SET - E 2020

Detailed syllabus for Mathematics, Physics, Chemistry Mathematics

Mathematics

Unit 1- SETS, RELATIONS AND FUNCTIONS:

Sets and their representation; Union, intersection and complement of sets and their algebraic properties; Power set; Relations, equivalence relations, functions; one-one,into and onto functions, composition of functions.

Unit 2 – COMPLEX NUMBERS AND QUADRATIC EQUATIONS:

Complex numbers as ordered pairs of reals, Representation of complex numbers in the form a+ib and their representation in a plane, Argand diagram, algebra of complex numbers, modulus and argument (or amplitude) of a complex number, square root of a complex number, triangle inequality, Quadratic equations in real and complex number system and their solutions. Relation between roots and co-efficients, nature of roots, formation of quadratic equations with given roots.

Unit 3 – MATRICES AND DETERMINANTS:

Matrices, algebra of matrices, types of matrices, determinants and matrices of order two and three. Properties of determinants, evaluation

of determinants, area of triangles using determinants. Adjoint and evaluation of inverse of a square matrix using determinants and elementary transformations, Test of consistency and solution of simultaneous linear equations in two or three variables using determinants and matrices.

Unit 4 – PERMUTATIONS AND COMBINATIONS:

Fundamental principle of counting, permutation as an arrangement and combination as selection, Meaning of P (n,r) and C(n,r), simple applications.

Unit 5 – BINOMIAL THEOREM AND ITS SIMPLE APPLICATIONS:

Binomial theorem for a positive integral index, general term and middle term, properties of Binomial coefficients and simple applications.

Unit 6- SEQUENCES AND SERIES:

Arithmetic and Geometric progression, insertion of arithmetic, geometric means between two given numbers. Relation between A.M. and G.M. Sum up to n terms of special series: Sn, Sn2, Sn3. Arithmetico-Geometric progression.

Unit 7- LIMIT, CONTINUITY AND DIFFERENTIABILITY; APPLICATION OF DERIVATIVES:

Real-valued function, algebra of functions, polynomials, rational, trigonometric, logarithmic and exponential functions, inverse functions. Graphs of simple functions. Limits, continuity and differentiability. Differentiation of the sum, difference, product and quotient of two functions. Differentiation of trigonometric, inverse trigonometric, logarithmic, exponential, composite and implicit function; derivatives of order up to two. Rolle's and Lagrange's Mean value Theorems. Applications of derivatives: Rate of change of quantities, monotonic-increasing and decreasing functions, Maxima and minima of functions of one variable, tangents and normal.

Unit 8 – INTEGRAL CALCULUS AND ITS APPLICATIONS:

Integral as an anti-derivative. Fundamental integrals involving algebraic, trigonometric, exponential and logarithmic functions. Integration by substitution, by parts and by partial fractions. Integration using trigonometric identities.

Evaluation of simple integrals of the type

Integral as limit of a sum. Fundamental Theorem of Calculus. Properties of definite integrals. Evaluation of definite integrals, determining areas of the regions bounded by simple curves in standard form.

Unit 9 – DIFFERENTIAL EQUATIONS:

Ordinary differential equations, There order and degree, Formation of differential equations, Solution of differential equations by method of separation of variables, solution of homogeneous and linear differential equations

Unit 10 – CO-ORDINATE GEOMETRY:

Cartesian system of rectangular co-ordinates in plane, distance formula, section formula, locus and its equation, translation of axes, slope of a line, parallel and perpendicular lines, intercepts of a line on the coordinate axes.

Straight Lines

Various forms of equation of a line, intersection of lines, angle between two lines, conditions for concurrence of three lines, distance of a point from a line, equations of internal and external bisectors of angles between two lines, coordinates of centroid, orthocenter and circumcentre of a triangle, equation of family of lines passing through the point of intersection of two lines.

Circles, Conic sections

Standard form of equation of a circle, general form of the equation of a circle, its radius and centre, equation of a circle when the end points of a diameter are given, point of intersection of a line and a circle with the Centre at the origin and the condition for a line to be tangent to a circle, equation of the tangent, Sections of cones, equations of conic sections

(parabola, ellipse and hyperbola) in standard form, condition for $y = mx + c$ to be a tangent and point of tangency.

Unit 11 – THREE DIMENSIONAL GEOMETRY:

Coordinates of a point in space, distance between two points, section formula, direction ratios and direction cosines, angle between two intersecting lines. Skew lines, the shortest distance between them and its equation. Equation of a line and a plane in different forms, intersection of a line and a plane, coplanar lines.

Unit 12 – VECTOR ALGEBRA:

Vectors and scalars, addition of vectors, components of a vector in two and three dimensional space, scalar and vector products, scalar and vector triple product.

Unit 13 – STATISTICS AND PROBABILITY:

Measures of Dispersion: Calculation of mean, median, mode of grouped and ungrouped data calculation of standard deviation, variance and mean deviation for grouped and ungrouped data.

Probability: Probability of an event, addition and multiplication theorems of probability, Baye's theorem, probability distribution of a random variate, Bernoulli trials and Binomial distribution

Unit 14 – TRIGONOMETRY:

Trigonometrical identities and equations. Trigonometric functions, Inverse trigonometrical functions and their properties. Heights and Distances.

Physics

Unit 1: Units and Measurement

S I units, Fundamental and derived units, least count, accuracy and precision of measuring instruments, errors in measurement, dimensions of physical quantities, dimensional analysis and its applications

Unit 2: Kinematics

Frame of reference, motion in a straight line, position-time graph, speed and velocity, uniform and non-uniform motion, average speed and instantaneous velocity, uniformly accelerated motion, velocity-time, position-time graphs, relations for uniformly accelerated motion, scalars and vectors, vector addition and subtraction, zero vector, scalar and vector products, unit vector, resolution of a vector, relative velocity, motion in a plane, projectile motion, uniform circular motion

Unit 3: Laws of Motion

Force and inertia, Newton's first law of motion, momentum, Newton's second law of motion, impulse, Newton's third law of motion, law of conservation of linear momentum and its applications, equilibrium of

concurrent forces, static and kinetic friction, laws of friction, rolling friction, dynamics of uniform circular motion, centripetal force and its applications.

Unit 4: Work, Energy and Power

Work done by a constant force and a variable force, kinetic and potential energies, work energy theorem, power, potential energy of a spring, conservation of mechanical energy, conservative and non-conservative forces, elastic and inelastic collisions in one and two dimensions.

Unit 5: Rotational Motion

Centre of mass of a two-particle system, centre of mass of a rigid body, basic concepts of rotational motion, moment of a force, torque, angular momentum, conservation of angular momentum and its applications, moment of inertia, radius of gyration, values of moments of inertia for simple geometrical objects, parallel and perpendicular axes theorems and their applications, rigid body rotation, equations of rotational motion.

Unit 6: Gravitation

The universal law of gravitation, acceleration due to gravity and its variation with altitude and depth, Kepler's laws of planetary motion, gravitational potential energy, gravitational potential, escape velocity, orbital velocity of a satellite, geo-stationary satellites.

Unit 7: Properties of Solids and Liquids

Elastic behaviour, stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, modulus of rigidity, pressure due to a fluid column, Pascal's law and its applications, viscosity, Stokes' law, terminal velocity, streamline and turbulent flow, Reynolds number, Bernoulli's principle and its applications, surface energy and surface tension, angle of contact, application of surface tension, drops, bubbles and capillary rise, heat, temperature, thermal expansion, specific heat capacity, calorimeter, change of state, latent heat, heat transfer-conduction, convection and radiation, Newton's law of cooling.

Unit 8: Thermodynamics

Thermal equilibrium, zeroth law of thermodynamics, concept of temperature, heat, work and internal energy, first law of thermodynamics, second law of thermodynamics, reversible and irreversible processes, Carnot engine and its efficiency.

Unit 9: Kinetic Theory of Gases

Equation of state of a perfect gas, work done on compressing a gas, assumptions of kinetic theory of gases, concept of pressure, kinetic energy and temperature, rms speed of gas molecules, degrees of freedom, law of equipartition of energy, applications to specific heat capacities of gases, mean free path, Avogadro's number.

Unit 10: Oscillations and Waves

Periodic motion, period, frequency, displacement as a function of time, periodic functions, simple harmonic motion (SHM) and its equation, phase, oscillations of a spring, restoring force and force constant, energy in SHM, kinetic and potential energies, simple pendulum, derivation of expression for its time period, free, forced and damped oscillations, resonance, wave motion, longitudinal and transverse waves, speed of a wave, displacement relation for a progressive wave, principle of superposition of waves, reflection of waves, standing waves in strings and organ pipes, fundamental mode and harmonics, beats, Doppler effect in sound

Unit 11: Electrostatics

Electric charge, conservation of charge, Coulomb's law, forces between two point charges, forces between multiple charges, superposition principle and continuous charge distribution, 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 a uniform electric field, electric flux, Gauss's law and its applications to find field due to infinitely long uniformly charged straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell, electric potential and its calculation for a point charge, electric dipole and system of charges, equipotential surfaces, electrical potential energy of a system of two

point charges in an electrostatic field, conductors and insulators, dielectrics and electric polarization, capacitor, 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.

Unit 12: Current Electricity

Electric current, drift velocity, Ohm's law, electrical resistance, resistances of different materials, I-V characteristics of Ohmic and non-ohmic conductors, electrical energy and power, electrical resistivity, colour code for resistors, series and parallel combinations of resistors, temperature dependence of resistance, electric cell and its internal resistance, potential difference and emf of a cell, combination of cells in series and in parallel, Kirchhoff's laws and their applications, Wheatstone bridge, metre bridge, potentiometer principle and its applications.

Unit 13: Magnetism, Magnetic Effects of Current

Current loop as a magnetic dipole and its magnetic dipole moment, bar magnet as an equivalent to solenoid, magnetic field lines, Earth's magnetic field and magnetic elements, para, dia and ferro magnetic substances, magnetic susceptibility and permeability, hysteresis, electromagnets and permanent magnets, Biot-Savart law and its application to current carrying circular loop, Ampere's law and its applications to infinitely long current carrying straight wire and solenoid,

force on a moving charge in uniform magnetic and electric fields, cyclotron, 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.

Unit 14: Electromagnetic Induction and Alternating Currents

Electromagnetic induction, Faraday's law, induced emf and current, Lenz's law, eddy currents, self and mutual inductance, alternating currents, peak and rms value of alternating current and voltage, reactance and impedance, LCR series circuit, resonance, quality factor, power in AC circuits, watt-less current, AC generator and transformer.

Unit 15: Electromagnetic Waves

Electromagnetic waves and their characteristics, transverse nature of electromagnetic waves, electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays), applications of electromagnetic waves.

Unit 16: Optics

Ray Optics: Reflection and refraction of light at plane and spherical surfaces, mirror formula, total internal reflection and its applications, deviation and dispersion of light by a prism, lens formula, magnification,

power of a lens, combination of thin lenses in contact, microscope and astronomical telescope (reflecting and refracting) and their magnifying powers.

Wave Optics: Wavefront and Huygens' principle, laws of reflection and refraction using Huygens's principle, interference, Young's double slit experiment and expression for fringe width, diffraction due to a single slit, width of central maximum, resolving power of microscopes and astronomical telescopes, polarisation, plane polarized light, Brewster's law, uses of plane polarized light and polaroids.

Unit 17: Modern Physics:

Dual nature of radiation, photoelectric effect, Hertz and Lenard's observations, Einstein's photoelectric equation, particle nature of light, matter waves, wave nature of particle, de'Broglie relation, Davisson-Germer experiment, alpha-particle scattering experiment, Rutherford's model of atom, Bohr model, energy levels, hydrogen spectrum, composition and size of nucleus, atomic masses, isotopes, isobars and isotones, radioactivity, alpha, beta and gamma radiation and their properties, radioactive decay law, mass-energy relation, mass defect, binding energy per nucleon and its variation with mass number, nuclear fission and fusion.

Unit 18: Electronic Devices

Semiconductors, semiconductor diode I-V characteristics in forward and reverse bias, diode as a rectifier, I-V characteristics of LED, photodiode, solar cell and zener diode, zener diode as a voltage regulator, junction transistor, transistor action, characteristics of a transistor, transistor as an amplifier (common emitter configuration) and oscillator, transistor as a switch.

Chemistry

Physical Chemistry

Unit 1: Some basic Concept of Chemistry: Matter and its nature, Daltons atomic theory;, concept of atom, molecule, element and compound; Physical quantities and their measurements in Chemistry, precision and accuracy, significant figures, S.I. units, dimensional analysis; Laws of chemical combination; Atomic and molecular masses, mole concept, molar mass, percentage composition, empirical and molecular formulae,; Chemical equations and stoichiometry.

Unit 2: States of Matter, Chemical Bonding and Molecular structure: Classification of matter: Gaseous state: Liquid State and Solid State, Ionic bonding, Covalent bonding, Quantum mechanical approach to covalent bonding; Molecular orbital Theory.

Unit 3: Chemical Thermodynamics:

Fundamentals, First Law of thermodynamics: Concept of work, heat, internal energy and enthalpy, heat capacity, molar heat capacity; Hess's Law of constant heat summation; Enthalpies of bond dissociation, combustion, formation, atomization, sublimation, phase transition, hydration, ionization, and solution, Second Law of thermodynamics: Spontaneous processes, ΔS, ΔG, ΔG°, and equilibrium constant.

Unit 4: Solutions :

Molarity, Molality, mole fraction, percentage, vapour pressure of solutions, Raoult's Law-Ideal and non-ideal solutions, vapour pressure; Colligative properties of dilute solutions, relative lowering of vapour pressure, depression of freezing point, elevation of boiling point and osmotic pressure; Determination of molecular mass using colligative properties; Abnormal values of molar mass; vant's Hoff Factor and its significance.

Unit 5: Equilibrium:

Concept of equilibrium and dynamic equilibrium, Equilibria involving physical process, Equilibria involving chemical processes, Ionic Equilibrium: Weak and strong electrolytes, ionization of electrolytes, Acid Base concepts(Arrhenius, Bronsted-Lowry and Lewis), Acid –Base equilibria, Ionization constants, ionization of water, pH scale, common ion effect, hydrolysis of salts and pH of their solutions, solubility of sparingly soluble salts, solubility products and buffer solutions.

Unit 6: Redox reactions and Electrochemistry:

Concepts of oxidation and reduction, redox reactions, oxidation number, rules for assigning oxidation number, balancing of redox reactions, Electrolytic and metallic conduction, conductance, molar conductivities and their variation with concentration, Kohlrausch's law and its applications. Electrochemical cells, Electrodes, electrode potentials, Standard electrode potential, Half-cell and cell reactions, emf of a galvanic cell and its measurements, Nernst equation, relationship between EMF and Gibb's energy change; Dry cell and Lead acid batteries, Fuel cells.

Unit 7: Chemical Kinetics:

Rates of a chemical reaction, factors affecting the rate of reactions; concentration, temperature, pressure and catalyst, elementary and complex reactions, order and molecularity of reactions, rate law, rate constant and its units, Zero and first order reactions, their characteristics, Half- life, effect of temperature on rate of reactions- Arrhenius theory, activation energy and its calculation, collision theory of bimolecular gaseous reactions.

Inorganic Chemistry

Unit 8: Periodic table and Periodicity in properties:

Modern periodic law and s, p, d and f block elements, periodic trends in properties of elements, atomic and ionic radii, ionization enthalpy, electron gain enthalpy, valence, oxidation states and chemical reactivity.

Unit 9: General principles and process of Isolation of metals:

Mineral, ore, Metallurgy, General principles of metallurgy, Refining of Al, Cu, Zn and Fe.

Unit 10: s-block Elements:

General introduction, electronic configuration, and general trends in physical and chemical properties of elements, anomalous properties if the first element of each group, diagonal relationships, Preparation and properties of sodium carbonate, sodium hydroxide, Sodium bicarbonate, Biological significance of Na, K, Mg and Ca.

Unit 11: p-Block elements:

Electronic configuration, general trends in physical properties and chemical properties across the periods and down the groups; unique behavior of first element in each group, Group wise study of the p-block elements (Group 13 to Group 18 elements)

Unit 12: d- and f- Block elements:

Transitions elements: Introduction, electronic configuration, characteristics, general trends in properties of first row transition elements, Preparation, properties and uses of $K_2Cr_2O_7$ and $KMnO_4$. Lanthanides and Actinides: Electronic configuration and oxidations states.

Unit 13- Co-ordination compounds:

Introduction, Werner's theory, ligands, co-ordination number, dentacity, chelate complexes, IUPAC names, isomerism, Bonding- valence bond theory, crystal field theory, important coordination compounds in biological systems.

Organic Chemistry

Unit 14: Some basic principles of organic Chemistry:

Hybridization, Classification of organic compounds based on Functional Groups, Homologous series, Isomerism-structural and stereoisomerism, Nomenclature(Trivial and IUPAC),Free radicals, carbocation, carboanion and their stability, electrophiles and nucleophiles, Inductive effect, electromeric effect, resonance, hyperconjugation, Types of reactions-Substitution, addition, elimination and rearrangement.

Unit 15: Hydrocarbons:

Alkanes, Alkenes and Alkynes, Aromatic hydrocarbons- Nomenclature, general methods of preparation and chemical reactions, Uses.

Unit 16: Halogen derivatives of Alkanes:

General methods of preparation, properties and reactions, nature of C-X bond; mechanism of substitution reactions, Uses of chloroform, iodoform, freons and DDT.

Unit 17: Compounds containing Oxygen:

Alcohols, phenols and ethers, Aldehydes and Ketones: General methods of preparation, properties, reactions and uses.

Unit 18: Compounds containing Nitrogen:

Amines, Nitro compounds- General methods of preparation, properties, reactions and uses.

Unit 19: Polymers:

Introduction, classification of polymers, addition and condensation polymerization, Copolymerization, Natural and synthetic rubber, Vulcanization, some important polymer synthesis and uses- polyethene, nylon, polyester and bakelite.

Unit 20: Biomolecules:

Carbohydrates, Proteins, Vitamins and Nucleic acids: Introduction and importance of biomolecules.