Lateral Entry to B. Tech. Syllabus for Diploma Students

LE – TECH. (Diploma)

A. ENGINEERING MATHEMATICS – 40 Questions

Algebra: Definition of complex number, Conjugate of complex number, Modulus and amplitude of a complex number. Algebra of complex numbers. Cube root of unity and their properties, De'Moivre's theorem and its application, Permutation, Combination, Binomial Theorem for any rational index, Relationship between Binomial coefficients.

Determinant and Matrices: Properties of determinants. Crammer's Rule, Types of matrices, Transpose, Adjoint and inverse of a matrix upto third order. Solution of simultaneous equation by matrix method.

Trigonometry: Trigonometrical ratios, multiple and submultiple angles, solution of trigonometrical equations, Properties of triangles, Inverse circular function and its properties.

Analytical Geometry: Distance formula, Division formula, Area of trapezium, Area of Triangle, Equation of straight lines in different form, Distance of a point from a line, Equation of circle in different forms.

Vector Algebra: Definition, Algebra of vectors, Position Vector, Resolution of vector into components, normal vector, unit vector, Scalar and Vector product of two vectors and their application, scalar triple product and its application.

Calculus: Limit and continuity of function, Derivative of standard functions, Derivative of composite functions. Differentiation of implicit functions, Differentiation of function in parametric form, Differentiation using logarithm, Differentiation of a function with respect to another function, Successive differentiation in simple cases, Maxima, minima and point of

inflection, Partial derivative, Euler's theorem for homogeneous functions.

Standard methods of integration (by parts, by substitution, by partial fraction etc.). Definite integrals and their properties. Area bounded by curves.

Ordinary Differential Equation: Order and degree of differential equation, formation of differential equation. Solution of first order and first degree differential equation. (Linear and homogeneous)

Coordinate Geometry of three Dimension: Distance and Division formulae, Direction cosine and direction ratio of a line, condition of perpendicularity and parallelism, Equation of plane under different conditions, angle between two planes, Distance of a point from a plane, General equation of a sphere, Equation of a sphere with given diameter.

Probability and Statistics: Measures of central tendency (Mean, Median, Mode), Measures of dispersion (Mean Deviation, Standard Deviation and Variance), Definition of probability, equally likely, Mutually exclusive and independent events. Addition theorem of probability.

B.   ENGINEERING MECHANICS – 40 Questions

Force and Moments

Force and its effects, Classification of forces, Principle of Transmissibility, Principle of Superposition, Action and Reaction, Tension and Compression, Free Body Diagram.

Co-planer concurrent forces: Resultant of forces, Equilibrium of forces and equilibrant, Parallelogram law of forces and determination of the resultant of two concurrent forces, Components and resolve parts of a force, Principle of resolution of a force and any number of forces, Analytical determination of resultant of number of concurrent forces, Lami's Theorem, Triangle law of forces and polygon law of forces. Coplanar non-concurrent forces: Moment of a force, Statement and proof of Varignon's theorem, Conditions of equilibrium, Determination of resultant of two like and unlike parallel forces, Couple and its moment, Various types of supports with their reactions, Simple problems on coplanar non concurrent forces with the help of free body diagram.

Center of Gravity and Moment of Inertia

Centroid and Center of Gravity(C.G.), Expression for C.G. of straight line (uniform rod),triangle, rectangle, circular,semicircular lamina. Expression for C.G. of solids like hemisphere and cone (Expression only). Different types of engineering sections (symmetrical and non-symmetrical built up sections). Location of the C.G. of the above sections. Definition of Moment of Inertia (M.I.) of plain figure as second moment of area. Perpendicular axes theorem, parallel axis theorem. M.I. of plane lamina like rectangle, triangle, circle, and semicircle (from 1st principle) M.I.of different engineering sections.

Friction

Frictional force, angle of friction, limiting friction, co-efficient of friction, Laws of Static Friction. Simple problems on ladder, Body on Inclined planes with applied force parallel to the plane and horizontal, Screw Jack.

Gear Drive

Various types of gears, Gear terminology, Velocity ratio and expression for the velocity ratio for simple gears. Types of gear trains (simple and compound gear trains)

Simple Lifting Machine

Definition of a machine. Simple and compound lifting machines. Mechanical Advantage (MA), Velocity Ratio (VR) and efficiency of lifting machine. Relationship between MA, VR and efficiency. Laws of machine, Friction in machines, Friction in terms of load and friction in terms of effort. Reversible machine and self-locking machine. Condition of reversibility of a machine. Velocity Ratio and efficiency of 1st, 2nd & 3rd system of pulleys; Simple and differential wheel & axle, Screw jack.

Simple Stress and Strain

Stress, strain, tensile, compressive and shear types of stress and strain, Hooke's Law of elasticity, Poisson's ratio, Elastic limit, Elastics Constants (E, G & K) relationship between E,G &K, Stress-strain curve and salient points on stress-strain curve for ductile material. Simple problems on stress and strain in case of material with uniform cross section.

Dynamics

Kinematics and kinetics of a particle, Principle of Dynamics:-Newton's laws of motion, D'Alembert's Principle and its application. Motion of particle acted upon by a constant force. Engineering Application of Work, Power and Energy: Work done, force-displacement diagram, Work done in stretching a spring, Power, Indicated Power, Brake Power and efficiency. Kinetic and potential energy & its application, Force, Momentum and Impulse, Conservation of energy and linear momentum, Collision of elastic bodies, Co-efficient of restitution (e), Velocity after impact. Impact of body with a fixed plane.

C. BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
(40 Questions)

C 1. BASIC ELECTRICAL ENGINEERING (20 Questions)

Fundamentals and AC Theory: Concept of Source and Load, Ohm's Law, Concept of resistance, Series and Parallel DC circuits, Kirchhoff's Laws, Faraday's Laws of Electromagnetic Induction, Fleming's Left 7 Hand Rule and Right Hand Rule. Generation of alternating emf, Difference between DC and AC, Amplitude, Cycle, Time period, Frequency, Phase, Phase Angle, Phase Difference, Instantaneous value, RMS value, Average value, Amplitude factor and Form factor, Phasor diagram representation of AC values, AC through pure resistance, inductance and capacitance, AC through RL, RC and RLC circuits, Impedance Triangle and Power Triangle.

Conversion of Electrical Energy:. DC machine and its main parts. DC generators: Principle of operation and emf equation. DC motors: Principle of operation, classification, torque

equation and applied voltage V-back emf Eb relation. Starters used for DC motors, Use of different types of DC generators and motors, Concept of single phase Transformer and its application, Principle of operation of Three-phase and Single-phase Induction Motors.

Power Billing: Calculation of Power used in small electrical appliances and installation, Calculation of Energy consumption in small electrical installations, Earthing installation, types (Pipe and Plate earthing) and uses.

Measuring Instruments and Storage Devices: Introduction to measuring instruments, Expression for Torque in measuring instruments, Use of PMMC and MI type of instruments(Ammeters and Voltmeters). Connection diagram of AC/DC ammeter, voltmeter, energy meter and wattmeter for single phase electrical system only, Introduction to storage devices and their types. Charging, Discharging and Maintenance of Lead Acid battery.

C 2. BASIC ELECTRONICS ENGINEERING (20 Questions)

Electronic Devices: Classification of material according to electrical conductivity (Conductor, Semiconductor & Insulator) with respect to energy band diagram only. Principle of working and use of PN junction diode, Zener diode and Light Emitting Diode (LED), Integrated circuits (I.C) & its advantages.

Electronic Circuits: Principles of working of different types of Rectifiers with their merits and demerits, Transistor, Different types of Transistor Configuration and state output and input current gain relationship in CE, CB and CC configuration (No mathematical derivation), Need of biasing and explain different types of biasing with circuit diagram (only CE configuration), Amplifiers (concept), Working principles of single phase CE amplifier.

Communication System: Basic communication system (concept & explanation with help of Block diagram), Concept of Modulation and Demodulation, Difference between them, Different types of Modulations (AM, FM and PM) based on signal, carrier and modulated wave (Only Concept, No Mathematical Derivations).

Transducers And Measuring Instruments: Concept of Transducer and sensor with their differences, Working principle of photo emissive, photoconductive, photovoltaic transducer and its application, Multimeter and its applications.

4. Lateral Entry to B. Tech. for B. Sc. Students (LE – TECH. (B.Sc.))

A.   MATHEMATICS (+ 2 Level) - (30 Questions)

Logic : Statement, Negation, Implication, Converse, Contraposititve, Conjuction, Disjunction, tautology, Truth Table, Principle of Mathematical induction.

Sets, Relation and Function : Union, Intersection, Difference, Symmetric difference and Complement of sets , De Morgan's laws,Venn diagram, Cartesian product of sets,Power Set, Relation and function : domain , codomain and range of a relation, types of relations, Equivalence relation, Representation of three dimensional space by RxRxR, types of functions and their domain and range such as:
Constant function, identity function, modulus function, logarithm function, exponntial function, greatest integer function.
surjective, injective and bijective functions, sum , difference and quotient of functions and their range, Composite function, Inverse of a function.

Number system : Real numbers (algebraic and order properties, rational and irrational numbers), Absolute value, Triangle inequality, AM ≥ GM, Inequalities(simple cases), Complex numbers as ordered pairs of reals, representation of a complex number in the form a +ib and their representation in a plane, Argand diagram, Algebra of complex numbers, modulus and argument of complex numbers, Conjugate a complex number, Quadratic equation in real numbers, and their solution, Relation between roos and coefficients, nature of roots, formation of quadratic equation with roots.Permutations and Combinations, fundamental principle of counting, permutation as an arrangement and combination as a selection, meaning of P(n,r) and C(n,r), simple applications, Binomial theorem for positive integral index, general term and middle term, properties of Binomial coefficient and their applications, Identities involving binomial co-efficients.

Determinants and matrices : Determinants and matrices up to third order, Minors and cofactors, Properties of determinants, Matrices upto third order, Types of matrices, algebra of matrices, properties of determinant, evaluation of determinants, Adjoint and inverse of matrix, Application of determinants and matrices to the solution of linear equations (in three unknowns).

Trigonometry : Compound angles, Multiple and Submultiple angles, Trigonometric identities , Solution of trigonometric equations,trigonometric functions, Properties of triangles, Inverse trigonometric function and their properties

Co-ordinate geometry of two dimensions : Cartesian system of rectangular co-ordinates in a 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. Various forms of equations of a line, intersection of lines, angles between two lines, conditions for concurrence of three lines, distance of a point from a lineequations of internal and external bisectors of angles between two lines, coordinates of centroid, orthocentre and circumcentre

of a triangle, equation of family of lines satisfying various conditions,. Pairs of straight lines, Standard form of equation of a circle, general form of the equation of a circle, radius and centre of a circle, equation of a circle when the end points of a diameter are given, points of intersection of a line and a circle and condition for a line to be tangent to a circle, Equations of tangents to a circle, Equations of parabola, Ellipse and hyperbola in simple forms, their tangents in standard form. Condition of tangency.

Coordinate geometry of three dimensions : Coordinates of a point in space, distance between two points, section formula, Direction cosines and direction ratios, Projection, angle between two intersecting lines.Angle between two planes, Angle between a line and a plane. Distance of a point from a line and a plane.Equations of a line and a plane in different forms, intersection of a line and a plane, coplanar lines.

Sequence and Series : Definition, Infinite geometric series, Arithmetico-geometric series, Exponential and Logarithmic series, Geometric mean between two given numbers, Relation between AM and GM

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

Differential calculus: Concept of limit, limits of polynomial functions, rational functions, trigonometric functions, exponential and logarithmic functions, Continuity of functions, Contuinity and differentiability, Derivative of standard Algebraic and Transcendental functions, Differentiation of trigonometric,inverse trigonometric,logarithmic and exponential functions,Derivative of composite functions, functions in parametric form, Implicit differentiation, Differentiation of the sum, difference, product and quotient of two functions, derivatives of order upto 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 normals, Geometrical application of derivatives such as finding tangents and normals to plane curves.

 Integral calculus: Standard methods of integration (substitution, by parts, by partial fraction, etc), Integration of rational, irrational functions and trigonometric functions. Definite integrals and properties of definite integrals, Fundamental Theorem of Calculus, Evaluation of definite integrals, determining areas of the regions bounded by simple curves in standard form.

Differential equations : Definition, order, degree of a differential equation, General and particular solution of a differential equation, Formation of a differential equation, Solution of a differential equations by method of separation of variables, Homogeneous differential equations of first order
and first degree, Linear differential equations of the form dy/dx +p(x)y = q(x),

Probability and statistics:
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, Mutually exclusive events, Independent events, Compound events, Conditional probability,

Addition theorem,Baye's theorem, random variables, probability distribution of a random variate(Binomial distribution only)

B.   PHYSICS (+ 3 Level) - (15 Questions)

Mechanics: Vector algebra, gradient, divergence, curl and their significance. Ordinary differential equation:1st order and 2nd order homogenous differential equation laws of motion, motion in a uniform field, components of velocity and acceleration in different coordinate systems. Motion under a central force, Kepler's law, Gravitational law and field. Potential due to a spherical body, Gauss and Poisson equations for gravitational self-energy. System of particles, center of mass, equation of motion, conservation of linear and angular momenta, conservation of energy, elastic and inelastic collisions. Rigid body motion, rotational motion, moment of inertia and their products. Special theory of relativity: Postulates of special theory of relativity, length contraction, time dilation, relativistic addition of velocities.

Oscillations: Harmonic oscillations, kinetic and potential energy, examples of simple harmonic oscillations, spring and mass system, simple and compound pendulum, torsional pendulum. Superposition of two simple harmonic motions of the same frequency along the same line, interference, superposition of two mutually perpendicular simple harmonic vibrations of the same frequency, Lissajous figures, case of different frequencies. Forced and damped oscillations.

Motion of charged particles in electric and magnetic fields: E as an accelerating field, electron gun, case of discharge tube, linear accelerator, E as deflecting field-CRO, sensitivity. Properties of Matter: Elasticity, small deformations, Hooke's law, elastic constants for an isotropic solid, beams supported at both the ends, cantilever, torsion of a cylinder, bending moments and shearing forces. Bernoulli's theorem, viscous fluids, streamline and turbulent flow. Poiseulle's law. Capillarity, tube of flow, Reynolds's number, Stokes law. Surface tension and surface energy, molecular interpretation of surface tension, pressure across a curved liquid surface, angle of contact and wetting.

Electrostatics: Coulomb's law (in vacuum) expressed in vector forms, calculation of E for simple distributions of charge at rest, dipole and quadruple fields Work done on a charge in an electrostatic field expressed as a line integral, conservative nature of the electrostatic field. Electric potential , $E = -dV/dx$, Torque on a dipole in a uniform electric field and its energy, flux of the electric field, Gauss' law and its application for finding E for symmetric charge distributions, Gaussian pillbox, fields at the surface of a conductor. Screening of electric field by a conductor. Capacitors, electrostatic energy, force per unit area of the surface of a conductor in an electric field .Capacitance of an isolated spherical conductor, parallel plate ,spherical and cylindrical condenser. Gauss law in dielectrics.

Electric Currents: Steady current, Current density vector J, non-steady currents and continuity equation, Kirchhoff's law and analysis of multi-loop circuits, rise and decay of current in LR and
CR circuits, decay constants, transients in LCR circuits, AC circuits, Complex numbers and their applications in solving AC circuit problems, complex impedance and reactance, series and parallel resonance, Q factor, power consumed by an AC circuit, power factor.

Magneto statics: Force on a moving charge, Lorentz force equation and definition of B, force on a straight conductor carrying current in a uniform magnetic field, torque on a current loop,

magnetic dipole moment, Biot and Savart's law, calculation of B in simple geometric situations, Ampere's law $\nabla\nabla.\ B=0,\ \nabla \times B\ ,\ = \mu_0 J$, field due to a magnetic dipole.

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force $e=\sigma.E.dr$, Integral and differential forms of Faraday's law, mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, electromagnetic field, energy density.

Electromagnetic Waves: The wave equation satisfied by E and B, plane electromagnetic waves in vacuum, Poynting's vector.

Kinetic theory of Matter: Real gas: Van der Waals gas, equation of state, nature of Van der Waals forces, comparison with experimental P-V curves. The critical constants, distinction between gaseous and vapour state, Joule expansion of ideal gas, and of a Vander Waals gas, Joule coefficient, estimates of J-T cooling.

Thermodynamics: Blackbody radiation: energy distribution in blackbody spectrum. Planck's quantum postulates, Planck's law. Interpretation of behaviour of specific heats of gases at low temperature.

Kinetic Theory of Gases: Maxwellian distribution of speeds in an ideal gas: distribution of speeds and of velocities, distinction between mean, rms and most probable speed values. Law of equipartition of energy and its applications to specific heat of gases.

Physical Optics: The principle of superposition , Interference of a light, double-slit interference, coherence requirement for the sources, optical path retardation, lateral shift of fringes, Localized fringes: thin films, Michelson interferometer, Fresnel diffraction: Fresnel half-period zones, plates, straight edge, rectilinear propagation. Fraunhofer diffraction : Diffraction of a single slit, the intensity distribution, diffraction at a circular aperture and a circular disc. Diffraction gratings: Diffraction at N parallel slits, intensity distribution, plane diffraction grating, polarization of transverse waves, plane, circular and elliptically polarized light. Polarization by reflection and refraction. Double reflection and optical rotation: Refraction, in uniaxial crystals, its electromagnetic theory. Phase retardation plates, double image prism, rotation of plane of polarized light, origin of optical rotation in liquids and in crystals.

Quantum Mechanics: Origin of the quantum theory: failure of classical physics to explain the phenomena such as blackbody spectrum, photoelectric effect, Ritz combination principle in spectra, stability of an atom, Planck's radiation law, Einstein's explanation of photoelectric effect, Bohr's quantization of angular momentum and its applications to hydrogen atom, limitations of Bohr's theory. Wave particle duality and uncertainty principle: de Broglie's hypothesis for matter waves, the concept of wave and group velocities, evidence for diffraction and interference of particles, experimental demonstration of matter waves. Consequence of de Broglie's concepts; quantization in hydrogen atom; quantized energy levels of a particle in a box, wave packets, Heisenberg's uncertainty relation for p and x, its extension to energy and time. Consequence of the uncertainty relation: gamma ray microscope, diffraction at a slit, particle in a box, position of electron in a Bohr orbit. Quantum Mechanics: Schrodinger's equation. Postulatory basis of quantum mechanics, operators, expectation values, transition probabilities, applications to particle in a one dimensional box, harmonic oscillator, reflection at a step potential, transmission across a potential barrier.

Week spectra: continuous X-ray spectrum and its dependence on voltage, Characteristics X-rays. Moseley's law, Raman effect, Stokes and anti-Stocks lines, fission and fusion (concepts),

energy production in stars by p-p and carbon cycles (concepts). Cyclotron.

Solid State Physics: X-ray diffraction, Bragg's law,
Magnetism: Atomic magnetic moment, magnetic susceptibility, Dia-Para-, and Ferromagnetism, Ferromagnetic domains, Hysteresis.
Band Structure: Energy bands, energy gap, metals, insulators, semiconductors.
Solid State Devices: Semiconductors - Intrinsic semiconductors, electrons and holes, Fermi level. Temperature dependence of electron and hole concentrations. Doping: impurity states, n and p type semiconductors.
Semiconductor devices: p-n junction, majority and minority charge carriers, junction diode, Zener diode.
Electronics: Power supply: diode as a circuit element, load line concept, rectification, ripple factor, Zener diode, voltage stabilization, IC voltage regulation, characteristics of a transistor in CB, CE and CC mode.
Field effect transistors: JFET volt-ampere curves, biasing JFET, RC coupled amplifier, gain, frequency response, input and output impedance.
Digital electronics: Decimal to binary and binary to decimal conversion. AND, OR, NOT NOR, XOR, XNOR, NAND gates. NAND, NOR gates as universal gates.

C.   CHEMISTRY (+ 3 Level) - (15 Questions)

Kinetic Theory of Gases : Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation derivation not required) and their importance.

Liquids : Surface tension, Viscosity, coefficient of viscosity of liquid using Effect of temperature on surface tension and coefficient of viscosity of a liquid.

Solids : Symmetry elements, unit cells, crystal systems, Bravais lattice types Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. XRay diffraction by crystals, Braggs law. Defects in crystals.

Chemical Kinetics : Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Halflife of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory.

Solutions : Thermodynamics of ideal solutions: Ideal solutions and Raoults law, deviations from Raoults law non-ideal solutions. Vapour pressure-composition and temperaturecomposition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

Thermodynamics : Definition of thermodynamic terms, systems, surroundings etc. Types of systems, intensive and extensive properties, state and path functions and their differentials, thermodynamic processes, concept of heat and work. First law of thermodynamics, statement, definition of internal energy, enthalpy, heat capacity, heat capacity at constant volume, constant pressure and their relation, calculation of w, q, U, H, for the expansion of ideal gases under isothermal and adiabatic conditions for reversible processes, Work done in irreversible process.

Thermochemistry : Standard state, standard enthalpy of formation, Hess's law of heat of summation and its application, heat of reaction at constant pressure and constant volume, enthalpy of neutralization, bond dissociation energy and its calculation from thermochemical data, temperature dependence of enthalpy. Kirchoff's equation. Third law of Thermodynamics.

Chemical equilibrium : Equilibrium constant and free energy. Relationship between Kp, Kc, Kx. Derivation of law of mass action (Study of homogeneous and heterogeneous equilibria). Le chaterlier's principle.

Ionic equilibria : Degree of ionization of weak electrolytes, ionic product of water, salt hydrolysis, solubility product and its applications, Buffer solutions.

Phase equilibrium: Statement and meaning of the terms - phase, component and degree of freedom, derivation of Gibbs phase rule, Clausius-clapeyron equation, phase equilibrium of one component system - water and sulphur system. Two component systems including eutectics, congruent and incongruent melting points, (Pb- Ag system).

Electrochemistry-I: Specific conductance and equivalent and molar conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution, migration of ions and Kohlrausch law, transport number Arrhenius theory of electrolytic dissociation and its limitations, weak and strong electrolytes, Ostawald's dilution law, its uses and limitations. Application of conductivity measurements, determination of degree of dissociation of weak electrolytes Determination of solubility product of a sparingly soluble salt, conductometric titration(acid-base).

Electrochemistry-II: Types of reversible electrodes- gas metal ion, meta-metal ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrodes-reference electrodes, standard electrode potentials, sign conventions, electrochemical series and its significant, EMF of a cell and its measurements. Computation of cell EMF, concentration of cell with and without transport, liquid junction potential, definition of pH. Determination of pH using hydrogen electrode, quinehydrone electrode, buffers-mechanism of buffer action, Henderson equation. Hydrolysis of salts (quantitative treatment).

Atomic Structure: Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation (Mathematical derivations excluded) significance of quantum numbers, shapes of s,p,d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements. Anomalous electronic configuration.

Periodic Properties: Atomic and ionic radii, ionization enthalpy and electron – gain enthalpy, electronegativity-definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behaviour.

Chemical Bonding: Covalent Bond - valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion, (VSEPR) theory of NH_3 , H_3O+, SF_4, CIF_3, ICl_2 and H_2O. MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules.

S & P Block Elements: Allotropy in C, S and P, Inertpiar effect. Diagonal relationship, anomalous behavior of first member of each group. Hydrides and their classification. Structure and properties of hydrids of p block elements. Structure of diborane, oxoacids of P S and Cl, halides and oxohalides: PCl_3, PCl_5, $SOCl_2$.

General Principles of Metallurgy: chief modes of occurrence of metal based on standard electrode potentials. Ellingham diagram for reduction of metal oxide using carbon as reducing agent. Hydro metallurgy. Purification of metals (Al,Pb,Fe,Cu,Ni,Zn) electrolytic and oxidative refining , Parting process , van Arkel - de Boer process and Mond process.

Fundamentals of organic chemistry: Inductive effect, resonance, hyper conjugation. Strength of organic acids & bases.

Reactive intermediate- carbocations, carbanions, free-radicals and carbenes - formation, stability and structure, types and mechanism of organic reactions- SN1 , SN2, SE1, SE2 , E1, E2, AdE, AdN,

Stereochemistry of Organic compounds: Conformations with respect to ethane, butane & cyclohexane. Concept of chirality, configuration. Geometrical and optical isomerism. Enatiomerism, diastereomerism and meso compounds. D-L, cis-trans nomenclature,CIP rule, R/S (for one chiral carbon atom) and E/Z nomenclature.

Aliphatic Hydrocarbons : Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbes synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogena- tion.

Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydro- halogenation of alkyl halides (Saytzeffs rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. *KMnO₄*) and trans-addition (bromine), Addition of HX (Markownikoffs and anti-Markownikoffs addition), Hydration, Ozonolysis, Alkynes: (Upto 5 Carbons) Preparation: Acetylene from *CaC₂* and conversion into higher alkynes; by de- halogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline *KMnO₄*, ozonolysis.

Aromatic hydrocarbons: Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Case benzene): Elec- trophilic substitution: nitration, halogenation and sulphonation. Friedel-Crafts reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

Alkyl and Aryl Halides

Alkyl Halides (Up to 5 Carbons) Types of Nucleophilic Substitution (*SN₁, SN₂* and *SNᵢ*) reac-tions. Preparations & Reactions of Alkyl Halides.

Aryl Halides Preparation: from phenol, Sandmeyer & Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replace- ment by OH group) and effect of nitro substituent. Benzyne Mechanism: *KNH₂/NH₃* (or *NaNH₂/NH₃*).

Alcohols, Phenols and Ethers (Upto 5 Carbons)

Alcohols: Preparation: Preparation of 1, 2 and 3 alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes and ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. ReimerTiemann Reaction, Gattermann-Koch Reaction,

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): Formaldehye, acetaldehyde, acetone and benzalde- hyde

Preparation: from acid chlorides and from nitriles.

Reactions Reaction with HCN, ROH, *NaHSO₃*, *NH₂ − G* derivatives. Iodoform test. Aldol Con- densation, Cannizzaros reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction.

Carboxylic acids and their derivatives. Carboxylic acids (aliphatic and aromatic) Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell Vohlard - Zelinsky Reaction.

Amines and Diazonium Salts

Amines (Aliphatic and Aromatic): (Upto 5 carbons) Preparation: from alkyl halides, Gabriels Ph- thalimide synthesis, Hofmann bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO2, Schotten Baumann Reaction. Electrophilic substi- tution (case aniline): nitration, bromination, sulphonation.

Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes.

Amino Acids: Preparation of Amino Acids: Strecker synthesis using Gabriels phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis. Reactions of Amino acids: ester of COOH group, acetylation of NH2 group, complexation with Cu2+ ions, ninhydrin test.