Syllabus

ANNEXURE 1: B.TECH (4 YEARS COURSE)

A. Mathematics

a. Sets, relations and functions:
Sets and their representation; Union, intersection and complement of sets and their algebraic properties.; Power set; Relation, Types of relations, equivalence relations, function ;. One-one, into and onto functions, composition of functions.

b. Complex numbers and quadratic equations:
Complex number a ordered pair of real , Representation of complex numbers in the form a+ib and their representation in a plane, Argand diagram, algebra of complex number , 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 root and coefficients, nature of roots, formation of quadratic equation with given roots.

c. 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.

d. 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 application.

e. Mathematical induction:
Principle of Mathematical Induction and its simple applications.

f. 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.

g. Sequences and series:
Arithmetic and Geometric progressions, insertion of arithmetic, geometric means between two given number. Relation between A.M. and G.M. Sum upto n tem1s of special series: Sn, Sn2, Sn3.Arithmetico Geometric progress ion.

h. Limit, continuity and differentiability:
Real - valued functions, algebra of functions, polynomial. Rational, trigonometric, logarithmic and exponential functions, inverse functions. Graphs of simple functions. Limit continuity and differentiability. Differentiation of the sum, difference. Product and quotient of two functions. Differentiation of trigonometric, inverse trigonometric, logarithmic, exponential, composite and implicit functions; derivative of order upto two. Rolle's and Lagrange's Mean Value Theorem. Applications of derivative: Rate of change of quantities-, monotonic - increasing and decreasing functions, Maxima and minima of functions of one variable. Tangents and normal's.

i. Integral calculus:

Integral as an anti- derivative. Fundamental integral involving algebraic, trigonometric. Exponential and logarithmic function .Integration by substitution, by part and by partial fractions. Integration using trigonometric identities .Evaluation of simple integrals of the type

$$\int \frac{dx}{x^2 \pm a^2}, \int \frac{dx}{\sqrt{x^2 \pm a^2}}, \int \frac{dx}{a^2 - x^2}, \int \frac{dx}{\sqrt{a^2 - x^2}}, \int \frac{dx}{ax^2 + bx + c}, \int \frac{dx}{\sqrt{ax^2 + bx + c}},$$

$$\int \frac{(px + q)dx}{ax^2 + bx + c}, \int \frac{(px + q)dx}{\sqrt{ax^2 + bx + c}}, \int \sqrt{a^2 \pm x^2}\, dx, \int \sqrt{a^2 - x^2}\, dx$$

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 curve in standard form.

j. Differential equations:

Ordinary differential equation, their order and degree. Formation of differential equation. Solution of differential equation by the method of separation of variable , solution of homogeneous and linear differential equation of the type:

$\frac{d(y)}{d(x)} + p(x)y = q(x)$

k. Co-ordinate geometry:

Cartesian y tern of rectangular co-ordinate I 0 in a plane, distance formula, section formula, locus and its equation, translation of axes, lope of a line, parallel and perpendicular lines, intercepts of a line on the coordinate axe .

Straight line:-

Various forms of equations of a line, intersection of lines, angles between two lines, conditions for concurrence of three lines, distance of appoint from a line, equations of internal bisectors of angles between two lines, coordinates of centroid, orthocentre 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 circle, general form of the equation of circle, general form of the equation of a circle, its radius and centre, equation of a circle when the end point of a diameter are given, points of intersection of a line circle with the centre at the origin and 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 forms, conditions for y=mx+c to be a tangent and point (s)of tangency.

l. Three dimensional geometry:

Coordinates of a point in space, distance between two points, section formula, direction ratios and direction. Cosines, angel between two intersecting lines. Skew lines, the shortest distance between them and its equation, Equations of a line and a plane, coplanar lines.

VECTOR ALGEBRA :

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.

m. Statistics and probability :
Measures of Dispersion : Calculation of mean , median, mode of grouped and ungrouped date calculation of standard deviation, variance and mean deviation for grouped and ungrouped date.

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

n. Trigonometry:
Trigonometrical identities and equations, Trigonometrical functions, inverse trigonometrical functions and their properties. Heights and Distances.

o. Mathematical reasoning :
Statements logical operations and, or, implies, implied by, if and only if Understanding of tautology, contradiction, converse and contra positive.

B. PHYSICS
The syllabus has two sections – A and B Section –A pertains to the Theory Part having 80% weightage, while Section – B contains Practical   Component (Experimental Skills) having 20% weightage.

SECTION –A

a. Physics And Measurement
Physics, technology and society , S I units , Fundamental and derived units.Least count accuracy and precision, Dimensions of Physical quantities , dimensional analysis and its application.

b. 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 accelerate motion, velocity – time, position – time graphs, and relations for uniformly accelerated motion. Scalars and Vectors, Vector addition and Subtraction. Zero Vector, scalar and Vector products, Unit vector , Scalar and Vector products, Unit Vector ,Resolution of a Vector , Relative Velocity Motion in a plane, Projectile Motion ,Uniform Circular Motion .

c. Laws Of Motion
Force and inertia, Newton's Second Low of motion; Impulse: Newton's Second Low 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,

d. 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.

e. Rotational motion:
Centre of mass of a two-particle system, centre of mass of a rigid body; Basic concepts of rotational motion ;moments of a force , torque , angular momentum , conservation of angular moment of inertia , radius of gyration Values of moments of inertia radius of gyration, Values of moments of intertie for simple geometrical objects, parallel and perpendicular axes theorems and their applications. Rigid body rotation, equations of rotational motion.

f. 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 enert; gravitational potential. Escape velocity. Orbital velocity of a satellite, Geo-Stationary satellites.

g. Properties Of Solids And Liquids
Elastic behavior, 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, calorimetry; change of state, latent heat. Heat transfer-conduction, convection and radiation, Newton's Law of cooling.

h. 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.

i. Kineticstheory Of Gases
Equation of state of perfect gas,work done on compressing a gas. Kinetic energy and temperature: RMS Speed of gas molecules; Degree of freedom, Law of equipartition of energy, applications to specific heat capacities of gases; Mean free path, Avogadro's number.

j. Oscillation And Waves
Periodic motion-period, frequency, displacement as a function of time. Periodic functions, Simple harmonic motion(S.H.M) and its equation; phase; oscillations of a spring-restoring force and force constant; energy in S.H.M.-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 wave. Displacement relation for a progressive wave. Principle of superposition of waves, speed of 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.

k. Electrostatics
Electric charges: Conversation 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 point of charge, 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 application to find field due to infinitely long uniformly charge straight wire, uniformly charged infinite plane sheet and uniformly charged straight wire, uniformly charged infinite plane sheet and uniformly charged thin special shell. Electric potential and its calculation for a point charge, electric dipole and system charges; Equipontential surfaces, Electrical potential energy of a system of two point charges in an electrostatics 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.

l. Current Electricity

Electric current, drift velocity, Ohm's Law, Electrical resistance, Resistance of different materials, V-I Characterstics of Ohmic and nonohmic 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, poetential difference and emf of a cell, combinations of cells in series and in parallel. Kirchoff's laws and their applications. Wheatstone bridege, Metrebridge. Potentiometer-Principle and its applications.

m. Magnetic Effects Of Current And Magnetism

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 fieles. Cyclotron.

Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current carrying conductors-definition of ampere. Torque experience by a current loop in uniform magnetic field. Moving coil galvanometer, its current sensitivity and conversion to ammeter and voltmeter.

Current loop as a magnetic dipole and its magnetic dipole moment. Bar magnet as an equivalent 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.

n. Electromagnetment Introduction 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/voltage; reactance and impedance; LCR series circuit, resonance; Quality factor, power in AC circuits, wattles current AC generator and transformer.

o. Electromagnetic Waves

Electromagnetic waves and their characteristic .Transverse nature of electromagnetic waves.Electromagnetic spectrum (ratio waves, microwaves, infrared, visible, ultraviolet, Xrays , gamma rays). Application of emf waves.

p. Optics

Reflection and refraction of light at plane and spherical surface, mirror formula. Total internal reflection and its application , 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; wave front and Huygens's principle, laws of reflection and refraction using Huygens's principle. interference, young's double slit experiment and expression for fringe width, coherent sources and sustained interference of light. Diffraction due to a single slit, width of central maximum. Resolving power of microscopes and astronomical telescopes, polarisation, plane polarized light and Polaroid's.

q. Dual Nature Of Matter And Radiation

Dual nature of radiation, photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation; Particle nature of light. Matter waves-wane nature of particle, de Broglie relation. Davision-Germer experiment.

r. Atom And Nuclei

Alfa particle scattering experiment; Rutherford's model of atom; Bohr model, energy level, hydrogen spectrum, composition and size of nucleus, atomic masses, isotopes, isobars: isotones, Radioactivity alpha, beta and gamma particles/rays 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.

s. Electronic Devices

Semiconductor; 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 voltage regulator, junction transistor, Transistor action, characteristics of transistor; transistor as a amplifier(common emitter configuration) and oscillator. Logic gates (OR, AND, NOT, NAND and NOR).Transistor as a switch.

t. Communication Systems

Propagation of electromagnetic waves in the atmosphere; Sky and space wave propagation, Need for modulation. Amplitude and Frequency Modulation, Amplitude and Frequency Modulation. Bandwidth of signals. Bandwidth of Transmission medium, Basic Elements of a Communication system (Block Diagram only).

SECTION –B

a. Experimental Skills

Familiarity with the basic approach and observations of the experimental and activities;

1. Venire calipers- its use to measure internal and external diameter and depth of vessel.
2. Screw gauge –its determine thickness/ diameter of thin sheet /wire.
3. Simple pendulum –dissipation of energy by plotting a graph between square of amplitude and time.
4. Metre scale –mass of a given objective by principle of moments.
5. Young's modules of elasticity of the material of a metallic wire.
6. Surface tension of water by capillary rise and effect of detergents.

7. Co-efficient of Viscosity of a given viscous. Liquid by measuring terminal velocity of a given spherical body.
8. Plotting a cooling curve for the relationship between the temperature of a hot body and time.
9. Speed of sound in air at room temperature using a resonance tube.
10. Specific heat capacity of a given (i) solid and (ii) liquid by method of mixtures.
11. Resistivity of a material of a given wire using Meter Bridge.
12. Resistivity of a given wire using Ohm's law.
13. Potentiometer-
    (i) Comparison of emf of two primary cells.
    (ii) Determination of internal resistance of a cell.
14. Resistance and figure of merit of a galvanometer by half deflection method.
15. Focal length of :
    (i) Convex mirror
    (ii) Concave mirror, and
    (iii) Convex lens
    Using parallax method
16. Plot of angle of deviation vs angle of incidence for a triangular prism.
17. Refractive index of a glass slab using a travelling microscope.
18. Characteristic curves of a p-n junction diode in forward and reverse bias.

19. Characteristic curves of a Zener diode finding reverse break down voltage
20. Characteristic curves of a transistor and finding Current gain and voltage gain.
21. Identification of Diode, LED, Transistor, IC Resistor, and Capacitor from mixed collection of such Itemd.
22. Using multimeter to:
    (i) Identify base of a transistor
    (ii) Distinguish between NPN and PNP type Transistor
    (iii) See the unidirectional flow of current in case of a diode and an LED.
    (iv) Check the correctness or otherwise of a given electronic component
        (diode, transistor or IC)

C. CHEMISTRY

SECTION:A

PHYSICAL CHEMISTRY

a. Some Basic Concepts Chemistry

Matter and its nature, Dalton's 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.

b. States Of Matter

Classification of matter into solid, liquid and gaseous States.

Gaseous State:

Measurable properties of gases; Gas laws – Boyle's law, Charle's law, Graham's law of diffusion, Avogadro's law, Dalton's law of partial pressure; Concept of Absolute scale of temperature; Ideal gas equation; Kinetic theory of gases (only postulates);Concept of average, root mean square and most probable velocities; Real gases, deviation from Ideal behavior, compressibility factor and van der Waals equation.

Liquid State:

Properties of liquids – vapour pressure, viscosity and Surface tension and effect of temperature on them (qualitative treatment only).

Solid State:

Classification of solids: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea); Bragg's Law and its applications: Unit cell and lattices, packing in solids (fcc, bcc and hcp lattices), voids, calculations involving unit cell parameters, imperfection in solids; Electrical and magnetic properties.

c. Atomicstructure

Thomson and Rutherford atomic models and their limitations; Nature of electromagnetic radiation, Photoelectric effect; Spectrum of hydrogen atom, Bohr model of hydrogen atom – its postulates, derivation of the relations for energy of the electron and radii of the different orbits, limitations of Bohr's model; dual nature of matter, de-Broglie's relationship, Heisenberg uncertainty principle, Elementary ideas of quantum mechanics, quantum mechanical model of atom, its important features. Concept of atomic orbitals as one electron wave functions; Variation of and with r for 1s and 2s orbitals; various quantum numbers (principal, angular momentum and magnetic quantum numbers) and their significance; shapes of s, p and d-orbitals, electron spin and spin quantum number; Rules for filling electrons in orbitals-aufbau Principle, Pauli's exclusion principle and Hund's rule, electronic configuaration of elements, extra stability of half-filled and completely filled orbitals.

d. Chemical Bonding And Molecular Strucure

Kossel- Lewis approach to chemical bond formation concept of ionic and covalent bonds,

Ionic Bonding: Formation of ionic bonds, factors affecting the formation of ionic bonds; calculation of lattice enthalpy.

Covalent Bonding: Concept of electronegativity, Fajan'rule , dipole moment; Valence Shell Electron Pair Repulsion(VSEPR) theory and shapes of simple molecules.

Quantum mechanical approach to covalent Bonding:

Valence bond theory – Its important features, concept of hybridization involving s, p and d orbitals Resonance.

Molecular Orbital Theory- Its important features, LCAOs, types of molecular orbital (bonding, antibonding), sigma and pi-bonds, molecular orbital electronic configurations of homo-nuclear diatomic molecules, concept of bond order, and bond length and bond energy.

Elementary idea of metallic bonding. Hydrogen bonding and Its applications.

e. Chemical Thermodynamics

Fundamentals of thermodynamics: System and surroundings, extensive and intensive properties, state functions, types of processes.

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: Spontancity of processes: As of the universe and AG of the system as criteria for spontaneity, AG (Standard Gibbs energy change) and equilibrium constant.

f. Solutions
Different methods for expressing concentration of solution – molality, molarity, mole fraction, percentage (by volume and mass both), vapour pressure of solutions and Raoult's Law- Ideal and non-ideal solutions, vapour pressure – composition, plots for ideal and non-ideal solutions: Colligative properties of dilute solution – relative lowering of vapour pressure, depression of freezing point, elevation of boiling point osmotic pressure; Determination of molecular mass using colligative properties; Abnormal value of molar mass, van't Hoff factor and its significance.

g. Equilibrium
Meaning of equilibrium, concept of dynamic equilibrium.

Equilibria involving physical processes: Solid –liquid, liquid – gas and solid – gas equilibria,Henry's law, general characterics of equilibrium involving physical processes,

Equilibria involving chemical process: Law of chemical equilibrium, equilibrium constants (Kp and Kc) and their significance, significance of AG and AG in chemical equilibria, factors affecting equilibrium concentration, pressure, temperature, effect of catalyst; Le Chatelier's principle.

Ionic equilibrium: Weak and strong electrolytes, ionization of electrolytes, various concepts of acids and bases(Arrhenius, Bronsted - Lowry and Lewis)and their ionization ,acid – baseequilibria (including multistage ionization)and ionization constants, ionization of water, pH of scale, common ion effect, hydrolysis of salts and pH of their solutions, solubility of sparingly soluble salts and solubility products, buffer solutions.

h. Redoxreactions And Electrochemistry

Electronic concepts of oxidation and reduction, redox reactions, oxidation number, rules for assigning oxidation number, balancing of redox reactions.

Eectrolytic and metallic conduction, conductance in electrolytic solutions, molar conductivities and their variation with concentration: Kohlrausch's law and its applications.

Electrochemical cells – Electrolytic and Galvanic cells, different types of electrodes, electrode potentials including standard electrode potential, half – cell and cell rections, emf of a Galvanic cell and its measurement; Nernst equation and its applications; Relationship between cell potential and Gibbs' energy change; Dry cell and lead accumulator; Fuel cells.

i. Chemical Kinetics
Rate of a chemical reaction, factors affecting the rate of reaction: concentration, temperature, pressure and catalyst; elementary and complex reactions, order and molecularity of reactions, rate law, rate constant and its units, differential and integral forms of zero and first order reactions, their characteristics and half-lives, effect of temperature on rate of reactions- Arrhenius theory, activation energy and its calculation, collision theory of bimolecular gaseous reactions(no derivation).

j. Surface Chemistry
Adsorption-Physisorption and chemisorptions and their characteristics, factors affecting adsorption of gases on solids – Freundlich and Langmuir adsorption isotherms, adsorption from solutions.
Catalysis -Homogeneous and heterogeneous activity and selectivity of solid catalysts, enzyme catalysis and its mechanism.
Colloidal state-distinction among true solution colloids and suspensions, classification of colloids- lyophilic, lyophobic; multimolecular, macromolecular and associated colloids (micelles),preparation and properties of Colloids – Tyndall effect, Brownian movement, electrophoresis, dialysis, coagulation and flocculation; Emulsions and their characteristics.

SECTION – B

INORGANIC CHEMISTRY

a. Classification Of Elements   And Periodicity In Properties
Modem periodic law and present from of the periodic table s, p, d and f block elements, periodic trends in properties of element atomic and ionic radii, ionization enthalpy, electron gain enthalpy, valence, oxidation states and chemical reactivity.

b. General Principles And Processes Of Isolation Of Metals
Modes of occurrence of elements in nature , minerals, ores; steps involved in the extraction of metals – concentration reduction (chemical and electrolytic methods) and refining with special reference to the extraction of Al, Cu and Zn Fe; Thermodynamic and electrochemical principles involved in the extraction of metals.

c. Hydrogen
Position of hydrogen in periodic tables, isotopes, preparation, properties and uses of hydrogen; Physical and chemical properties of water and heavy water: Structure, preparation, reactions and uses of hydrogen peroxide: Classification of Hydrogen as a fuel.

d. S Block Elements (Alkali And Alkalineearthmetals)
Group -1 and 2 Elements

General interdiction electronic configuration and general trends in physical and chemical properties of elements, anomalous properties of the first element of each group, diagonal relationships.

Preparation and properties of some impotents compounds – sodium carbonate and sodium hydrogen and sodium hydrogen carbonate: industrial use s of lime, limestone, plaster of Paris and cement, Biological signification of Na, K, Mg and Ca.

e. P Block Elements

Group -13 to Group 18 Elements

General introduction: Electronic configuration and general trends in physical and chemical properties of elements across the periods and down the groups: unique behavior of the first element in each group.

GroupWise study of the P – block elements Group -13

Preparation, properties and use of boron and aluminum: Structure , properties and uses of borax, boric acid, diborane, boron trifluoride , aluminum chloride and alums

Group – 14

Tendency for catenation: Structure, properties and uses of Allotropes and oxides of carbon, silicon tetrachloride, silicates, zcolites and silicones.

Group -15

Properties and uses of nitrogen and phosphorus : Allotropic forms of phosphorus and preparation , properties , structure and uses of ammonia , nitric , acid , structures of oxides and oxoacids of nitrogen and phosphorus ,

Group -16

Preparation, properties, structure and uses of ozone: Allotropic forms of sulphur: Preparation, properties, structure and uses of sulphuric acid (including its industrial preparation); Structures of oxoacide of sulphur.

Group – 17

Preparation, properties and uses of hydrochlorides acid: Trends in the acidic nature of hydrogen halides: structures of Interhalogen compounds and oxide and oxoacide of halogens.

Group - 18

Occurrence and uses of noble gases, structures of fluorides and oxides of xenon.

f. d and –block elements

Transition Elements : General introduction , elements configuration , occurrence and characteristics, general trends in properties of the first row transition elements – physical properties , ionization enthalpy , oxidation states , atomic radii, colour, catalytic behavior, magnetic properties , complex formation , interstitial compounds , alloy formation : properties and uses of K2 Cr2 O2 KMnO4.

Inner Transition Elements

Lanthanides - Electronic configuration, oxidation states and lanthanoide contraction.

Antinodes – Electronic configuration and oxidation states,

g. Co – Ordination Compounds

Interdiction to co-ordination compounds Werner's theory: ligands, co-ordination number, denticity, chelation : IUPAC nomenclature of mononuclear co- ordination compounds, isomerism: Bonding – Valence bond approach and basic ideas of Crystal field theory , colour and magnetic properties : impotence of co- ordination compounds (in qualitative analysis extraction of metals and in biological systems).

h. Environmental Chemistry

Environmental pollution: Atmospheric, water and soil.

Atmospheric pollution: Tropospheric and Stratospheric.

Tropospheric pollutants: Gaseous pollutants: Oxides of carbon, nitrogen and sulphur, hydrocarbon, their sources, harmful effects and prevention; Green house effect and Global warming; Acid rain;

Particular pollutants: Smoke, dust, smog, fumes, mist; their sources, harmful effects and prevention.

Stratospheric pollution: formation and breakdown of ozone, depletion of ozone layer-its mechanism and effects.

Water pollution: Major pollutants such as : Pesticides (insecticides and fungicides),their harmful effects and prevention.

Soil pollution: Major pollutants such as: Pesticides (insecticides, herbicides and fungicides) their harmful effect and prevention. Strategies to control environmental pollution.

SECTION –C

ORGANIC CHEMISTRY

a. Purification And Characterisation Of Organic Compounds
    Purification: Crystallization, sublimation, distillation, differential extraction and chromatography- principles and their applications.
    Qualitative analysis: Detection of nitrogen ,sulphur, phosphorus and halogens.
    Quantitative analysis(basic principles only)-Estimation of carbon, hydrogen, nitrogen, halogens, sulphur, phosphorus. Calculation of empirical formulae and molecular formulae; Numeric problems in organic quantitative analysis.

b. Some Basic Principle Of Organic Chemistry
    Tetravalency of carbon; Shapes of simple molecules hybridization (s and p);classification of organic compounds based on functional groups: and those containing, halogens, oxygen, nitrogen, sulphur; Homologous series ;Isomerism-structural and stereoisomerism.
    Nomenclature (Trivial and IUPAC)
    Covalent bond fission-Homolytic andhetrolytic free radicals, carbocation and carbanions; stability of carbocations and free radicals, electrophiles and nucleophiles. Electronics displacement in a covalent bond-Inductive effect ,electronic effect, resonance and hyperconjugation. Common types of organic reaction-Substitution, addition, elimination and rearrangement.

c. Hydrocarbons
    Classification, isomerism IUPAC nomenclature, general methods of preparation, properties and reactions.
    Alkenes-Conformation Sawhorse and Newman projections (of ethen) Mechanism of halogenations of alkenes.
    Alkanes: Geometrical isomerism; Mechanism of electrophilic addition; addition of hydrogen, halogens, water, hydrogen halides (Markownikoffs and peroxide effect); ozonolysis and polymerization.
    Alkynes: Acidic character; Addition of hydrogen, halogens, halogens, water, hydrogen halides; Polymerization.
    Aromatic hydrocarbons: Nomenclature, benzene structure and automatically; Mechanism of electro philic substitution; halogenations, nitration, Friedel –Craft's alkylation and acylation, directive influence of Functional group in mono-substituted benzene.

d. Organic Compounds Containing Halogens
    General methods of preparation, properties and reactions; Nature of C–X bond; Mechanism of substitution reactions. Uses:Environmenaleffects of choloform, iodoformfreons and DDT.

e. Organic Compounds Containing Oxygen
    General methods of preparation, properties, reactions and uses.

    ALCOHOLS,PHENOLS AND ETHERS
    Alcohols: Identification of primary, secondary and tertiary alcohols, mechanism of dehydration.Phenols: Acidic nature, electrophilic substitution reaction: Halogenations, nitration and sulphonation, Reimer-Tiemann reaction.
    Ethers: Structure
    Aldehyde and Ketones: Nature of carbonyl group; Nuclephilic addition to > C=O group, relative relativities of aldehydes and ketones; Important reactions such as-

necleophiluc addition reactions (addition of HCN,NH and its deriuvatives),Grignard regent; Oxidation ;reduction (WolffKishner and Clemmensen); acidity of α-hydrogen, aldol condensation, cannizzaro reaction, Haloform reaction.Chemical tests to distinguish between aldehydes and Ketones.

CARBOXYLICACIDS

Acidic strength and factors affecting it.

f. Organiccompounds Containing Nitrogen
General methods of preparation, properties, reactions and uses.

Amines: Nomenclature, classification, structure, basic character and identification of primary, secondary and tertiary amines and their basic character.
Diazonium Salts: Importance in synthetic organic chemistry.

g. Polymers
General introduction and classification of polymers, general methods of polymerization addition and condensation, copolymerization-addition and condensation, copolymerization. Natural and synthetic rubber and vulcanization: some important polymers with emphasis on their monomers and uses-polythene, nylon, polyester and Bakelite.

h. Biomolecules
General introduction and importance of biomolecules.

- o **Carbohydrates**: Classification: aldoses and ketoses; monosaccharides (glucose and fructose) and constituent monosaccharides of oligosaccharides (sucrose, lactose and maltose).
- o **Proteins:** Elementary Idea of α-amino acids, peptide bond, polypeptides; Proteins: primary, secondary, tertiary and quaternary structure (qualitative idea only) denaturation of proteins, enzymes.
- o **Vitamins:** Classification and functions
- o **NucleicAcids-**Chemical constitution of DNA and RNA. Biological functions of nucleic acids.

i. Chemistry In Everyday Life
Chemicals in medicines: Analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertilitydrugs, antibiotics, antacids, antihistamins-their meaning and common examples.

Chemicals in food: Preservatives, artificial sweetening agents-common examples

Cleansing agents: Soap and detergents, cleansing action.

j. Principles Related To Practical Chemistry
  - ➤ **Detection of extra elements (N.S.halogens) in organic compounds;**Detection of the following Functional groups: hydroxyl (alcoholic and phenolic) carbony1 (aldehyde and ketone), carboxy1 and amino groups in organic compounds.
  - ➤ **Chemistry involved in the preparation of the following:**
    Inorganic compounds: Mohr's salt, potash alum. Organic compounds: Acetanilide, pnitroacetanilide - Acids bases and the use of indicators, oxalic-acid vs KMnO4, Mohr's salt vs KMnO4.

> **Chemical principles involved in the qualitative salt analysis:**
> Cations-Pb2,Cu2,AC3+,Fe3+,Zn2+,Ni2+,Ca2+,Ba2+,Mg2+,NH4+
> Anions-CO2-3.S2-, SO42-, NO3-.NO2-,Cl-,Br-,L-.
> (Insoluble salts excluded).
> **Chemical principles involved in the following experiments:**
> 1.Enthalpy of solution of $CuSO_4$,
> 2. Enthalpy of neutralization of strong acid and strong base.
> 3. Preparation of lyophilic and lyophobic sols.
> 4. Kinetic study of reaction of iodide ion with hydrogen peroxide at room temperature.

ANNEXURE 2: LATERAL ENTRY TO B. TECH (3 YEAR PROGRAMME)

ANNEXURE2.1: Lateral Entry to B. Tech. for Diploma Students (LE – TECH. (Diploma))

A. ENGINEERING MATHEMATICS – 40 Questions

a. 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.

b. 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.

c. Trigonometry:

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

d. 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.

e. 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.

f. 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.

g. 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)

h. 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.

i. 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

a. 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.

b. 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.

c. 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.

d. 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)

e. 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.

f. 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.

g. 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)**

C1. BASIC ELECTRICAL ENGINEERING (20 Questions)

a. 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.

b. 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 emfEb 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.

c. 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.

d. 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)

a. 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.

b. 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.

c. 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).

d. 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.

ANNEXURE 2.2: Lateral Entry to B. Tech. for B. Sc. Students (LE – TECH. (B.Sc.))

A. MATHEMATICS (+ 2 Level)

a. **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 , co-domain 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, exponential function, greatest integer function. surjective, injective and bijective functions, sum , difference and quotient of functions and their range, Composite function, Inverse of a function.

b. **Number system :**

Real numbers (algebraic and order properties, rational and irrational numbers), Absolute value, Triangle inequality, $AM \geq GM$, 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 roots 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.

c. **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).

d. **Trigonometry :**

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

e. **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 line equations 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.

f. **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.

g. **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

h. **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.

i. **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.

j. **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.

k. **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 $dy/dx + p(x)y = q(x)$,

l. **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)**

a. **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 $\nabla\nabla.B=0$, $\nabla\times B,= \mu 0J$, 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.

b. **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.

c. **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.

d. **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)

a. **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.

b. **Liquids :**

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

c. **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.

d. 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.

e. Solutions :

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

f. 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.

g. 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 thermo chemical data, temperature dependence of enthalpy. Kirchoff's equation. Third law of Thermodynamics.

h. Chemical equilibrium :

Equilibrium constant and free energy. Relationship between K_p, K_c, K_x. Derivation of law of mass action (Study of homogeneous and heterogeneous equilibria). Le chaterlier's principle.

i. Ionic equilibria :

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

j. 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).

k. 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, conductometrictitration(acid-base).

l. **Electrochemistry-II:**

Types of reversible electrodes- gas metal ion, meta-metal ion, metalinsoluble 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 ofbuffer action, Henderson equation. Hydrolysis of salts (quantitative treatment).

m. **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.

n. **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.

o. **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, ClF_3, ICl_2 and H_2O. MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules.

p. **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, $SOCl_2$.

q. **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.

r. **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- SN_1 , SN_2, SE_1, SE_2 , E_1, E_2, AdE, AdN,

s. **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.

t. **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. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoffs and anti-Markownikoffs addition), Hydration, Ozonolysis, Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC_2 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.

u. **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).

v. **Alkyl and Aryl Halides**

Alkyl Halides (Up to 5 Carbons) Types of Nucleophilic Substitution (SN_1, SN_2 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: KNH_2/NH_3 (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. HNO_3). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

w. **Phenols:**

(Phenol case) Preparation: Cumenehydroperoxide 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, $NaHSO_3$, 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.

x. **Amines and Diazonium Salts**

Amines (Aliphatic and Aromatic): (Upto 5 carbons) Preparation: from alkyl halides, GabrielsPh- thalimide synthesis, Hofmannbromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten Baumann Reaction. Electrophilic substi- tution (case aniline): nitration, bromination, sulphonation. Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes.

y. Amino Acids:

Preparation of Amino Acids: Strecker synthesis using Gabrielsphthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis. Reactions of Amino acids: ester of COOH group, acetylation of NH_2 group, complexation with Cu_2+ ions, ninhydrin test.

ANNEXURE 3:MBA (2 YEARS COURSE)

A. Quantitative Techniques – 30 Questions

B. Analytical and Logical Reasoning – 30 Questions

C. Verbal Reasoning and Comprehension – 30 Questions

D. General Awareness and Business Fundamentals – 30 Questions

ANNEXURE 4:MTECH (2 YEARS COURSE)

A. Analytical and Logical Reasoning – 10 Questions

B. ENGINEERING MATHEMATICS – 20 Questions

a. Ordinary Differential Equations:

Solution of first order , second order and higher order differential equations(separable equation, exact differential equation, homogeneous equation with constant co efficient, Euler Cauchy equations ,solution by undetermined coefficients and variation of parameters)

b. Linear Algebra:

Matrices ,Vectors, Determinants and linear system of equations ,Eigen value problems, symmetric, skew symmetric ,orthogonal matrices .Complex matrices ,Hermitian , Skew Hermitian and Unitary matrices, Similarity of matrices.

c. Fourier series

Fourier series and expansion of functions of any period, odd and even functions, half range expansion.

d. Laplace Transform

Use of Laplace transform for solving differential equations, Convolution and Integral equations.

e. Complex Analysis

Analytic functions, Cauchy-Riemann equations, Laurent's series, singularities and zeros.

f. Numerical Methods:

Interpolation, numerical integration, solution of first order ordinary differential equations.

g. Probability and Statistics

Probability distribution (discrete and continuous) , sampling distribution, correlation and regression analysis.

C. Branch Subject (Respective Branch) – 60 Questions

COMPUTER SCIENCE ENGINEERING

a. Digital Logic:

Logic functions, Minimization, Design and synthesis of combinational and sequential circuits; Number representation and computer arithmetic (fixed and floating point).

b. Computer Organization and Architecture:

Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage.

c. Programming and Data Structures:

Programming in C; Functions, Recursion, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps.

d. Algorithms:

Analysis, Asymptotic notation, Notions of space and time complexity, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide-and conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching. Asymptotic analysis (best, worst, average cases) of time and space, upper and lower bounds, Basic concepts of complexity classes–P, NP, NP-hard, NP-complete.

e. Theory of Computation:

Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undecidability.

f. Compiler Design:

Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization.

g. Operating System:

Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security.

h. Internet and Web Technology:

Internet and web, IPv4 vs IPV6, Web client & server, HTML

i. Networking:

OSI layer, protocols in various layers, Different media in physical layer, TCP/IP, SMTP/Pop3, FTP.

ELECTRICAL ENGINEERING

a. Electric Circuits and Fields:

Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks; sinusoidal steady-state analysis, resonance, basic filter concepts; ideal current and voltage sources, Thevenin's, Norton's and Superposition and Maximum Power Transfer theorems, two- port networks, three phase circuits; Gauss Theorem, electric field and potential due to point, line, plane and spherical charge distributions; Ampere's and Biot-Savart's laws; inductance; dielectrics; capacitance. Mutual Inductance; Tuned coupled Circuit.

b. Signals and Systems:

Representation of continuous and discrete-time signals; shifting and scaling operations; linear, time-invariant and Causal systems; Fourier series representation of continuous periodic signals; sampling theorem; Fourier, Laplace and Z transforms; Wavelet analysis.

c. Electrical Machines:

Single phase transformer–equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers–connections, parallel operation; autotransformer; energy conversion principles; DC machines–types, windings, generator characteristics, Excitation, armature reaction andcommutation, starting and speed control of motors; three phase induction motors–principles, types, performance characteristics, starting, speed control and applications; salient / two reaction theory analysis; single phase induction motors; synchronous machines–performance, regulation and parallel operation of generators, motor starting, characteristics and applications; servo and stepper motors.

d. Power Systems:

Basic power generation concepts; transmission line models and performance; Mechanical Design (Tension, sag etc); cable performance, insulation; corona and radio interference; distribution systems; per-unit quantities; bus impedance and admittance matrices; load flow; voltage control; power factor correction; economic operation; symmetrical components; fault analysis; principles of over-current, differential and distance protection; solid state relays and digital protection; circuit breakers; system stability concepts, swing curves and equal area criterion; HVDC transmission and FACTS concepts for power quality, Reactive power compensation, Automatic generation control; Renewable Energy Power generation (PV/wind).

e. Control Systems:

Principles of feedback; transfer function; block diagrams; steady-state errors; Routh and Nyquist techniques; Bode plots; root loci; lag, lead and lead-lag compensation; state Pole-zero addition, Stability of transfer function(system);space model; state transition matrix, controllability and observability.

f. Electrical and Electronic Measurements:

Bridges and potentiometers; PMMC, moving iron, dynamometer and induction type instruments; Potentiometer, Galvano meters, Damping scheme measurement of voltage, current, power, energy and power factor; instrument transformers; digital voltmeters and multimeters; phase, time and frequency measurement; Q-meters; oscilloscopes; potentiometric recorders; error analysis.

g. Analog and Digital Electronics:

Characteristics of diodes, BJT, FET; amplifiers–biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers–characteristics and applications; simple active filters; VCOs and timers; combinational and sequential logic circuits; multiplexer and De-multiplexer; Schmitttrigger; multi-vibrators; sample and hold circuits; A/D and D/A converters, 8051 micro controller. Introduction to 8085/8086 microprocessor basics & architecture, programming and interfacing of I/O devices.

h. Power Electronics and Drives:

Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs – static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters –fully controlled and half controlled; principles of choppers and inverters; basic concepts of adjustable speed dc and ac drives and variable frequency drive. Dual Converters.

ELECTRONICS ENGINEERING

a. Network:

Mesh and nodal Analysis, Network theorems: superposition, Thevenin and Norton's maximum power transfer, Wye-Delta transformation. Steady state sinusoidal analysis using phasors. Linear constant coefficient differential equations; time domain analysis of simple RLC circuits, Solution of network equations using Laplace transform: frequency domain analysis of RLC circuits. 2-port network parameters: driving point and transfer functions. State equations for networks. Series and parallel resonance

b. Analog Electronics:

Energy bands in silicon, intrinsic and extrinsic silicon. Carrier transport in silicon: diffusion current, drift current, mobility, and resistivity. Generation and recombination of carriers. p-n junction diode, Zener diode, tunnel diode Characteristics of diode, BJT, JFET and MOSFET. Diode circuits. Transistors at low and high frequencies, Amplifiers, single and multi-stage. Feedback amplifiers. Operational amplifiers,characteristics and circuit configurations. Precision rectifier. V-to-I and I-to- V converter. Opamp based active filters. Oscillators and signal generators.

c. Digital Electronics:

Boolean algebra, minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinatorial circuits: arithmetic circuits, code converters, multiplexers, decoders, Sequential circuits: latches and flip-flops, counters and shift-registers. Sample and hold circuits, ADCs, DACs. Semiconductor memories. Microprocessor (8086): architecture, programming, memory and I/O interfacing.

d. Signals, Systems and Communications:

Periodic and aperiodic signals. continuoustime and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and FFT, z-transform.,transfer function, Impulse and frequency response of first- and

second order systems. Convolution, correlation and characteristics of linear time invariant systems. Pulse transfer function. IIR and FIR filters. Amplitude and frequency modulation and demodulation. Sampling theorem, pulse code modulation. Frequency and time division multiplexing. Amplitude shift keying, frequency shift keying and pulse shift keying for digital modulation.

e. Control Systems:

Open loop and closed loop (feedback) systems and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of LTI control systems and frequency response. Tools and techniques for LTI control system analysis: root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Control system compensators: elements of lead and lag compensation, elements of Proportional-Integral-Derivative (PID) control. State variable representation and solution of state equation of LTI control systems.

f. Electromagnetics:

Elements of vector calculus: divergence and curl; Gauss' and Stokes' theorems, Maxwell's equations: differential and integral forms. Wave equation, Poynting vector. Plane waves: propagation through various media; reflection and refraction; phase and group velocity; skin depth.

g. Instrumentation and Measurement:

Static and dynamic characteristics of Instrument, Basic electrical measurement such as Resistance, Inductance and capacitance, oscilloscope and Multimeter.

MECHANICAL ENGINEERING

a. APPLIED MECHANICS AND DESIGN

I. Engineering Mechanics:

Freebody diagrams and equilibrium; trusses and frames; kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations; impact.

II. Strength of Materials:

Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for Plane stress and plane strain, thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; strain energy methods.

III. Theory of Machines:

Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels.

IV. Vibrations:

Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, critical speeds of shafts.

V. Design:

Design for static and dynamic loading; failure theories; fatigue strength and the SN curve; principles of the design of machine elements such as bolted, riveted and welded joints, shafts, spur gears, rolling and sliding contact bearings, brakes and clutches.

b. FLUID MECHANICS AND THERMAL SCIENCES

I. Fluid Mechanics:

Fluid properties; fluid statics, manometry, buoyancy; control- volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc.

II. Heat-Transfer:

Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, lumped heat capacity, heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, concept of using various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

III. Thermodynamics:

Zeroth, First and Second law soft thermodynamics; thermodynamic system and processes; Carnot cycle. Basic concept of availability and irreversibility; behavior of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion.

IV. Applications:

Power Engineering: Steam Tables, Rankine, Brayton cycles with regeneration and reheat .I.C. Engines: air-standard Otto, Diesel cycles. Refrigeration and air-conditioning: Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychrometric chart, basic psychrometric processes. Turbomachinery: Pelton-wheel, Francis and Kaplan turbines—impulse and reaction principles, velocity diagrams.

C. MANUFACTURING AND INDUSTRIAL ENGINEERING

I. Engineering Materials:

Structure and properties of engineering materials, crystal imperfections, heat treatment, T-T-T diagrams for engineering materials.

II. Metal Casting:

Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations.

III. Forming:

Plastic deformation of metals; fundamentals of hot and cold working processes; forging, rolling, extrusion, drawing and sheet metal forming processes; shearing, deep drawing, bending, principles of powder metallurgy.

IV. Joining:

Physics of welding, brazing and soldering; gas welding and arc welding; design considerations in welding.

V. Machining and Machine Tool Operations:

Mechanics of machining, single and multipoint cutting tools, tool geometry and materials, tool wear and ; economics of machining; principles of non-traditional machining processes; principles of work holding, principles of design of jigs and fixtures.

VI. Metrology and Inspection:

Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; measurement of surface roughness; Measurement of straightness and flatness, tolerance analysis in manufacturing and assembly.

VII. Computer Integrated Manufacturing:

Basic concepts of CAD/CAM and Computer Integrated Manufacturing.

VIII. Production Planning and Control:

Forecasting models, aggregate production planning, scheduling, materials requirement planning.

IX. Inventory Control:

Deterministic and probabilistic models; safety stock inventory control systems.

X. Modern Trends in Manufacturing:

Just in time systems, Supply chain management.

NOTE: For M. Tech in Mechatronics the students should follow either Mechanical or Electrical or Electronics Subject syllabus.