SYLLABUS FOR OJEE – 2020

Odisha Joint Entrance Examination (OJEE) is conducted with a view to preparing merit lists for admission in various professional courses in the State. The decision of the OJEE Committee as regards to the scope of the syllabus is final.

1. B. Pharm

A. PHYSICS (+ 2 Level) - (45 Questions)

Measurements and Motion: Fundamental and derived physical quantities, Concept of Mass, Length and Time, Measurement of different quantities in SI Units. Practical units for measurement of microscopic and macroscopic lengths (AU, light year, parsec, nanometer, A^0) .Accuracy and precision of measuring instruments. Errors in measurement, Combination of errors, significant figures. Dimension of physical quantities, Dimension analysis of physical quantities- Conversion of physical quantities from one system of units to another. Concepts of vectors and scalars, Components of vectors, Unit vectors, Addition(triangles law, parallelogram law, polygons law), Subtraction and Multiplication (vector & scalar) of vectors. Lami's theorem. Frame of reference. Equations of linear motion for uniformly accelerated bodies (by calculus and graphical method). Newton's laws of motion, impulse momentum theorem Conservation of energy and momentum, laws of friction, sliding and rolling friction. Motion in a plane: projectile motion, Circular Motion- radial and tangential acceleration, Centripetal force, Banking of tracks, Work , energy, power: work done by constant and variable force, work energy theorem, potential energy of a spring, motion in a vertical circle, elastic and inelastic collision in one and two dimensions. Kepler's laws of Planetary Motion (Statements only). Newton's law of Gravitation. Gravitational field and potential, variation of g with altitude and depth. Earth satellites- Orbital and Escape velocities. Geo stationary satellites. Moment of inertia, radius of gyration, theorems of moment of inertia, Moment of Inertia for rod, ring and circular disc. Center of mass of two particle system and rigid body, motion of center of mass, moment of force, torque, angular momentum, laws of conservation of angular momentum and its applications.

Heat & Thermodynamics: Concept of heat and temperature, Scales of Temperature (Celsius, Fahrenheit, Kelvin), Definition of mechanical equivalent of heat (J), Thermal energy, Heat Capacity, Specific heat of solids and liquids, Latent heat, principle of calorimetry , thermal expansion of solids, liquids and gases. Heat transfer-Thermal conductivity of solids, Steady state, determination of thermal conductivity by Searles method. Kirchhoff's laws of heat radiation, Stefan's law of heat radiation, Wien's law, Newton's Law of cooling.

Kinetic Theory of gases- Pressure of an ideal gas, mean and RMS speed, Kinetic interpretation of temperature, Degrees of freedom, Law of equipartition of energy. Concept of mean free path.

Zeroth law of thermodynamics, first Law of thermodynamics, Specific heats of a gaseous system, Relation between Cp and Cv, Work done during Isothermal and Adiabatic

processes, Carnot's conceptual heat engine and its efficiency ,co efficient of performance of refrigerator, Second law of thermodynamics, Absolute Scale of Temperature.

Characteristics of Materials: Elastic and Plastic behaviors of solids, Elastic limit, Hooke's law. Young's modulus, Shear and Bulk modulus, Poisson's ratio.

Liquids : Pressure due to liquid column, Pascal's law and its applications**.** Surface Tension and Surface Energy, Excess pressure across a spherical liquid surface, angle of contact and expression for capillary rise. Streamlined and turbulent flow, equation of continuity, Bernoulli's equation and its application, Viscosity- coefficient of viscosity and its variation with temperature and pressure., Stokes law and terminal speed

Electricity & Magnetism : Coulombs law and conservation of charge, electric flux, Gauss law and its applications**.** Electric field intensity and Potential at a point in an electric field, Relation between them, electric potential and field due to an electric dipole, torque and potential energy of a dipole in external electric field. Capacitance- dielectric constant and its effect on capacitance. Series and parallel grouping of capacitances, Energy stored in a charged capacitor, dielectrics and electric polarization .Electric current, drift velocity and mobility of charge carriers. Ohm's law, Variation of resistance of metallic conductors with temperature, Kirchhoff's laws and its application to a balanced Wheatstone bridge .Internal resistance of a cell , potential difference and emf of a cell. Combination of Cells and resistors- series and parallel. Heating effect of electric current and Joule's law, Electric power and electric energy.

Magnetic Permeability and Susceptibility of materials, Properties of dia, para and ferro magnetic materials. magnetic elements of Earth. Biot–Savart's and Amperes law- Magnetic Field due to a st conductor and circular coil.. Moving coil galvanometer (dead beat only). Force on a moving charge and current carrying conductor in a uniform magnetic field. Force between two parallel current carrying st conductors .Torque, experienced by a current loop, moving coil galvanometer and its conversion to ammeter and voltmeter. Faraday's laws of electromagnetic induction, Lenz's law, emf induced in a rotating coil in a magnetic field. Self and Mutual induction, Alternating current: Phase relation between Voltage and Current in pure resistive, pure capacitive, pure inductive and series LCR circuits. Power factors, wattles current. Principle of transformer, elementary idea on electromagnetic waves. electromagnetic spectrum, basic idea of displacement current.

Wave motion: Simple harmonic motion, oscillation of a loaded spring , simple pendulum , qualitative ideas about free, damped and forced oscillations. wave propagation, characteristics of wave motion, longitudinal and transverse waves, superposition of waves:- Stationary waves, Beats. Open and closed organ pipes, velocity of sound in air- effect of pressure, temperature and humidity on it. Doppler Effect, laws of transverse vibration of string (Statement only).

Optics: Reflection and refraction at curved surfaces. Spherical mirror and thin lens formula and refraction through prism. Total internal reflection, Dispersion, Huygens principle (statement only), Young's double slit experiment .Interference in light.

Optical instruments: simple magnifier, compound microscope and astronomical telescope.

Electronic Devices: Thermionic emission, Statement of Richardson's equation and Child's Law, Vacuum triode- construction and characteristics, relationship between valve constants,

Descriptive idea of energy bands:- conductors, insulators and semi conductors, Intrinsic and extrinsic semiconductors, p-type and n-type semiconductors. PN junction, PNP and NPN transistor, PN Junction as a rectifier. Working of solar cells, photo diodes and LED .Elementary idea about OR, AND, NOT, NOR , NAND ,XOR, XNOR gates.

Atomic and Nuclear Physics: Bohrs atomic model, expression for radius, velocity , energy , frequency of an electron in nth orbit .Rydberg constant and Hydrogen spectra .Einstein photoelectric equation, dual nature of radiation and Debroglie wavelength. mass energy equivalence relation (Statement only).Atomic nucleus, nuclear forces, nuclear mass, binding energy, mass defect, artificial radio activity, radio isotopes and their uses. Nuclear fission, energy released during nuclear fission, chain reaction, controlled chain reaction, nuclear fusion, energy generation in the Sun, radiation hazards.

B. CHEMISTRY (+ 2 Level) - (45 Questions)

General Behaviour of Matter:

Solid State: Characteristics, Classification, Solubility, Melting points, Crystal structure of simple ionic compounds. Radius ratio and coordination number: density calculation, lattice points and voids.
Liquid State: Characteristics, Boiling and Freezing points, Viscosity, Surface tension, Osmosis and Osmotic Pressure, Raoult's law, Lowering of vapour pressure, Depression of freezing points, Elevation of boiling points, Anomalous molecular masses; Association and dissociation.
Solutions: Types of solutions, concentration and different ways of expressing concentration (percentage, ppm, strength, normality, molarity, molality and formality); Interrelations
Gaseous State: Gas laws, Kinetic model of gases, ideal gas equation, Van der waals' equation, compressibility factor, Average, root mean square and most probable velocities.

Basic Concepts of Chemistry (Atoms and molecules): Symbols, Valency, Atomic mass, Molecular mass, Avogadro's law, Mole concept, Equivalent mass of acid base salt Oxidant and Reductant. Percentage composition, empirical and molecular formula, chemical reactions and calculations based on stoichiometry.

Structure of atoms and molecules: Fundamentals particles and their properties, Rutherford and Bohr's models of atom, Hydrogen spectrum, defects of Bohr's model, dual nature of matter de-Broglie theory of matter wave, Heisenberg's uncertainty principle. Energy levels, Shells and Sub-shells, s,p and d orbitals, Quantum numbers, Pauli's exclusion principle, Aufbau-principle, Hund's rule, Electronic configuration of atoms, Extra stability of half filled and filled subshells.
Chemical bonds: Ionic, Covalent, Coordinate and Hydrogen bond, Hybridisation- sp, sp^2, sp^3, dsp^2,dsp^3, d^2sp^3 shapes of molecules, VSEPR theory, Molecular Orbital Theory of simple diatomic molecules.
Periodic classification: Periodic table and periodic laws, s, p, d and f block elements, Periodicity in properties such as atomic and ionic radii, ionization enthalpy, electron gain enthalpy, electronegativity and oxidation states.

Chemical energetics, equilibrium and kinetics:

Energetics: Internal energy, Enthalpy, Heats of reactions, Bond energy, Hess's law, Idea on enthalpy, entropy and free energy, spontaneity and conditions of equilibrium.

Equilibria : Reversible reaction, Law of mass action, Equilibrium constant Kp, Kc, Kx and their relation. Relationship between Equilibrium constant, reaction quotient and Gibbs energy. application of Equilibrium constant to ammonia synthesis and dissociation of HI, Decomposition and thermal dissociation. Theory of acids and bases, Dissociation of weak acids and bases, Ostwald's dilution law, Ionic product of water, Common ion effect, Solubility product and their applications, pH, Hydrolysis of salts, Buffer solutions.

Kinetics : Rate of chemical reaction, Factors affecting the rate, Rate constant, Order and Molecularity of a reaction, Simple zero and First order reaction, Half life period, Arrehnius equation and Activation Energy, Collision theory (qualitative idea only)

[Types of chemical reaction : Neutralisation and oxidation– Reduction reaction, Equivalent mass, Oxidation number, Balancing chemical reactions, by Ion electron method, Reactions involving $KMnO_4$, $K_2Cr_2O_7$, $Na_2S_2O_3$, oxalate etc.]

Non-metals: Group study, Preparation, Properties and uses of compounds of the elements. hydrogen (ortho and para hydrogen, isotopes of hydrogen, D_2O and H_2O_2). Dihydrogen as fuel. Allotropes of carbon. Nitrogen family (NH_3 and HNO_3). Oxygen, ozone and sulphur. Oxygen family (O_2, O_3, H_2S, SO_2, H_2SO_4 and its manufacturer by contact process). Halogens, Hydrogen halides and Interhalogen compounds. Zero group elements: Electronic configuration occurrence, physical and chemical properties and uses.

Electrochemistry: Electrolysis, Electrical Conductivity (Specific, Equivalent and molar), Faraday's laws, Kohlrausch law, Galvanic cell, Cell reaction, Nernst equation, Standard electrode potential, Electro chemical series, e.m.f. of simple cells. Fuel cells.

Surface Chemistry: Colloids: Preparation, purification, properties and uses. Emulsion, Adsorption: Types and applications.

Metals and metallurgy: Occurrence of metal, Minerals and ores, flux, slag, calcination, roasting, smelting (by reduction of oxides) and refining. General trends in the characteristics. Principles of extraction of Na, Mg, Ca, Al, Cu and Fe and their oxides, hydroxides, chlorides, nitrates and sulfates.

Organic chemistry:

Introductory: Functional Groups and organic radicals, Nomenclature by IUPAC system (substitutive method) , Isomerism (Structural and stereoisomenism – optical and geometrical) EZ & RS nomenclature, Electron mobility – Inductive effect, Resonance, Electromeric effect and Hyperconjugation; their applications. Types of organic reactions – addition, substitution, elimination reactions. Idea of electrophiles and nuclephiles; Reaction intermediates – idea of carbocations, carbanion & free radicals; their stabilities.

Aliphatic compounds: Methods of preparation and properties of alkanes, alkenes, alkynes (acidity of terminal alkynes), haloalkanes, alcohols, ether, aldehydes, ketones, carboxylic acids, acid derivatives (acid chlorides, esters and amides), nitroalkanes and amines.

Aromatic compounds: Aromaticity (Huckel's rule), Aromatic hydrocarbon (Preparation and reactions – Substitution, addition, ozonolysis) Directive influence of functional group. Phenols (Preparation and reactions) : Aldehydes (Preparations and reactions); Acids (Preparation and reactions). Amines (Preparation and reactions); Diazonium salts (synthetic application).

Biochemistry: Biological importance of organic compounds such as carbohydrates, amino

acids, proteins, Vitamins and nucleic acids (only by metabolic process).
Chemistry in the service of mankind: Polymers (nylon, terylene, neoprene, buna-S, PVC, Teflon &bakelite). Biodegradable Polymer Medicine-analgesic, antipyretic, antibiotic, antacid and antiseptic (structure and preparation not required).
Environmental chemistry: Source, effect and control measures of air and water pollution.

C. MATHEMATICS (+ 2 Level) - (45 Questions)

Logic : Statement, Negation, Implication, Converse, Contrapositive, 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 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.

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 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.

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)

D. BIOLOGY (+ 2 Level) - (45 Questions)

D 1. BOTANY

Diversity of plant life: Five kingdom system of classification with their merits and demerits. Structure, reproduction and economic importance of Bacteria, Viruses, Viroids & Lichens. Life history of representative members of different plant groups: *Spirogyra, Saccharomyces, Funaria, Dryopteris, Cycas*.

Morphology of angiosperms : Normal and Modified roots, stems and leaves, Inflorescence, Flower and its parts, Pollination, Fertilization, Fruits.

Taxonomy of flowering plants : Principles and units of classification (species, genus, family)

Binomial nomenclature, Studies of important families: Malvaceae, Solanaceae, Fabaceae, Asteraceae, Brassicaceae, Liliaceae.

Cell: Structure and function : Cell Theory, Totipotency, Prokaryotic and Eukaryotic cell, Structure of typical plant cell: Cell Wall, Cell Membrane, Cell Organelles (Plastids, mitochondria, endoplasmic reticulum, ribosomes, Golgibodies, Lysosomes, Peroxisomes). Important compounds of cell: Structure and functions of water, aminoacids, proteins, carbohydrates and fats. Properties and chemical nature of enzymes. Mode of enzyme action.

Continuity of life: Cell division: Mitosis, Meiosis and their significance, Mendel's laws of inheritance: Monohybrid and Dihybrid cross, Incomplete dominance, Multipleallelism, Quantitative inheritance.

Genetic material: Structure of nucleic acids. Evidences to establish 'DNA as genetic material' (Griffith and Avery's experiment). Concept of gene, Transcription and translation in Prokaryotes. Regulation of gene expression – induction and repression.

Recombinant DNA and Tissue culture technique: Recombinant DNA techniques and its significance. Gene bank, Production of Transgenic plants with examples, Tissue culture technique.

Microbes in Human welfare: Household & industrial product, sewage treatment, Biogas production, Biocontrol agents, Biofertilizers.

Complexities of plant life: Meristematic & Permanent tissues, Internal structures of dicot and monocot stems, roots and Isobilateral and Dorsiventral leaves, Normal secondary growth in dicot stem.

Plant Breeding: Elementary idea about hybridization, Breeding for Crop Improvement.

Processes in plants: Diffusion, Osmosis, Plasmolysis, Imbibition, Absorption and transport of water and minerals, Transpiration and its significance, Respiration and fermentation, Photosynthesis, Biological nitrogen fixation. Growth and development: Growth regulators – Physiological effects of Auxins, Gibberellin, Cytokinin, Ethylene and Abscissic acid.

Elementary idea of photoperiodism and vernalisation. Plant movements (with special reference to geotropism and phototropism).

Ecology: Man and environment, Ecosystem: Structure and function, Ecological adaptations (Hydrophytes and Xerophytes), plant succession (Hydrosere, Xeresere), Structure and function of Ecosystem.

Economic Botany: Economic importance of plants like Rice, Gram (green gram) Jute, Groundnut, Mango, Tulsi.

Common plant diseases: Symptoms and control measure of following plant diseases: Powdery mildew of peas, Bacterial blight of rice, Mosaic disease of Papaya.

D 2. ZOOLOGY

Animal World: Definition, scope and branches of zoology, characteristics of living organisms. Two Kingdom and Five Kingdom classification, their merits and demerits. Salient features and broad outline classification of animals (non-chordates up to phyla and chordates upto classes). Tools for study of taxonomy - zoological parks, sanctuaries and national parks.

Animal Histology: Epithelial, connective, muscular and nervous tissue. Details about blood and bone. Organs and organ systems.

Animal Locomotion: Joints and muscles in movements of man. Mechanism of muscle contraction. Disorders: Arthritis and osteoporosis.

Animal Nutrition: Intracellular and intercellular digestion. Digestive system of cockroach. Digestive system and physiology of digestion in human (ingestion, absorption, assimilation and egestion). Gastro-intestinal hormones and their role. Malnutrition and under-nutrition.

Animal Respiration: Types of Respiration (tracheal and Pulmonary). Structure and function of respiratory system in human. Mechanism of pulmonary respiration (breathing), transport of respiratory gases. Common respiratory disorders.

Animal Circulation: Open circulation in cockroach and closed circulation in human. Structure of human heart, cardiac cycle, arteries, veins, capillaries and portal system. Blood pressure, Haemoglobin, blood groups (ABO and Rh), Blood coagulation. Disorders: hypertension, atherosclerosis, arteriosclerosis, pace maker.

Animal Excretion: Types of Excretion (ammonotelism, ureotelism and uricotelism), Excretion in cockroach, Excretion in human - structure and function of kidney, role of liver in excretion. Disorders related to excretion - kidney failure, dialysis. Role of ADH.

Control and Co-ordination: Nervous system of cockroach, nervous system in human - central, peripheral and autonomic nervous system. Transmission of nerve impulse. Reflex action.

Human endocrine glands (Name, location), hormones and their functions. Hormones as messengers and regulators. Feed back control. Hormonal disorders.

Animal Reproduction and human development: Types of Reproduction : Asexual Reproduction - binary fission, multiple fission, budding and gemmule formation. Sexual reproduction in human – male and female reproductive systems, menstrual cycle.

Gametogenesis (spermatogenesis and oogenesis), fertilization development upto three germ layers, implantation, parturition and lactation.

Genetics and Evolution: Mendelism, Linkage and crossing over, recombination, sex chromosones, sex-determination, sex- linked inheritance, chromosomal aberrations. Human Genome Project. Genetic and chromosomal disorders in human - Haemophilia, Klinefelter's syndrome, Down's syndrome and Turner's syndrome.

Origin of life, Evidences of evolution, theories of evolution (Lamarkism and Darwinism).

Biotechnology: Genetic Engineering and Recombinant DNA Technology, DNA Finger printing. Immunity and immune disorders. Vaccines and Vaccination.

Human Diseases: Types, causes, diagnosis, prevention and treatment- AIDS, STD, Cancer and Diabetes.

Biology in human welfare: Common problems of adolescence - Drugs, Alcohol, risks of indiscriminate use of drugs and antibiotics.

Environmental Issues: Air and Water pollution and their control. Solid waste management, Radioactive waste management. Agrochemicals and their effects. Green house effect. Ozone Layer depletion. Deforestation.

2. Lateral Entry to B. Pharm (LE – PHARM) – 60 Questions

The course content is same as the syllabus of part-I and part-II of Diploma in Pharmacy as per the Education Regulation – 1991 of Pharmacy Council of India.

3. Lateral Entry to B. Tech. 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, Contrapositive, 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 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.

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 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.

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=σ.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 temperature composition 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. $KMnO_4$) 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 $KMnO_4$, 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 (SN_1, SN_2 and SN_i) 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 $NaNH_2/NH_3$).

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, $NaHSO_3$, $NH_2 - G$ 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.

5. MCA

A. MATHEMATICS - (60 Questions)

Logic : Statement, Negation, Implication, Converse, Contrapositive, 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.
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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. COMPUTER AWARENESS – 60 Questions

Introduction to Computer: Brief history of Computers, Components of a Computer, Computer related general knowledge, Application of Computers, Classification of Computers, Windows.

Computer Arithmetic: Number System with general base, Number base conversion, Elementary arithmetic operation.

Introduction to algorithm and computer languages.

6. Lateral Entry to MCA (LE – MCA)

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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.

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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. COMPUTER AWARENESS – 60 Questions

Introduction to Computer: Brief history of Computers, Components of a Computer, Computer related general knowledge, Application of Computers, Classification of Computers, Windows.

Computer Arithmetic: Number System with general base, Number base conversion, Elementary arithmetic operation.

C Language: Keywords, Constants, Variables, Identifiers, operators, statements. Writing simple C program. Arithmetic and logical expression, simple if, nested if, if-else-ladder, conditional operators, switch case, for, while and do while loops. Concept of functions in C.

C++ and data structure: Object oriented concepts and relationships, control structures, file concepts, Algorithm Analysis, linked list, stack, queue, binary tree, sorting and searching techniques.

Fundamentals of computer Organization and Networking: Sequential combinational circuits, Flip flops, Memory, K-map, Addressing modes, Fetch and execution cycle. OSI model, topologies and protocols, Internet protocols, Ipv4/Ipv6, Introductory concept on Network Security.

Introduction to Operating systems: Resource Management, types of operating systems, DOS and Unix commands,

Logical reasoning and verbal abilities: Data Interpretations, Series brain teasing problem

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

7. MBA

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

8. Integrated MBA

A. Quantitative Techniques –15 Questions

B. Analytical and Logical Reasoning – 15 Questions

C. Verbal Reasoning and Comprehension – 15 Questions

D. General Awareness and Business Fundamentals – 15 Questions

9. M. Pharm

The syllabus is as per BPUT B. Pharm course – 60 Questions

10. M. Arch.

A. Reasoning (Verbal / Analytical / Logical) – 30 Questions

B. Branch Subject (Architecture) – 60 Questions

ARCHITECTURE

City planning: Evolution of cities; principles of city planning; types of cities & new towns; planning regulations and building bye laws; eco-city, smart city concept; sustainable development.

Housing: Concept of housing; neighborhood concept; site planning principles; housing typology;

Housing standards; housing infrastructure; housing policies, finance and management; housing programs in India; self-help housing.

Landscape Design: Principles of landscape design and site planning; history of landscape design, landscape elements and materials; plant characteristics & planting design; environmental considerations in land scape planning.

Computer Aided Design: Application of computers in architecture and site planning; understanding elements of hard ware and software; computer graphics; usage of packages such as AutoCAD,3D-Studio,3D Max /sketchup, photoshop.

Environmental Studies , Climatology & Building Sciences: Components of Ecosystem; ecological principles concerning environment; climate responsive design; energy efficient building design; thermal comfort; solar architecture; principles of lighting and styles for illumination; basic principles of architectural acoustics; environment pollution, their control & abatement.

Introduction to Architecture and Urban Design: Principles of visual composition; proportion, scale, rhythm, symmetry, harmony, datum, balance, form, colour, texture; sense of place and space, division of space; barrier free design; focal point, vista, imageability, visual survey, figure-background relationship.

History of Architecture: *Indian*– Indus valley, Vedic, Buddhist, Indo-Aryan, Dravidian and Mughal

periods; *European*– Egyptian, Greek, Roman, medieval and renaissance periods-construction and architectural styles; vernacular and traditional architecture.

Theory of design & Contemporary Architecture: Architectural developments and impacts on society since industrial revolution; influence of modern art on architecture; works of

national and international architects; art novuea, eclecticism, international styles, post modernism, deconstruction in architecture, art deco, brutalism, structuralison.

Building Services: Water supply, sewerage and drainage systems; sanitary fittings and fixtures; plumbing systems, principles of internal & external drainage systems, principles of electrification of buildings, intelligent buildings; elevators & escalators, their standard sanduses; air-conditioning systems; fire fighting systems, building safety, security systems & building automation.

Building Construction and Management: Building construction techniques, methods and details; building systems and prefabrication of building elements; principles of modular coordination; estimation, specification, valuation, professional practice; project management techniques e.g., PERT, CPM etc.

Materials and Structural Systems: Behavioral characteristics of all types of building materials e. g.mud, timber, bamboo, brick, concrete, steel, glass, FRP, different polymers, composites; principles of strength of materials; design of structural elements in wood, steel and RCC; elastic and limit state design; complex structural systems; principles of pre-stressing; tall buildings; principles of disaster resistant structures.

Infrastructure, Services and Amenities: Principles of water supply and sanitation systems; water treatment; solid waste disposal systems; waste treatment, recycle & reuse; urban rain water harvesting; power supply and communication systems—network, design & guidelines; demography related standards at various level soft hesettlements for health, education, recreation, religious &public-semipublic facilities.

Architectural Conservation: Conservation, preservation, restoration, reconstruction, adoption, techniques of restoration, preservation & rehabilitation.

11. M. Plan.

A. Reasoning (Verbal / Analytical / Logical) –30 Questions

B. Branch Subject (Planning) – 60 Questions

PLANNING

Planning Theory and Techniques: Different theories by eminent planners/sociologist/geographers etc., Land use Planning, Different types of Plan in Planning system, Spatial Standards, Techniques of Preparing Base maps, Photo interpretation, Plan preparation Techniques & Surveys.

Urban Sociology and Planning Economics: Basic concept of Society, Settlement Planning, Neighborhood Concept, Economies of Scale.

Planning Legislation: Evolution of Planning Legislation, Indian Constitution, 73rd and 74th

Constitutional Amendment, Town and Country planning Act, Urban Planning and Development Authorities Act, Municipal Act, Land Acquisition Act, Environmental Act etc.

Housing and Community Planning: Housing standards, Policies and Programmes, Planning and design of Housing Areas, Housing Finance Policies, Emerging Issues and Challenges.

Environment Planning: Relation between Natural and built environment, Urban ecosystem, Environmental Risks, Environmental Imapct Assessment, Sustainable planning approaches like Eco city, Green City etc.

Infrastructure-Planning: Urban services system and networks; Water supply system, Drainage, Sewage Disposal, Solid waste management, electricity, Telecom etc.

Traffic and Transportation Planning: Urbanization and Transport Problems, Classification and Hierarchy of Urban Roads, Land use and Transportation relationships, Survey and Analytical Techniques, Planning and Management of Transportation system, Transportation policies.

Heritage and Conservation Planning: Scope and basic technique of urban Conservation, Clearance and Improvement schemes, Planning aspects, Land Management, Economic and Social aspects of Conservation, Urban Renewal, Conservation and Renewal Policies and Strategies.

Disaster Management and Planning: Risk sensisitive Land use Planning, Disaster Risk Assessment and Mitigation, Disaster safe construction Practices, Policies, Building codes and guidelines, Community based Disaster Preparedness, Disaster Education and Awareness, Post Disaster Management.

Project Formulation and Implementation: Methods of Project Identification, Formulation of Feasibility Reports and Detailed Project Reports, Project Appraisal – Technical, Financial, Social, Economic, Environmental, Institutional etc. Methods of Financing, Project Evaluation and Monitoring.

Urban Governance: Overview of Urban Governance, Principles of Governance, Urban local Governance mechanism, Participatory process in Urban Governance.

12. M. Tech.

A. Analytical and Logical Reasoning – 10 Questions

B. Engineering Mathematics – 20 Questions

C. Branch Subject (Respective Branch) – 60 Questions

ENGINEERING MATHEMATICS

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)

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.

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

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

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

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

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

RESPECTIVE BRANCH SUBJECTS

BIOTECHNOLOGY

Microbiology: Prokaryotic and eukaryotic cell structure; Microbial nutrition, growth; Microbial metabolism (aerobic and anaerobic respiration, photosynthesis);Nitrogen fixation; Chemical basis of mutations and mutagens; Microbial genetics (plasmids, transformation, transduction, conjugation); Viruses, Bacteria

Biochemistry: Bio molecules and their conformation; Weak inter-molecular interactions in bio macro molecules; Chemical and functional nature of enzymes; Kinetics of single substrate and bi- substrate enzyme catalyzed reactions; Bioenergetics; Metabolism (Glycolysis, TCA and Oxidative phosphorylation); Membrane transport and pumps; Cell cycle and cell growth control;

Molecular Biology and Genetics: Molecular structure of genes and chromosomes; DNA replication and control; Transcription and its control; Translational processes, Mendelian inheritance; Linkage, recombination and chromosome mapping; Chromosomal variation; Molecular basis of genetic diseases and applications.

Process Biotechnology: Bioprocess technology for the production of cell biomass and primary/secondary metabolites, such as baker's yeast, ethanol, citric acid, amino acids,

antibiotics; Chromatographic and membrane based bio separation methods; Immobilization of enzymes and cells and their application for bioconversion processes. Aerobic and anaerobic biological processes for stabilization of solid / liquid wastes ;Bioremediation.

Bioprocess Engineering: Kinetics of microbial growth, substrate utilization and product formation; Simple structured models; Sterilization; Batch, fed-batch and continuous processes; Mass transfer in bio reactors; Scale-up concepts; Various types of microbial and enzyme reactors; Instrumentation in bioreactors.

Plant and Animal Biotechnology: Special features and organization of plant cells; Totipotency; Regeneration of plants; Autotrophic and heterotrophic growth; Plant growth regulators and elicitors; Production of secondary metabolites by plant suspension cultures,

Characteristics of Animal Cells: Metabolism, Animal cell cultures; Kinetics of cell growth and product formation, Hybridoma technology; Livestock improvement; Cloning in animals; Genetic engineering in animal cell culture.

Immunology: The origin of immunology; Inherent immunity; Humoral and cell mediated immunity; Antigen; B and T cells and Macrophages; Major histo compatibility complex (MHC); Antigen processing and presentation; Molecular basis of antibody diversity; Polyclonal and monoclonal antibody; Complement; Antigen-antibody reaction; Immune tolerance; Hyper sensitivity; Autoimmunity.

Recombinant DNA Technology: Restriction and modification enzymes; Vectors: plasmid, bacteriophage and other viral vectors, cosmids, Tiplasmid, yeast artificial chromosome; cDNA and genomic DNA library; Gene isolation; Gene cloning; Expression of cloned gene; Transposons and gene targeting; DNA labeling; DNA sequencing; Polymerase chain reactions; DNA finger printing; Southern and northern blotting; In-situ hybridization; RAPD; RFLP; Site-directed mutagenesis; Gene transfer technologies; Gene therapy.

Bioinformatics: Major bioinformatics resources, Sequence and structure databases; Sequence analysis (biomolecular sequence file formats, scoring matrices, sequence alignment, phylogeny); DNA microarrays, Molecular modeling and simulations.

CHEMICAL ENGINEERING

Process Calculations and Thermodynamics: Laws of conservation of mass and energy; recycle, bypass and purge calculations; degree of freedom analysis. First and Second laws of thermodynamics. First law application to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: equation of state, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibria.

Fluid Mechanics and Mechanical Operations: Fluid statics, Newtonian and non-Newtonian fluids, Bernoulli equation, friction factors, energy balance, dimension analysis, flow through pipeline systems, flow meters, packed and fluidized beds, elementary

boundary layer theory, size reduction and size separation; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, mixing and agitation; conveying of solids.

Heat Transfer: Conduction, convection and radiation, heat transfer coefficients, steady and unsteady Heat conduction, boiling, condensation and evaporation; types of heat exchangers and evaporators

Mass Transfer: Fick's 1st law, molecular diffusion in fluids, mass transfer coefficients, Two film theory, film theory, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stage wise and continuous contacting and stage efficiencies; HTU & NTU concepts design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption.

Chemical Reaction Engineering: Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, non-ideal reactors; residence time distribution, single parameter model; non-isothermal reactors.

Instrumentation and Process Control: Measurement of process variables; sensors, transducers and their dynamics, transfer functions and dynamic responses of simple systems, process reaction curve, controller modes (P, PI, and PID); control valves; analysis of closed loop systems including stability, frequency response, cascade and feed forward control.

Process Equipment Design: Process design and sizing of chemical engineering equipment such as distillation column, heat exchangers and evaporators.

Chemical Technology: Inorganic chemical industries; sulfuric acid, NaOH, fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil and Fats); petroleum refining and petrochemicals; polymerization industries; polyethylene, polypropylene, PVC and polyester synthetic fibers.

CIVIL ENGINEERING

STRUCTURAL ENGINEEING

Mechanics: Bending moment and shear force in statically determinate beams. Simple stress and strain relationship: Stress and strain in two dimensions, principals tresses, stress transformation, Mohr's circle. Simple bending theory, flexural and shear stresses, unsymmetrical bending, shear centre. Thin walled pressure vessels, uniform torsion, bucking of column, combined and direct bending stresses.

Structural Analysis: Analysis of statically determinate trusses, arches, beams, cables and frames, displacements in statically determinate structures and analysis of statically indeterminate structures by force/energy methods, analysis by displacement methods

(slope deflection and moment distribution methods), influence lines for determinate and indeterminate structures. Basic concepts of matrix methods of structural analysis.

Concrete Structures: Concrete Technology- properties of concrete, basics of mix design. Concrete design - basic working stress and limit state design concepts, analysis of ultimate load capacity and design of members subjected to flexure, shear, compression and torsion by limit state methods. Basic elements of prestressed concrete, analysis of beam sections at transfer and service loads.

Steel Structures: Analysis and design of tension and compression members, beams and beam-columns, column bases. Connections- simple and eccentric, beam–column connections, plate girders and trusses. Plastic analysis of beams and frames.

Construction Materials: Characteristics of commonly used building materials like Cement, Aggregates, Admixtures, Fresh and Harden Concrete – Properties and Testing, Mix Design

GEOTECHNICAL ENGINEERING

Soil Mechanics: Origin of soils, soil classification, three-phase system, fundamental definitions, relationship and interrelationships, permeability & seepage, effective stress principle, consolidation, compaction, shear strength.

Foundation Engineering: Sub-surface investigations-scope, drilling bore holes, sampling, penetration tests, plate load test. Earth pressure theories, effect of water table, layered soils. Stability of slopes- nfinite slopes, finite slopes. Foundation types-foundation design requirements. Shallow foundations- bearing capacity, effect of shape, water table and other factors, stress distribution, settlement analysis in sands & clays. Deep foundations– pile types, dynamic & static formulae, load capacity of piles in sands & clays, negative skin friction.

WATER RESOURCES ENGINEERING

Fluid Mechanics and Hydraulics: Properties of fluids, principle of conservation of mass, momentum, energy and corresponding equations, potential flow, applications of momentum and Bernoulli's equation, laminar and turbulent flow, flow in pipes, pipe networks. Concept of boundary layer and its growth. Uniform flow, critical flow and gradually varied flow in channels, specific energy concept, hydraulic jump. Forces on immersed bodies, flow measurements in channels, tanks and pipes. Dimensional analysis and hydraulic modelling. Kinematics of flow, velocity triangles and specific speed of pumps and turbines.

Hydrology: Hydrologic cycle, rainfall, evaporation, infiltration, stage discharge relationships, unit hydrographs, flood estimation, reservoir capacity, reservoir and channel routing. Well hydraulics.

Irrigation: Duty, delta, estimation of evapo-transpiration. Crop water requirements. Design of lined and unlined canals, waterways, headworks, gravity dams and spillways. Design of weirs on permeable foundation. Types of irrigation system, irrigation methods. Water logging and drainage, Reclamation of defective soil

ENVIRONMENTAL ENGINEERING

Water requirements: Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, sludge disposal, effluent discharge standards. Domestic waste water treatment, quantity of characteristics of domestic waste water, primary and secondary treatment Unit operations and unit processes of domestic waste water, sludge disposal.

Air Pollution: Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/recycle, energy recovery, treatment and disposal).

Noise Pollution: Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

TRANSPORTATION ENGINEERING

Highway Planning: Geometric design of highways, testing and specifications of paving materials, design of flexible and rigid pavements.

Traffic Engineering: Traffic characteristics, theory of traffic flow, intersection design, traffic signs and signal design, highway capacity.

SURVEYING

Principle of Surveying, Surveying by Chain, Compass and Theodolite, Levelling and Contouring, Tacheometry, Total Station.

COMPUTER SCIENCE / INFORMATION TECHNOLOGY

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

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.

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.

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.

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

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

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.

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

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

ELECTRICAL ENGINEERING

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.

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.

Electrical Machines: Single phase transformer–equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers–connections, parallel operation; auto-transformer; energy conversion principles; DC machines–types, windings, generator characteristics, Excitation, armature reaction and commutation, 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.

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).

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.

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.

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.

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

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

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.

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.

Signals, Systems and Communications: Periodic and aperiodic signals. continuous-time 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.

Control Sysms:

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.

Electromagnetics:

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

Instrumentation and Measurement

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

ENVIRONMENTAL ENGINEERING

Ecology: Definition, Branches and Scope of ecology. Ecological adaptation & concept of limiting factor. Different types of ecosystem in India. Structural and functional attributes of an ecosystem, Biotic and Abiotic components, Food chain, Food web and energy flow. Ecological succession, Biogeochemical cycles. Concept of population & population attributes, Concept of carrying capacity and environmental resistance. Development and evolution of ecosystem.

Environmental chemistry: Atmospheric chemistry: Types of Pollutants, their sources and impacts, pathways of pollutants. major regions of atmosphere, particles, ions and radicals in atmosphere, thermochemical and photochemical reaction in atmosphere, smog, NOx, SO_X, hydrocarbons, suspended particulate matter, chemistry of action of pollutants and effects(acid rain, global warming, green house effect and Ozone layer depletion).

Soil chemistry: Inorganic and organic components of soil, nitrogen pathway in soil, Fertilizers. Toxic chemicals in the environment: pesticides, arsenic, cadmium, lead, mercury, carbon monoxide, PAN, MIC, Radioactive wastes. Microbial metabolism of heavy metals, pesticides etc.

Water supply system: Population estimation, Design period, Water demands, Raw water Source selection, collection, transport (Preliminary Hydraulic design of pressure conduits system), Surface Water Treatment System and Treated water distribution Systems. Water quality parameters: Drinking water Standards & their significance (BIS 10500), gravimetric, potentiometric and spectrophotometric methods of determination of water quality parameters.

Wastewater collection and Treatment systems: Wastewater quantity and characteristics, Wastewater collection, transport (Hydraulic design of gravity sewerage system), Primary, secondary (aerobic and anaerobic biological treatment) and tertiary treatment methods, effluent disposal standardsl, Sludge treatment and disposal.

Air Noise pollution: Air pollution meteorology, measurement of Air Pollutants and their standards, Atmospheric dispersion of stack effluents, Air pollution control devices. Noise pollution: Sources, effects, measurement and control.

Solid waste management: Municipal solid waste: Sources, composition and characteristics of municipal solid waste, generation, collection rates, transportation, waste handling and separation, storage and processing at the source, aerobic and anaerobic biological treatment Engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

Biomedical waste, E-waste and plastic waste management: Sources, Hazards associated with bio-medical wastes, Bio safety, Storage of biomedical wastes, disposal and processing.

EIA: Screening and scooping criteria, rapid and comprehensive EIA, environmental health impact assessment, environmental risk analysis. environmental laws.

MECHANICAL ENGINEERING

APPLIED MECHANICS AND DESIGN

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.

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.

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

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

Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N 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.

FLUID MECHANICS AND THERMAL SCIENCES

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.

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.

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.

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.

MANUFACTURING AND INDUSTRIAL ENGINEERING

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

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

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.

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

Machining and Machine Tool Operations: Mechanics of machining, single and multi-point 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

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.

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and Computer Integrated Manufacturing.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning.

Inventory Control: Deterministic and probabilistic models; safety stock inventory control systems.

Modern Trends in Manufacturing: Just in time systems, Supply chain management.

METALLURGICAL ENGINEERING

Thermodynamics and Rate Processes: Laws of thermodynamics, activity, equilibrium constant, applications to metallurgical systems, solutions, phase equilibria, Ellingham and phase stability diagrams, thermodynamics of surfaces, interfaces and defects, adsorption and segregation; basic kinetic laws, order of reactions, rate constants and rate limiting steps; principles of electrochemistry-single electrode potential, electro-chemical cells and polarizations, aqueous corrosion and protection of metals, oxidation and high temperature corrosion –characterization and control; heat transfer – conduction, convection and heat transfer coefficient relations, radiation, mass transfer–diffusion and Fick's laws, mass transfer coefficients; momentum transfer–concepts of viscosity, shell balances, Bernoulli's equation, friction factors.

Extractive Metallurgy: Minerals of economic importance, comminution techniques, size classification, Flotation, gravity and other methods of mineral processing; agglomeration, pyro- hydro-and electro- metallurgical processes; material and energy balances; principles and processes for the extraction of non-ferrous metals– aluminium, copper, zinc, lead, magnesium, nickel, titanium and other rare metals; iron and steelmaking–principles, role structure and properties of slags, metallurgical coke, blast furnace, direct reduction processes, primary and secondary steel making, ladle metallurgy operations including deoxidation, desulphurization, sulphide shape control, inert gas rinsing and vacuum reactors; secondary refining processes including AOD, VAD, VOD, VAR and ESR; ingot and continuous casting; stainless steelmaking, furnaces and refractories.

Physical Metallurgy: Crystal structure and bonding characteristics of metals, alloys, ceramics and polymers, structure of surfaces and interfaces, nano-crystalline and amorphous structures; solid solutions; solidification; phase transformation and binary phase diagrams; principles of heat treatment, properties and applications of steels, cast

iron, aluminium and titanium alloys; surface treatments; recovery, recrystallization and grain growth; industrially important ferrous and non-ferrous alloys; elements of X-ray and electron diffraction; principles of scanning and transmission electron microscopy; industrial ceramics, polymers, composites and biomaterials; electronic basis of thermal, optical, electrical and magnetic properties of materials; electronic and opto-electronic materials.

Mechanical Metallurgy: Elasticity, yield criteria and plasticity; defects in crystals; elements of dislocation theory –types of dislocations, slip and twinning, source and multiplication of dislocations, stress fields around dislocations, partial dislocations, dislocation interactions and reactions; strengthening mechanisms; tensile, fatigue and creep behaviour; super-plasticity; fracture– Griffith theory, basic concepts of linear elastic and elasto-plastic fracture mechanics, ductile to brittle transition, fracture toughness; failure analysis; mechanical testing –tension, compression, torsion, hardness, impact, creep, fatigue, fracture toughness and formability.

Manufacturing Processes: Metal casting–patterns and moulds including mould design involving feeding, gating and risering, melting, casting practice sins and casting, permanent mould casting, investment casting and shell moulding, casting defects and repair; hot, warm and cold working of metals, Metal forming–fundamentals of metal forming processes of rolling, forging, extrusion, wired rawing and sheet metal forming, defects informing; Metaljoining–soldering, brazing and welding, common welding processes of shielded metal arcwelding, gas metal arc welding, gas tungsten arc welding and submerged arc welding; welding metallurgy, problems associated with welding of steels and aluminium alloys, defect sin welded joints; powder metallurgy; NDT using dye-penetrant, ultrasonic, radiography, eddy current, acoustic emission and magnetic particle methods.

PLASTIC ENGINEERING

Polymer Science and Engineering: Natural Polymers, Synthetic polymers –homo polymers, co-polymers, cross linked polymers, polymerisation- Addition Polymerization, step growth polymerisation, Degree of polymerisation, polydispersity, molecular weight of polymers, molecular weight distribution.

Polymerisation techniques, Analysis and characterisation of polymers, melt flow index, Polymer processing: injection moulding, blow moulding, extrusion, compression moulding, polymer additives, polymer blends and alloys. Engineering plastics, commodity plastics, high performance plastics. Application of polymers.

Chemistry: Chemical bonding atomic structure, organic chemistry, name reaction, physical chemistry Chemical kinetics –Spectroscopy.

Material Science: Mechanical properties of material - Magnetic and Dielectric materials – Conductor and Semi conductor materials.

Applied Mechanics: Law of Mechanics – Lame's theorem – Forces, Moments and Couples – Displacement, velocity and Acceleration – Friction – Moment of Inertia.

TEXTILE ENGINEERING

Textile Fibres: Classification of textile fibres; Essential requirements of fibre forming polymers; Gross and fine structure of natural fibres like cotton, wool and silk. Introduction to important bast fibres; properties and uses of natural and man-made fibres; physical and chemical methods of fibre and blend identification and blend analysis. Molecular architecture, amorphous and crystalline phases, glass transition, plasticization, crystallization, melting, factors affecting T_g and T_m; Process of viscose and acetate preparation. Polymerization of nylon-6, nylon-66, polyethyl terephthalate, polyacrylonitrile and polypropylene; Melt Spinning processes, characteristic features of PET, polyamide and polypropylene spinning; wet and dry spinning of viscose and acrylic fibres; post spinning operations such as drawing, heat setting, tow- to-top conversion and different texturing methods. Methods of investigating fibre structure. e.g., Density, X-ray diffraction, birefringence, optical and electron microscopy, I.R. absorption, thermal methods (DSC, DMA/TMA, TGA); structure and morphology of man-made fibres, mechanical properties of fibres, moistures absorption in fibres; fibre structure and property correlation.

Yarn manufacture and yarn structure & properties: principle of yarn formation in ring spinning, rotor spinning, airjet spinning, wrap spinning, twist less spinning and friction spinning. Concepts of single and folded yarn twist, Idealized helical yarn structure; yarn count and twist factors, twist contraction; Limits of twist. Idealized packing; measurement of packing density and radial packing density of yarn; Packing in actual yarns; Specific volume of yarns; Equation of yarn diameter. Ideal migration, tracer fiber technique, characterization of migration behavior, migration in spun yarns, mechanisms of migration, effect of various parameters on migration behavior. Translation of fiber properties into yarn properties; Extension of continuous filament yarn for small strains and large strains; Extension and breakage of spun yarn, Blended yarn structure, Structure and property relationship of ring, rotor, air-jet, friction spun yarn and their comparison.

Fabric manufacture and Fabric Structure: Principles of cheese and cone winding processes; random and precision winding; package faults and their remedies; different sizing systems, sizing of spun and filament yarns, primary and secondary motions of loom, fabric appearance and weaving performance; dobby and jacquard shedding; mechanics of weft insertion with shuttle; warp and weft stop motions, warp protection, weft replenishment; functional principles of weft insertion systems of shuttle- less weaving machines, principles of multiphase and circular looms. Principles of weft and warp knitting; basic weft and warp knitted structures. Classification, production and areas of application of nonwoven fabrics. Basic woven fabric constructions and their derivatives; crepe, cord, terry, gauze, leno and double cloth structures. Pierce geometrical model, flexible thread model and rigid thread model, Square fabric, Jammed Structure, square and jammed fabric, Crimp interchange, Maximum possible cover factor. Yarn cross sections in the fabric, elastical model of plain woven fabrics; thickness, cover and maximum sett of woven fabrics. Concepts of fabric handle and its evaluation

Statistical quality control and Textile Testing: Random Variable, Continuous Random Variable- Normal Distribution, Discrete Random Variable- Binomial Distribution and poisson's distribution. Normal approximation to binomial and poisson distribution. Sampling techniques, sample size and sampling errors. Correlation analysis, significance tests, Quality control chart, acceptance of sampling, and analysis of variance. Measurement of fibre length, fineness, crimp, strength and reflectance; measurement of cotton fibre maturity and trash content;HVI and AFIS for fibre testing. Measurement of yarn count, twist and hairiness; tensile testing of fibres, yarn and fabrics; evenness testing of yarns; testing equipment for measurement test methods of fabric properties like thickness, compressibility, air permeability, drape, crease recovery, tear strength, bursting strength, abrasion resistance, cover factor etc. FAST and Kawabata instruments and systems for objective fabric evaluation. Methods for determination of wash, light and rubbing fastness. Evaluation of fastness properties with the help of grey scale. Sewability testing, Seam strength, Seam slippage, Seam pucker, Needle Cutting Index

Technical Textile: Concept of Geotextiles: Automotive textiles: Textile reinforced Composite Material, Protective Clothing, Medical Textile, filtration Textile, Sports and recreation textiles, Agro textiles, Building Textiles, Packaging Textile, electronics Textiles, their properties and applications

Preparatory Processes for Chemical Processing: Chemistry and practice of preparatory processes for cotton, wool and silk. Mercerization of cotton. Preparatory processes for nylon, polyester and acrylic and polyester/cotton blends.

Dyeing: Classification of dyes. Dyeing of cotton, wool, silk, polyester, nylon and acrylic with appropriate dye classes. Dyeing polyester/cotton and polyester/wool blends. Batch wise and continuous dyeing machines. Dyeing of cotton knitted fabrics and machines used. Dye fibre interaction. Introduction to thermodynamics and kinetics of dyeing.

Printing: Styles of printing. Printing thickeners including synthetic thickeners. Printing auxiliaries. Printing of cotton with reactive dyes. Printing of wool, silk, nylon with acid and metal complex dyes. Printing of polyester with disperse dyes. Methods of dye fixation after printing. Resistand discharge printing of cotton, silk and polyester. Printing of polyester/ cotton blends with disperse/reactive combination. Transfer printing of polyester. Developments in inkjet printing.

Advances in chemical processing: Basic criteria for combining pretreatment methods, combined desizing and bleaching, scouring and bleaching, desizing, scouring and bleaching of natural, man-made and blended textiles. Concept of short liquor processing: advantages and limitations, Short liquor pretreatment and dyeing of various textiles, Performance assessment of each method**.** Color Fastness criteria of dyed and printed textile. Methods to determine color fastness to washing, light, perspiration, sublimation and chlorine treatment and their grading. Importance and method of evaluation of wetting agents, optical brighteners, flame retardants, water repellents and soil release agents. Development of new continuous and batch machines as well as modified processes. Specification of water for use in industries and its discharge to public sewage, bio-degradation of chemicals. Measurement of waste water load. Preventive measures to reduce waste water load.