TS EAMCET CHEMISTRY SYLLABUS

1) ATOMIC STRUCTURE:

Developments leading to the Bohr's model of atom; Wave nature of electromagnetic radiation; Particle nature of electromagnetic radiation- Planck's quantum theory; Dual behaviour of matter; Bohr's model for Hydrogen atom; Explanation of line spectrum of hydrogen; Limitations of Bohr's model; Quantum mechanical considerations of subatomic particles; Heisenberg's uncertainty principle; Quantum numbers; Energies of orbitals; Filling of orbitals in atoms. Aufbau Principle, Pauli's exclusion Principle and Hund's rule of maximum multiplicity; Electronic configurations of atoms; Stability of half-filled and completely filled orbitals.

2) CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES:

Modern periodic law and present form of the periodic table; Nomenclature of elements with atomic number greater than 100; Electronic configuration of elements and the periodic table; Electronic configuration and types of elements s, p, d and f blocks; Trends in physical properties: (a) Atomic radius, (b) Ionic radius (c) Ionization enthalpy, (d) Electron gain enthalpy, (e) Electronegativity; Periodic trends in chemical properties: (a) Periodicity of valence or Oxidation states, (b) Anomalous properties of second period elements - diagonal relationship; Periodic trends and chemical reactivity.

3) CHEMICAL BONDING AND MOLECULAR STRUCTURE:

Kossel - Lewis approach to chemical bonding, Octet rule, covalent bond-Lewis representation of simple molecules, formal charges, limitations of octet rule; Ionic or electrovalent bond - Crystal structure of sodium chloride, Lattice enthalpy; General properties of ionic compounds; Bond Parameters - bond length, bond angle, bond enthalpy, bond order, resonance - Polarity of bonds - dipole moment; Fajan's rules; Valence Shell Electron Pair Repulsion (VSEPR) theory; Predicting the geometry of simple molecules; Valence bond theory-Orbital overlap concept-Directional properties of bonds-overlapping of atomic orbitals, strength of sigma and pi bonds-Factors favouring the formation of covalent bonds; Hybridisation- different types of hybridization involving s, p and d orbitals- shapes of simple covalent molecules; Coordinate bond -definition with examples; Molecular orbital theory - Formation of molecular orbitals, Linear combination of atomic orbitals (LCAO)-conditions for combination of atomic orbitals

- Energy level diagrams for molecular orbitals -Bonding in some homo nuclear diatomic molecules- H_2, He_2, Li_2, B_2, C_2, N_2 and O_2; Hydrogen bonding-cause of formation of hydrogen bond - Types of hydrogen bonds-inter and intra molecular-General properties of hydrogen bonds.

4) STATES OF MATTER: GASES AND LIQUIDS:

Intermolecular forces; Thermal Energy; Intermolecular forces *vs* Thermal interactions; The Gaseous State; The Gas Laws; Ideal gas equation; Graham's law of diffusion; Dalton's Law of partial pressures; Kinetic molecular theory of gases; Kinetic gas equation of an ideal gas (No derivation) deduction of gas laws from Kinetic gas equation; Behaviour of real gases - Deviation from Ideal gas behaviour - Compressibility factor *vs* Pressure diagrams of real gases.

5) STOICHIOMETRY:

Importance of chemistry-some basic concepts - Properties of matter - uncertainty in measurement-significant figures, dimensional analysis; Atomic and molecular masses- mole concept and molar mass. Concept of equivalent weight; Percentage composition of compounds and calculations of empirical and molecular formulae of compounds; Stoichiometry and stoichiometric calculations; Redox reactions-classical idea of redox reactions, oxidation and reduction reactions-redox reactions in terms of electron transfer; Oxidation number concept; Types of Redox reactions-combination, decomposition, displacement and disproportionation reactions; Balancing of redox reactions - oxidation number method, Half reaction (ion- electron) method.

6) THERMODYNAMICS:

Thermodynamic Terms; The system and the surroundings; Types of systems and surroundings; The state of the system; The Internal Energy as a State Function. (a) Work (b) Heat (c) The general case, the first law of Thermodynamics; Applications-Work; Enthalpy- a useful new state function; Extensive and intensive properties; Measurement of DU and DH: Calorimetry; Enthalpy change, D_rH of reactions - reaction Enthalpy (a) Standard enthalpy of reactions, (b) Enthalpy changes during phase transformations, (c) Standard enthalpy of formation, (d) Thermochemical equations (e) Hess's law of constant heat summation; Enthalpies for different types of reactions. (a) Standard enthalpy of combustion (Δ_cH^q), (b) Enthalpy of atomization (Δ_aH^q), phase transition, sublimation and ionisation, (c) Bond Enthalpy ($\Delta_{bond}H^q$), (d) Enthalpy of solution ($\Delta_{sol}H^q$) and dilution; Lattice enthalpy Spontaneity. (a) Is decrease in enthalpy a criterion for spontaneity (b) Entropy and spontaneity, the second law of thermodynamics, (c) Gibbs Energy and spontaneity; Absolute entropy and the third law of thermodynamics.

7) CHEMICAL EQUILIBRIUM AND ACIDS-BASES:

Equilibrium in Physical processes; Equilibrium in chemical processes - Dynamic Equilibrium; Law of chemical Equilibrium - Law of mass action and Equilibrium constant; Homogeneous Equilibria, Equilibrium constant in gaseous systems. Relationship between K_P and K_C; Heterogeneous Equilibria; Applications of Equilibrium constant; Factors affecting Equilibria - Le Chatelier's principle - application to industrial synthesis of Ammonia and Sulphur trioxide; Ionic Equilibrium in solutions; Acids, bases and salts- Arrhenius, Bronsted-Lowry and Lewis concepts of acids and bases; Buffer solutions-designing of buffer solution-Preparation of Acidic buffer; Solubility Equilibria of sparingly soluble salts. Solubility product constant, Common ion effect on solubility of ionic salts.

8) HYDROGEN AND ITS COMPOUNDS:

Position of hydrogen in the periodic table; Dihydrogen-Occurrence and Isotopes; Hydrides: Ionic, covalent, and non-stoichiometric hydrides; Water: Physical properties; structure of water, ice. Chemical properties of water; hard and soft water, temporary and permanent hardness of water; Heavy Water; Hydrogen as a fuel.

9) s - BLOCK ELEMENTS (ALKALI AND ALKALINE EARTH METALS)

Group 1 Elements: Alkali metals; Electronic configurations; Atomic and Ionic radii; Ionization enthalpy; Hydration enthalpy; Physical properties; Chemical properties; Uses; General characteristics of the compounds of the alkali metals: Oxides; Halides; Salts of oxo acids; Anomalous properties of Lithium: Differences and similarities with other alkali metals, Diagonal relationship; similarities between Lithium and Magnesium;

Group 2 Elements: Alkaline earth elements; Electronic configuration; Ionization enthalpy; Hydration enthalpy; Physical properties, Chemical properties; Uses; General characteristics of compounds of the Alkaline Earth Metals: Oxides, hydroxides, halides, salts of oxoacids (Carbonates; Sulphates and Nitrates); Anomalous behavior of Beryllium; its diagonal relationship with Aluminium.

10) p- BLOCK ELEMENTS GROUP 13 (BORON FAMILY):

General introduction - Electronic configuration, Atomic radii, Ionization enthalpy, Electro negativity; Physical & Chemical properties; Important trends and anomalous properties of boron.

11) p-BLOCK ELEMENTS - GROUP 14 (CARBON FAMILY):

General introduction - Electronic configuration, Atomic radii, Ionization enthalpy, Electro negativity; Physical & Chemical properties; Important trends and anomalous properties of carbon; Allotropes of carbon; Uses of carbon.

12) ORGANIC CHEMISTRY-SOME BASIC PRINCIPLES, TECHNIQUES AND HYDROCARBONS

SOME BASIC PRINCIPLES AND TECHNIQUES

General introduction; Tetravalency of Carbon: shapes of organic compounds; Structural representations of organic compounds; Classification of organic compounds; Nomenclature of organic compounds; Isomerism; Fundamental concepts in organic reaction mechanisms; Fission of covalent bond; Nucleophiles and electrophiles; Electron movements in organic reactions; Electron displacement effects in covalent bonds: inductive effect, resonance, resonance effect, electromeric effect, hyperconjugation; Types of Organic reactions.

HYDROCARBONS

Classification of Hydrocarbons; **Alkanes** - Nomenclature, isomerism (structural and conformations of ethane only); Preparation of alkanes; Properties - Physical properties and chemical reactivity, Controlled Oxidation, Isomerization, Aromatization, reaction with steam; **Alkenes** - Nomenclature, structure of ethene, Isomerism (structural and geometrical); Methods of preparation; Properties- Physical and chemical reactions: Addition of hydrogen, halogen, water, sulphuric acid, hydrogen halides (Mechanism- ionic and peroxide effect, Markovnikov's, anti Markovnikov's or Kharasch effect). Oxidation, Ozonolysis and Polymerization.

Alkynes - Nomenclature and isomerism, structure of acetylene. Methods of preparation of acetylene; Physical properties, Chemical reactions- acidic character of acetylene, addition reactions- of hydrogen, Halogen, Hydrogen halides and water. Polymerization.

Aromatic Hydrocarbons: Nomenclature and isomerism, Structure of benzene, Resonance and aromaticity; Preparation of benzene. Physical properties. Chemical properties: Mechanism of electrophilic substitution. Electrophilic substitution reactions - Nitration, Sulphonation, Halogenation, Friedel-Crafts alkylation and acylation; Directive influence of functional groups in mono substituted benzene; Carcinogenicity and toxicity.

13) SOLID STATE:

General characteristics of solid state; Amorphous and crystalline solids; Classification of crystalline solids based on different binding forces (molecular, ionic, metallic and covalent solids); Probing the structure of solids: X-ray crystallography; Crystal lattices and unit cells. Number of atoms in a unit cell (primitive, body centred and face centred cubic unit cell); Close packed structures: Close packing in one dimension, in two dimensions and in three dimensions- tetrahedral and octahedral voids- formula of a compound and number of voids filled - locating tetrahedral and octahedral voids; Packing efficiency in simple cubic, bcc, hcp, ccp lattice; Calculations involving unit cell dimensions-density of the unit cell; Imperfections in solids-types of point defects-stoichiometric and non-stoichiometric defects. Electrical properties, Magnetic properties (Band theory of metals, conductors, semiconductors and insulators and n and p type semiconductors)

14) SOLUTIONS:

Types of solutions; Expressing concentration of solutions - mass percentage, volume percentage, mass by volume percentage, parts per million, mole fraction, molarity and molality; Solubility: Solubility of a solid in a liquid, solubility of a gas in a liquid, Henry's law; Vapour pressure of liquid solutions: vapour pressure of liquid- liquid solutions. Raoult's law as a special case of Henry's law - vapour pressure of solutions of solids in liquids; Ideal and non- ideal solutions; Colligative properties and determination of molar mass-relative lowering of vapour pressure-elevation of boiling point-depression of freezing point-osmosis and osmotic pressure-reverse osmosis and water purification; Abnormal molar masses-van't Hoff factor.

15) ELECTROCHEMISTRY AND CHEMICAL KINETICS: ELECTROCHEMISTRY:

Electrochemical cells, Galvanic cells; Nernst equation-equilibrium constant from Nernst equation- electro chemical cell and Gibbs energy of the cell reaction; Conductance of electrolytic solutions- measurement of the conductivity of ionic solutions-variation of conductivity and molar conductivity with concentration-strong electrolytes and weak electrolytes-applications of Kohlrausch law; Electrolytic cells; Electrolysis: Faraday's laws of electrolysis-products of electrolysis; Batteries: primary and secondary batteries, Fuel cells, Corrosion of metals-Hydrogen economy

CHEMICAL KINETICS: Rate of a chemical reaction; Factors influencing rate of a reaction: dependance of rate on concentration- rate expression and rate constant- order of a reaction, molecularity of a reaction; Integrated rate equations-zero order reactions-first order reactions-half-life of a reaction; Pseudo first order reaction; Temperature dependence of the rate of a reaction. Effect of catalyst, Collision theory of chemical reaction rates.

16) SURFACE CHEMISTRY:

Adsorption and absorption: Distinction between adsorption and absorption-mechanism of adsorption; types of adsorption; characteristics of physisorption; characteristics of chemisorption; adsorption isotherms; adsorption from solution phase; applications of adsorption

Catalysis: catalysis, homogeneous and heterogeneous, Adsorption theory of heterogeneous catalysis, activity and selectivity of solid catalysis, Shape - selective catalysis by zeolites, Enzyme catalysis, Catalysis in industry.

Colloids; Classification of colloids: Classification based on physical state of dispersed phase and dispersion medium- classification based on nature of interaction between dispersed phase and dispersion medium- classification based on type of particles of the dispersed phase- multi molecular, macromolecular and associated colloids- cleansing action of soaps-preparation of colloids-purification of colloidal solutions- properties of colloidal solutions: Tyndall effect, colour, Brownian movement-charge on colloidal particles, electrophoresis. Coagulation or

precipitation, Coagulation of lyophilic sols, protection of colloids, Colloids around us - applications of colloids.

Emulsions – types of emulsions

17) GENERAL PRINCIPLES OF METALLURGY:

Occurrence of metals, Concentration of ores - levigation, magnetic separation, froth floatation, leaching, Extraction of crude metal from concentrated ore-conversion to oxide, reduction of oxide to the metal, Thermodynamic principles of metallurgy-Ellingham diagram-limitations-applications-extraction of iron, copper and zinc from their oxides; Electrochemical principles of metallurgy, Oxidation and reduction, Refining of crude metal-distillation, liquation, poling, electrolysis, zone refining and vapour phase refining; Uses of aluminium, copper, zinc and iron

18) p-BLOCK ELEMENTS:

GROUP-15 ELEMENTS: Introduction - Occurrence- electronic configuration, atomic and ionic radii, ionisation enthalpy, electronegativity, physical and chemical properties; Dinitrogen-preparation, properties and uses; Compounds of nitrogen-preparation, properties and uses of ammonia; Oxides of nitrogen; preparation, properties and uses of nitric acid; Phosphorus-allotropic forms, Phosphine-preparation, properties and uses, Phosphorus halides, Oxoacids of phosphorus.

GROUP-16 ELEMENTS: Introduction - Occurrence- electronic configuration, atomic and ionic radii, ionisation enthalpy, electron gain enthalpy, electronegativity, physical and chemical properties; Dioxygen-preparation, properties and uses; Simple oxides: Ozone - preparation, properties, structure and uses; Sulphur allotropic forms; Sulphur dioxide- preparation, properties and uses; Oxoacids of sulphur; Sulphuric acid-Properties and uses only, Sulphuric acid-manufacture.

GROUP-17 ELEMENTS: Introduction - Occurrence, electronic configuration, atomic and ionic radii, ionisation enthalpy, electron gain enthalpy, electronegativity, physical and chemical properties; Chlorine- preparation, properties and uses; Hydrogen chloride- preparation, properties and uses; Oxoacids of halogens; Interhalogen compounds.

GROUP-18 ELEMENTS: Introduction - Occurrence, electronic configuration, ionization enthalpy, atomic radii, electron gain enthalpy, physical and chemical properties (a) Xenon-fluorine compounds- XeF_2, XeF_4 and XeF_6 -preparation, hydrolysis and formation of fluoro anions-structures of XeF_2, XeF_4 and XeF_6 (b) Xenon-oxygen compounds XeO_3 and $XeOF_4$ - their formation, structures and uses.

19) d AND f BLOCK ELEMENTS & COORDINATION COMPOUNDS:

d AND f BLOCK ELEMENTS: Position in the periodic table; Electronic configuration of the d-block elements; General properties of the transition elements (d-block) - physical properties, variation in atomic and ionic sizes of transition series, ionisation enthalpies, oxidation states,

trends in the M^{2+}/M and M^{3+}/M^{2+} standard electrode potentials, trends in stability of higher oxidation states, chemical reactivity and E^{θ} values, magnetic properties, formation of coloured ions, formation of complex compounds, catalytic properties, formation of interstitial compounds, alloy formation; Some important compounds of transition elements; Inner transition elements, Actinoids; Some applications of d and f block elements.

COORDINATION COMPOUNDS: Werner's theory of coordination compounds; Definitions of some terms used in coordination compounds; Nomenclature of coordination compounds-IUPAC nomenclature; Isomerism in coordination compounds - (a)Stereo isomerism-Geometrical and optical isomerism (b)Structural isomerism-linkage, coordination, ionisation and hydrate isomerism; Bonding in coordination compounds. (a)Valence bond theory - magnetic properties of coordination compounds-limitations of valence bond theory (b) Crystal field theory (i) Crystal field splitting in octahedral and tetrahedral coordination entities (ii) Colour in coordination compounds-limitations of crystal field theory; Bonding in metal carbonyls; Stability of coordination compounds; Importance and applications of coordination compounds.

20) POLYMERS

Classification of Polymers -Classification based on source, structure, mode of polymerization, molecular forces and growth polymerization Types of polymerization reactions-addition polymerization or chain growth polymerization- ionic polymerization, free radical mechanism-preparation of addition polymers-polythene, teflon and poly acrylonitrile; condensation polymerization or step growth polymerization- polyamides-preparation of Nylon 6,6 and nylon 6-poly esters-terylene-bakelite, melamine, formaldehyde polymer-copolymerization-Rubber-natural rubber-vulcanisation of rubber- Synthetic rubbers-preparation of neoprene and buna-N Molecular mass of polymers-number average and weight average molecular masses- poly dispersity index (PDI) Biodegradable polymers-PHBV, Nylon 2-nylon 6 Polymers of commercial importance-poly propene, poly styrene, poly vinyl chloride (PVC), urea-formaldehyde resin, glyptal, bakelite- their monomers, structures and uses

21) BIOMOLECULES:

Carbohydrates - Classification of carbohydrates-Monosaccharides: preparation of glucose from sucrose and starch- Properties and structure of glucose- D, L and (+), (-) configurations of glucose - Structure of fructose; Disaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); importance of carbohydrates.

Amino acids: Natural amino acids-classification of amino acids - structures and D and L forms-Zwitterions.

Proteins: Structures, classification, fibrous and globular- primary, secondary, tertiary and quaternary structures of proteins- Denaturation of proteins.

Nucleic acids: Chemical composition of nucleic acids, structures of nucleic acids, DNA finger printing, biological functions of nucleic acids.

Enzymes: Enzymes, mechanism of enzyme action.

Vitamins and Hormones.

22) CHEMISTRY IN EVERYDAY LIFE:

Drugs and their classification: (a) Classification of drugs on the basis of pharmacological effect (b) Classification of drugs on the basis of drug action (c) Classification of drugs on the basis of chemical structure (d) Classification of drugs on the basis of molecular targets.

Drug-Target interaction-Enzymes as drug targets (a) Catalytic action of enzymes (b) Drug-enzyme interaction; Receptors as drug targets.

Therapeutic action of different classes of drugs: antacids, antihistamines, neurologically active drugs: tranquilizers, non-narcotic analgesics, narcotic analgesics, antimicrobials-antibiotics, antiseptics and disinfectants- antifertility drugs.

Chemicals in food: Artificial sweetening agents, food preservatives, antioxidants in food.

Cleansing agents-soaps and synthetic detergents.

23) HALOALKANES AND HALOARENES:

Classification and nomenclature; Nature of C-X bond; Methods of preparation: Alkyl halides and aryl halides-from alcohols, from hydrocarbons (a) by free radical halogenation (b) by electrophilic substitution (c) by replacement of diazonium group (Sandmeyer reaction) (d) by the addition of hydrogen halides and halogens to alkenes-by halogen exchange (Finkelstein reaction); Physical properties-melting and boiling points, density and solubility; Chemical reactions: Reactions of haloalkanes (i) Nucleophilic substitution reactions (a) SN^2 mechanism (b) SN^1 mechanism (c) stereochemical aspects of nucleophilic substitution reactions-optical activity (ii) Elimination reactions (iii) Reaction with metals-Reactions of halo arenes: (i) Nucleophilic substitution (ii) Electrophilic substitution and (iii) Reaction with metals. Polyhalogen compounds.

24) ORGANIC COMPOUNDS CONTAINING C, H AND O (Alcohols, Phenols, Ethers, Aldehydes, Ketones and Carboxylic acids):

ALCOHOLS, PHENOLS AND ETHERS

Alcohols, phenols and ethers - classification; Nomenclature: (a) alcohols, (b) phenols and (c) ethers; Structures of hydroxy and ether functional groups; Methods of preparation:

Alcohols from alkenes and carbonyl compounds (reduction and reaction with Grignard reagents).

Phenols from haloarenes, benzene sulphonic acid, diazonium salts, cumene;

Physical properties of alcohols and phenols; Chemical reactions of alcohols and phenols

(i) Reactions involving cleavage of O-H bond-Acidity of alcohols and phenols, esterification

(ii) Reactions involving cleavage of C-O bond- reactions with HX, PX_3, dehydration and oxidation (iii) Reactions of phenols- electrophilic aromatic substitution, Kolbe's reaction, Reimer - Tiemann reaction, reaction with zinc dust, oxidation.

Ethers-Methods of preparation: By dehydration of alcohols, Williamson synthesis- Physical properties-Chemical reactions: Cleavage of C-O bond and electrophilic substitution of aromatic ethers, Some Commercially important alcohols (uses with special reference to methanol and ethanol).

ALDEHYDES AND KETONES

Nomenclature and structure of carbonyl group; Preparation of aldehydes and ketones-

(1) by oxidation of alcohols (2) by dehydrogenation of alcohols (3) from hydrocarbons - Preparation of aldehydes (1) from acyl chlorides (2) from nitriles and esters (3) from hydrocarbons-Preparation of ketones (1) from acyl chlorides (2)from nitriles (3)from benzene or substituted benzenes; Physical properties of aldehydes and ketones; Chemical reactions of aldehydes and ketones-nucleophilic addition, reduction, oxidation, reactions due to alpha hydrogen and other reactions (Cannizzaro reaction, electrophilic substitution reaction); Uses of aldehydes and ketones.

CARBOXYLIC ACIDS

Nomenclature and structure of carboxyl group; Methods of preparation of carboxylic acids (1) from primary alcohols and aldehydes (2) from alkyl benzenes (3)from nitriles and amides (4) from Grignard reagents (5) from acyl halides and anhydrides (6) from esters; Physical properties; Chemical reactions: (i) Reactions involving cleavage of O-H bond-acidity, reactions with metals and alkalies (ii) Reactions involving cleavage of C-OH bond-formation of anhydride, reactions with PCl_5, PCl_3, $SOCl_2$, esterification and reaction with ammonia (iii) Reactions involving-COOH group-reduction, decarboxylation (iv) Substitution reactions in the hydrocarbon part - halogenation and ring substitution; Uses of carboxylic acid.

25) ORGANIC COMPOUNDS CONTAINING NITROGEN: AMINES

Structure of amines; Classification; Nomenclature; Preparation of amines: reduction of nitro compounds, ammonolysis of alkyl halides, reduction of nitriles, reduction of amides, Gabriel phthalimide synthesis and Hoffmann bromamide degradation reaction; Physical properties; Chemical reactions: basic character of amines, alkylation, acylation, carbyl amine reaction, reaction with nitrous acid, reaction with aryl sulphonyl chloride, electrophilic substitution of aromatic amines-bromination, nitration and sulphonation.

DIAZONIUM SALTS

Methods of preparation of diazonium salts, Physical properties, Chemical reactions. Importance of diazonium salts in synthesis of aromatic compounds.

CYANIDES AND ISOCYANIDES

Structure and nomenclature of cyanides and isocyanides, Preparation, physical properties and chemical reactions of cyanides and isocyanides.

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