

St. Thomas College, Bhilai

Chemistry Monthly Teaching Schedule, 2019-20

B.Sc Part-I Paper – I

Name of Faculty Member- Ms. Neha Verma/Ms. Monika Bombarde

Month	Topic
August	Unit-I Atomic structure- Idea of de-Broglie matter-waves, Heisenberg Uncertainty principle, Schrodinger wave equation, significance of Ψ and Ψ^2 , radial & angular wave functions and probability distribution curves, Atomic orbital and shapes of s, p, d orbital's, Aufbau and Pauli exclusion principles, Hund's Multiplicity rule, electronic configuration of the elements effective nuclear charges. Periodic Properties- Ionization energy, electron gain enthalpy and electro negativity, trend in periodic table
October	Unit –II Chemical bonding- Covalent Bond : Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization & shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3 , H_3O^+ , SF_4 , ClF_3 , Cl_2 and H_2O M.O. Theory, homonuclear & heteronuclear bond strength & bond energy, percentage ionic character from dipole moment & electronegativity difference.
November	Unit–III: Chemical bonding- Ionic Solids- Ionic structures, radius ratio & coordination number, limitation of radius, ratio rule. lattice defects, semiconductors, lattice energy Born- Haber cycle. Solvation energy and solubility of ionic solids, polarising power & polarisability of ions, Fajans rule, Metallic bond- free electron, Valence bond & band theories.
December	Unit -IVs-Block elements- Comparative study, salient features of hydrides, solvation & complexation tendencies including their function in biosystems and introduction to alkyl & aryls, Derivatives of alkali and alkaline earth metals. p-block elements Halides hydrides, oxides, oxyacids of Boron Aluminum
January	Unit-V chemistry of noble gases-Chemical properties of the noble gases, chemistry of xenon, structure binding in xenon compounds. Nitrogen and Phosphorus, boranes, borazines, fullerenes and silicates interhalogens and pseudohalogens inorganic chemical analysis-Chemical principles involved in the detection of acids and basic radicals including interfering radicals.

Paper – II Name of Faculty Member- Dr. Chanda Verma

Month	Topic
July	Unit- I-Electronic effects : Inductive effect, Resonance, Hyperconjugation, hydrogen bonding, Steric effect, Electromeric effect, Mesomerism, Inductomeric effect, Aromaticity, delocalized, localized molecular orbitals, Nucleophiles, Electrophiles, Reaction intermediates, Types of reactions: substitution, addition, rearrangement,
August	Unit-II Stereochemistry : Conformation, Configuration, Optical isomerism, plane polarization light Erythro & threo Compounds. Epimer, Enantiomer, Diastereomer, Chirality, Resolution, Racemization, Elements of symmetry, Relative Configuration, Absolute configuration, sequence rules, Cis and Trans isomerism, E & Z
September	Unit- III Nomenclature Cycloalkanes : Preparation, Chemical properties of cycloalkanes Baeyer strain theory and Limitations, strainless theory, cyclopropane bond. Mononuclear and polynuclear Aromatic rings: Structure of Benzene, Aromatic electrophilic substitution General pattern of mechanism, Role of sigma and pi complexes, electrophilic substitution in naphthalene,
October	Unit- IV Alkenes, Dienes and Alkynes: Mechanism of dehydration of alcohols, Chemical reactions of alkenes Mechanism involved in electrophilic and free radical additions, Substitution in allylic, and vinylic alkenes. Hydroboration oxidation; oxymercuration, reduction, epoxidation, Chemical

	reactions in 1-2,1-4 additions,Dielalder's reactions
November	Chemical reactions of alkynes and acidity of alkynes Electrophilic and nucleophilic addition reactions., Hydroboration oxidation ;with ozone and KMnO ₄ , Nucleophilic substitution reaction in alkynes, Acidity in Alkynes, revision of reaction mechanism
December	Unit-V Arenes and aromaticity: Alkyl halides and aryl halides Allyl halides and aryl halides with energy profile diagram, Mechanism of eletrophillic Substitution
January	Mechanism and stereochemistry of elimination reactions and alkyl halides

Paper – III Name of Faculty Member- Dr. Ashish Ku.Bhui

Month	Topic
July	Unit-I Mathematical Concepts for Chemistry and Computer : Lograthmic relations, curves , sketching of linear graphs, Differentiation , Partial Differentiation example Integration and relevant functions, Maximum and minimum,Permutation,Combination , Probability, General introduction of computers,Components of computer Hardware and softwareTypes of printers, programming language Input and Output devices, Binary numbers, Introduction to programming, Computer languages , Operation systems
August	Unit-II. Molecular Velocities : Root Mean Square velocity , average and most probable velocity, Maxwells law of distribution(Graphical interpretation) Effect of temperature on distribution of molecular velocities, Collision frequency, mean free path, Joule Thompson effect Liquification of gases, Deviation of Ideal behavior, Real gases, Vandervaal's equation Relationship between in Vanderwaal's constant and critical constants, , Method of liquefaction of gases Law of corresponding states
October	Unit-III Liquid State :Inter Molecular Forces, Magnitude of Intermolecular Forces , Structure of Liquids, Properties of Liquids, Viscosity and surface Tension, Ideal and Non Ideal solutions, Modes of representing concentrations of solutions, activity and activity coefficient. Dilute solution: Colligative properties' Lowering of vapour pressure, Roalt's Law Osmosis, Van't Hoff theorem of dilute solution, Measurement of osmotic pressure, Relationship between lowering of vapour pressure and osmotic pressure, Elevation of boiling point , Depression of frezing point, Abnormal molecular mass, Association and dissociation and Van't Hoff factor.
November	Unit IV Liquid Crystal: Difference between liquid crystals ,Difference between liquids and solids, Classification; Structure of Nematic, and Colestic phases, Thermography, seven segment cells, Application of liquid crystals Colloidal state:Classification-optical, kinetic and electrical properties, Flocculation value ,Protection , Gold number, emulsion micelles, Gels, synergesis, thixotrophy Application of Colloids Flocculation value ,Protection Gold number, emulsion micelles, Gels, synergesis, thixotrophy ,Application of Colloids Flocculation value Protection , Gold number, emulsion . Unit-V Solid State : Space lattices, unit cells, Elements of Symmetry in crystallize solids, X-rays diffraction, Mills indices, identification of unit cell by Broggs Spectrometer, Powder method, Neutron and electron diffraction (Elementry idea only).
January	Catalysis : Homogeneous and Heterogeneous Catalysis, types of catalyst, characteristic of Catalyst, Enzyme Catalysed reactions, Miceller catalysed reactions, Industrial applications of Catalysis.

B.Sc. Part- II Paper No.-I

Name of faculty member- Dr. Ashish Ku.Bhui

Month	Topic
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August	Unit-I Chemistry of Elements of Ist Transition series: Characteristic properties of d-Block elements, Properties of the elements of the first series, their binary compounds and their complexes Oxidation state , Coordination number Geometry.
September	Unit-II Chemistry of Elements of Ind and IIIrd Transition series: general characteristics comparative treatments with III rd analogous in respect of ionic radii Oxidation state , Magnetic behavior Spectral property, Stereochemistry
October	Unit-III Oxidation and Reduction: use of redox potential data analysis of redox cycle Redox stability in water Frost , Lattimer and Pourbaix diagram Principles involved in the extraction of elements Coordination compounds: Werner's Coordination theorem and experimental verification Effective atomic number concept Chelates Nomenclature of coordination compounds' Isomers in coordination compounds Valence bond Theorem of Transition metal complexes
November	Unit-IV Chemistry of Lanthanide elements: Electronic structure, oxidation state and ionic radii Lanthanide contraction Complex formation Occurrence and isolation Lanthanide compounds General features and chemistry of actinides Chemistry of separation of Np,Pu and Am from U Similarities between the latter Actinides and Lanthanides
December	Unit-V Acids and Bases: Arrhenius , Bronsted Lowry concept Lux-Flood concept Solvent system and Lewis Concept Non aqueous solvents: Physical properties of solvents Reaction in non aqueous solvent with reference to liquid ammonia' SO ₂

Paper - II

Month	Topic
August	Unit-I Alcohols -Dihydric alcohols, nomenclature, methods of formation Phenols: Structure and bonding, physical properties and acidic character Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion Reactions of phenols, acylation and carboxylation.Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben - Hoesch reaction, Lederer - Manasse reaction and Reimer-Tiemann reaction. Epoxides:synthesis, Catalysed ring openings of epoxides, orientation of epoxides ring opening Reactions of Grignard and organolithium reagents with epoxides.
September	Unit-II Aldehydes & Ketones- Nomenclature and Structure of the carbonyls group. Synthesis of aldehydes and ketones using 1,3dithianes, synthesis of ketones from nitriles.Mechanism of nucleophilic additions to carbonyls group Benzoin, Aldol, Perkin and Knoevenagel condensations. Condensations with ammonia and its derivatives, Wittig reaction, Mannich reaction.Use of acetate as protecting group, Oxidation of aldehydes, Baeyer – Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen Condensation, Wolf-Kishner reaction, LiAlH ₄ and NaBH ₄ reduction. Halogenation of enolizable ketones.An introduction to α , β unsaturated aldehydes and ketones
October	Unit-III Carboxylic acids: structure and bonding, Physical properties, acidity of carbohydrates, Effect of substituents on acidic strength, HVZ reaction, Reduction of Carboxylic acids, Mechanism of Decarboxylation Methods of Formation and chemical reaction of unsaturated monocarboxylic acids, Dicarboxylic acids: method of formation and effect of heat and Dehydrating agent Substituted Carboxylic acids: Hydroxy and halo substituted acids Carboxylic acids - derivative: Structure of acid chloride, ester, amide and acid anhydride, Relative stability of Acyl derivatives, physical properties, interconversion of acid derivative by nucleophilic acyl Substitution
November	Unit-IV Organic compounds of nitrogen: preparation of Nitroalkanes, nitroarenes, chemical reactions of nitroalkanes, mechanism of nucleophilic substitution in nitroarenes Reactivity, structure and nomenclature of amines, Physical property, Stereochemistry of amines, separation of mixture of primary, secondary and tertiary amines Structural feature affecting basicity of amines, Preparation of alkyl and aryl amines, Reductive amination of aldehyde and ketonic compounds. Gabriel phthalimide synthesis, Hoffman Bromamide reaction Reaction of amines Electrophilic aromatic substitution in aryl amines Reaction of amines with Nitrous acids, synthesis

	transformation of aryl diazonium salts, Azocoupling
December	Unit-V Heterocyclic compound- Molecular orbital picture and aromatic character of pyrrole, furan, thiophene and pyridine, methods of synthesis and chemical reactions with emphasis on the mechanism of electrophilic substitution. Mechanism and nucleophilic substitution reaction in pyridine derivatives. Comparison of basicity of pyridine. Piperidine and pyrrole. Preparation and reaction of Indole, quinoline and isoquinoline and with special reference to Fisher Indole synthesis and skraup synthesis and Bisher-Napieralski synthesis, Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline. Amino acids and Peptides : Classification, Structure and stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis. Preparation and reaction of α - amino acids. Structure and nomenclature of peptides. Peptide synthesis, solid - phase peptide synthesis.

Paper:III

Name of Faculty-Dr. James Mathew/ Ms. Neha Verma

Month	Topic
August	Unit-I Thermodynamics-I Fundamentals of thermodynamic system, surroundings etc. Types of systems, extensive and intensive properties, state and path function operations, internal energy, enthalpy, heat capacity of gases at constant volume and at constant pressure Their relationship, first law of thermodynamics, limitations of first law. Joule-Thomson effect Inversion temperature of gases, Calculation of w, q, du and dH for the liquefaction of ideal gases under isothermal and adiabatic conditions Thermochemistry: Standard state, Hess's law of heat summation, Enthalpy of reaction at constant pressure and volume. Enthalpy of neutralization, enthalpy of combustion, enthalpy of formation, Calculation of bond energy Kirchhoff's equation .
September	Unit-II Thermodynamics-II- Second law of thermodynamics, spontaneous processes, need of the second law, Statements, Carnot cycle and efficiency of heat engine carnot theorem, Thermodynamic scale of temperature Gibbs-Helmholtz free energy variation of G and A with pressure volume and temperature Concept of entropy: entropy change in reversible and irreversible processes of an ideal gas Entropy change in isothermal mixing of an ideal gases, physical significance of entropy, Gibbs-Helmholtz equation
October	Unit-III Phase equilibrium- Gibbs Phase rule, Phase components and degree of freedom, Limitation of phase rule. Applications of phase rule to one component system - water system, sulphur system. Three component systems : solid solution liquid pairs. Liquid liquid mixture : (Partially miscible liquids) : phenol-water, trimethylamine-water nicotine systems, constant temperature, azeotrops. Nernst distribution law, Henry's law, application, solvent extraction.
November	Unit-IV Electrochemistry-I: Electrical conductance, specific and equivalent conductance, measurement of eq. conductance Kohlrausch's law; application of Kohlrausch's law in determination of dissociation constant of weak electrolyte, solubility of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titration. Theories of strong electrolytes : limitations of Ostwald dilution law, weak and strong electrolyte, Debye-Huckel- Onsager (DHO) equation for strong electrolyte, relaxation and electrophoretic effect. Migration of ions Transport number, definition and determination by Hittorf method and moving boundary method.
December	Unit-IV Electrochemistry-II Electrochemical cell or galvanic cell reversible and irreversible cells conventional representation of electrochemical cells, EMF of the cell, effect of temperature on EMF of the cell, Nernst equation, calculation of G, H and S for cell reaction Single electrode potential : standard hydrogen electrode, calomel electrode quinhydrone electrode, redox electrodes, electrochemical series. Concentration cells with & without transport, liquid junction potential, application of concentration cell in determining valency of ions, solubility product, activity coefficient. Determination of pH and pKa using hydrogen and quinhydrone

electrode potentiometric titrations, buffer solutions; Henderson-Hazel Equation, Hydrolysis of salts, Corrosion : type theories and prevention

B.Sc. Part III Paper No.- I

Name of faculty member- Dr. Ashish Ku.Bhui

Month	Topic
August	Unit-I Metal Ligand bonding in Transition metal complexes:- Limitation of VB Theorem Elementary idea of Crystal Field Theory Crystal Field Splitting in Octahedral, Tetrahedral and Square planar complexes Factor affecting CF parameters Thermodynamic and Kinetic Aspect of metal complexes A brief outline of thermodynamic stability of metal complexes and factor affecting stability Substitution reaction of square planar complexes
September	Unit-II Magnetic properties of Transition metal complexes: Types of magnetic behavior Methods of detection of Magnetic susceptibility Spin only formula L-S Coupling Correlation of μ_{obs} and μ_{eff} values Orbital contribution to magnetic moments Application of magnetic moment data for 3d metal complexes Electronic spectra of transition metal complexes Types of electronic transition, Selection rule for d-d transition, Spectroscopic ground state, spectrochemical series Orgel energy diagram for d^1 and d_3^{3+} states Discussion of the electronic spectrum for $\text{Ti}(\text{H}_2\text{O})_6^{3+}$
October	Unit-III Organometallic chemistry: Definition, nomenclature and classification Preparation, property, bonding, of alkyl and aryls of Lithium, Aluminium Hg, Sn and Ti as well as brief account of metal ethylenic complexes Homogeneous hydrogenation Mononuclear carbonyls and nature of bonding in metal carbonyls
November	Unit-IV Bio-inorganic Chemistry: Essential and trace elements in biological processes, metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metals with special reference to Ca^{2+} , nitrogen fixation.
December	Unit-V Hard and soft acids and bases Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis Silicones and Phosphazenes Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes

Paper - II

Name of Faculty Member- Dr. Chanda Verma/ Ms. Monika Bombarde

Month	Topic
August	Unit I Organomagnesium Compounds —Preparation & properties Organolithium Compounds – Preparation and Comparison with RMgX , Organo Sulphur Compounds – Preparation and comparison Chemical reaction of organometallic compounds. Organocadmium compounds Preparation and properties Thioether, Benzene Sulphonic Acids, Sulphguanidine Active Methylene Compounds – Diethyl malonate Ethylacetoacetate preparation and properties Keto- Enol tautomerism, Synthetic importance of active methylene compounds
September	Unit II Biomolecule —Carbohydrates & its configuration Threo and Erythro Diastereomers. Formation of Glycosides ethers Determination of Ring Size of Monosaccharides Cyclic Structure of D(+) Glucose, Structure Of Ribose and deoxy Ribose Introduction to Disaccharides : Maltose, Sucrose Structure determination of lactose Polysaccharides (Starch and Cellulose) Classification and Structure determination of protein levels Protein Denaturation / renaturation Constituents of Amino acids Ribonucleotides, Double Helical, Structure of DNA
October	Unit-III Synthetic polymer: Addition or chain growth polymerization. Free radical vinyl polymerization, Ziegler-Natta polymerization, Condensation or Step growth polymerization, Polyesters, polyamides, phenols- formaldehyde resins, urea- formaldehyde resins, epoxy resins and polyurethanes, natural and synthetic rubbers. Synthetic Dyes-Colour and constitution (Electronic Concept). Classification of Dyes. Chemistry of dyes. Chemistry and synthesis of Methyl Orange, Congo Red, Malachite Green, Crystal Violet, Phenolphthalein,

	fluorescein, Alizarine and Indigo.
November	Unit-IV Spectroscopy Mass spectroscopy- mass spectrum fragmentation of functional groups. InfraRed Spectroscopy- IR absorption Band their position and intensity, Identification of IR spectra. UV-Visible Spectroscopy- Beer Lambert's law, effect of Conjugation max Visible spectrum and colour. Anthocyanin as natural colouring matter (Introduction only) Application of Mass, IR, UV-Visible Spectroscopy to organic molecules
December	Unit-V NMR Spectroscopy: Introduction to NMR. Shielding and Number of signal in PMR, Chemical shift and characteristic values, splitting of Signals and Coupling constant. Application to organic molecules. ¹³ CMR Spectroscopy: Principal & Application. Magnetic Resonance Imaging (MRI)- Introductory idea.

Paper: III

Name of Faculty Member: Dr. James Mathew/ Ms. Neha Verma

Month	Topic
August	Unit-I Quantum mechanics Black body radiation, Plank's radiation law, photoelectric effect, Compton effect. DeBroglie's idea of matter waves, experimental verification Heisenberg's uncertainty principle, Sinosoidal wave equation, Operators : Hamiltonian operator, angular momentum operator, laplacian operators postulate of quantum mechanics Eigen values, Eigen function. Schrodinger time independent wave equation physical Significance of and Applications of Schrodinger wave equation: particle in one dimensional box Hydrogenation (separation into three equation's) radial wave function and angular wave function.
September	Unit-II Quantum mechanics-II Quantum mechanical approach of molecular orbit theory; basic idea criteria for forming M.O and A.O, LCAO approximation, formation of H ₂ ⁺ ion, calculation of energy levels from wave functions bonding and antibonding wave functions concept of orbitals and their characteristics, Hybrid orbital : SP, SP ² , SP ³ , Calculation of coefficients Ads used in these hybrid orbitals. Introduction to valence bond model of H ₂ , Comparison of M.O. and V.B. model, Huckle theory, application of huckel theory to ethane propene etc.
October	Unit-III Spectroscopy-I Introduction, characterization of electromagnetic radiation, regions of the spectrum, representation of spectra width and intensity of spectral transition, rotational spectra of diatomic molecules, energy level of rigid rotator, selection rule, determination of bond length qualitative description of non - rigid rotator isotopic effect. Vibrational spectra - Fundamental vibrational and their symmetry, vibrating diatomic molecules, energy levels of simple harmonic oscillator. Selection Rule, Pure vibrational Spectrum, determination of force constant, diatomic vibrating operator. Anharmonic Oscillator. Raman Spectra : Concept of polarizability, quantum theory of Raman spectra stokes and anti stokes lines pure rotational and vibrational Raman spectra, Application of Raman spectra stokes and anti stokes lines, pure rotational and vibrational Raman spectra, Applications of Raman spectra.
November	Unit-IV Spectroscopy-II Electronic Spectra: Electronic Spectra of diatomic molecule, Frank London principle, types of electronic transitions. Applications of electronic spectra. Photo-chemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry. Grothus-Draper law, Stark-Einstein law, Jablonski diagram depicting various process occurring in the excited state, qualitative description of fluorescence, occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield photosensitized reactions energy transfer

	processes (simple examples).
December	Unit-V Thermodynamics -Energy referred to absolute zero, third law of thermodynamics Test of III law of thermodynamics Nerst heat theorem application and limitation of Nerst heat theorem. Physical properties and molecular structure : polarization of molecules, {Classius-Mosotti equation. orientation of dipoles in an electric field. Dipol moment, induced dipole moment, measurement of dipole moment. Temperature methods and refractivity methods. Dipole moment and molecular structure. Magnetic Properties: Parmagenetism diamagnetism, ferromagnetism. Determination of magnetic susceptibility, elucidation of molecular structure.