

Govind Guru Tribal University, Banswara
Details of Discipline Centric Core and Elective Courses for freshers
who will be admitted in the session 2023-24
(Separate sheet to be used for each discipline/subject)

Name of University: Govind Guru Tribal University, Banswara

Name of Faculty(ies) : SCIENCE

Name of Discipline/Subject: CHEMISTRY

| Three-Year Bachelor Degree Program | | | | | Credits | | | |
|------------------------------------|-------|----------|------|-----------------------------------|---------|---|-------|---|
| # | Level | Semester | Type | Title | L + T | P | Total | |
| 1 | 5 | I | DCC | Inorganic Chemistry-I | 3 | 1 | 2 | 6 |
| 2 | 6 | II | DCC | Chemistry-II | 3 | 1 | 2 | 6 |
| 3 | 6 | III | DCC | Chemistry-III | 3 | 1 | 2 | 6 |
| 4 | 6 | IV | DCC | Chemistry-IV | 3 | 1 | 2 | 6 |
| 5 | 7 | V | DSE | Solutions and Electrochemistry | 3 | 1 | 2 | 6 |
| 6 | 7 | VI | DSE | Molecules of Life | 3 | 1 | 2 | 6 |

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GOVIND GURU TRIBAL UNIVERSITY, BANSWARA

Discipline Centric Course (DCC) INORGANIC CHEMISTRY-I CHEMISTRY SEMESTER I

Unit 1

Atomic Structure: Recapitulation of Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance.

Schrödinger's wave equation, significance of ψ and ψ^2 . Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals.

Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, aufbau principle and its limitations.

Unit 2

Periodicity of Elements: Brief discussion of the following properties of the elements, with reference to *s* & *p*-block and the trends shown:

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

(b) Atomic and ionic radii

(c) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization enthalpy and trends in groups and periods.

(d) Electron gain enthalpy and trends in groups and periods.

(e) Electronegativity, Pauling's/ Allred Rochow's scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity.

Unit 3

Chemical Bonding:

(i) *Ionic bond:* General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

(ii) *Covalent bond:* Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule,

Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2 , O_2 , C_2 , B_2 , F_2 , CO , NO , and their ions; HCl (idea of *s-p* mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H_2O , NH_3 , PCl_3 , PCl_5 , SF_6 , ClF_3 , I_3^- , BrF_2^+ , PCl_6^- , ICl_2^- , ICl_4^- and SO_4^{2-} .

Multiple bonding (ζ and π bond approach) and bond lengths.

Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization.

Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

(iii) *Metallic Bond*: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

(iv) *Weak Chemical Forces*: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction. Hydrogen bonding (theories of hydrogen bonding, valence bond treatment). Effects of weak chemical forces, melting and boiling points, solubility, energetics of dissolution process.

Reference Books:

- Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010
- Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
- Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
- Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.*, Oxford University Press, 1994.
- Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.

Practical C – I Lab:

(A) Titrimetric Analysis

- (i) Calibration and use of apparatus
- (ii) Preparation of solutions of titrants of different Molarity/Normality

(B) Acid-Base Titrations

Principles of acid-base titrations to be discussed.

- (i) Estimation of sodium carbonate using standardized HCl.
- (ii) Estimation of carbonate and hydroxide present together in a mixture.
- (iii) Estimation of carbonate and bicarbonate present together in a mixture.
- (iv) Estimation of free alkali present in different soaps/detergents

(C) Oxidation-Reduction Titrimetry

Principles of oxidation-reduction titrations (electrode potentials) to be discussed.

- (i) Estimation of Fe(II) and oxalic acid using standardized KMnO_4 solution
- (ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
- (iii) Estimation of Fe(II) with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator (diphenylamine, N-phenylanthranilic acid) and discussion of external indicator.

Reference Books:

- Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.

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GOVIND GURU TRIBAL UNIVERSITY BANSWARA

B.Sc. Three Year Graduate Course Semester II CHEMISTRY DCC CHEMISTRY - II

Unit 1

- **Structure and Bonding**—Localized and delocalized chemical bond, Van der Waals interaction, charge transfer complexes, resonance, hyperconjugation, aromaticity, electromeric, inductive effect, hydrogen bonding.
- **Mechanism of Organic Reactions** – Curved arrow notation, drawing electron movements with arrows, half – headed and double – headed arrows, types of organic reactions, energy considerations.
- **Reactive Intermediates** – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes, their formation and stabilities.
- **Methods of Determination of reaction mechanism** (product analysis, intermediates, isotope effect, kinetic and stereochemical studies).
- **Stereochemistry of Organic Compounds of isomerism, types of isomerism –**
- **Optical Isomerism**- Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion retention and racemization. Relative and absolute configuration, sequence rules D and L, R and S systems of nomenclature.
- **Geometric isomerism**- determination of configuration of geometric isomers. E and Z system of nomenclature geometric isomerism in oximes and alicyclic compounds.
- **Conformational isomerism**- conformational analysis of ethane and n-butane conformations of cyclohexane, axial and equatorial bonds. Newman

projection and Sawhorse formulae, Fischer and Flying Hons, Wedge formulae.

- Difference between configuration and conformation.

Unit 2

- **Arenes and Aromaticity:** Nomenclature of benzene derivatives, the aryl group, aromatic nucleus and side chain, structure of benzene, molecular formula and Kekule structure, stability and carbon- carbon bond lengths of benzene, resonance structure and M. O. diagram.
- **Aromaticity:** The Huckel rule, aromatic ions, Aromatic electrophilic substitution: General pattern of the mechanism. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel -Craft reaction. Energy profile diagrams, Activating and deactivating substituents, orientation and ortho-para ratio. Side chain reactions of benzene derivatives. Birch reduction, Methods of formation a chemical reaction of alkylbenzenes, alkynyl benzene and biphenyl.
- **Alkyl and Aryl Halide:** Nomenclature and classes of Alkyl Halide, methods of formation, chemical reactions, mechanism of nucleophilic substitution reactions of alkyl halides, S_N1 , and S_N2 reactions with energy profile diagrams, factors affecting S_N2 , and S_N1 reactions.
- Haloform reaction, Freons.
- Methods of formation of aryl halides, nuclear and side chain reactions, the addition elimination and elimination - addition reaction, mechanisms of nucleophilic aromatic substitution reactions.
- Relative reactivities of alkyl halides v/s allyl, viny and aryl halides, synthesis and uses of DDT and BHC.

Unit 3

- **Gaseous State** – Postulates of Kinetics theory of gases, deviation from ideal behaviour, van der waals equation of state,
- **Critical Phenomena** – PV isotherm of real gases, continuity of states, the isotherm of Van der waal equation, relationship between critical constant and van der waal constant, the law of corresponding states, reduced equation of state.
- **Molecular velocities** – Root mean square, average and most probable velocity, qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter, liquefication of gases (based on Joule Thomson effect).
- **Solid State** – Definition of space lattice, unit cell, Bravais lattice.

- **Laws of crystallography** – (1) Law of constancy of interfacial angles (2) Law of rationality of indices, Weiss and Miller indices (3) Law of symmetry, symmetry elements in crystals, Classification of crystal, X – ray diffraction by crystals, derivation of Bragg equation, determination of crystal structure of NaCl, KCl and CsCl (Laue's method and power method).
- **Colloidal State** – Definition of colloids, classification of colloids.
- **Solid in Liquid (Sols):** Properties – kinetics, optical and electrical, stability of colloids, protective action, Hardy Schulze law, gold number.
- **Liquid in Liquid (emulsions):** Types of emulsions, preparation, emulsifier.
- **Liquids in solid (Gels)** – Classification, preparation and properties, inhibition, general application of colloids.

Books recommended :

- Principles of Physical Chemistry: B. R. Puri and L. R. Sharma.
- A Text Book of Physical Chemistry: A. S. Negi and S. C. Anand.
- Physical Chemistry, Pt. I & II: C.M. Gupta, J.K.Saxena and M. C. Purohit.
- Physical Chemistry (Hindi Ed.): Suresh Ameta. R.C. Khandelwal, R. Ameta & J. Vardia, Himanshu.
- Advanced Organic Chemistry by Mukherji, Singh & Kapoor
- Organic Chemistry by Bahl and Bahl
- Advanced Organic Chemistry by Morrison & Boyd
- Organic Chemistry by Suresh Ameta, Pinki B Punjabi and B.K. Sharma (Himanshu Publication)

Paper Code: C-II Lab

Practical Syllabus –

1. **Semi micro analysis of inorganic mixture** – The mixture shall contain five radicals at least two cations and two anions soluble in water or in HCl, two cations of the same group except II A & II B may be given. Not more than one interfering radical may be given. Interfering radical may not be given with typical anion combination.
2. **Detection of extra elements** –
 - (i) (N.S, and halogen) if any and functional group in given simple organic compounds. (One organic compound from the following list be given for identification).
Carboxylic acids. Phenols, Alcohols, Carbohydrates, Aldehydes, Ketones, Nitro

Compounds, Amino compounds, Anilides. Amides, Esters, Thioamide, Hydrocarbons,
Halogen containing compounds

(ii) Crystallization:

Concept of crystallization

Phthalic acid from hot water (using fluted filter paper and stemless funnel).

Acetanilide from boiling water

Naphthalene from ethanol

Benzoic acid from water.

Simple Sublimation: Camphor, Naphthalene, Phthalic acid and Succinic acid.

Mixed Melting Point determination

Urea- Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1)

3. **Physical Chemistry Experiments-** Any one of the following experiments may be given in the examination.

Viscosity and Surface tension -

(a) To determine the percentage composition of a given mixture (non interacting systems) by viscosity method.

(b) To determine the percentage composition of a given binary mixture by surface tension method

(c) To determine the parachor value of - CH₂ group.

(d) To determine the rheochor value of - CH₂ group.

Transition Temperature

(1) Determination of the transition temperature of the given substance by thermometric/ dilatometric method (e.g.: MnCl₂.4H₂O, SrBr₂ 2H₂O)

Thermochemistry

(1) To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.

(2) To determine the enthalpy of neutralization of a weak acid/ weak base versus strong base/ strong acid and determine the enthalpy of ionization of the weak acid / weak base.

(3) To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber Cycle.

Books recommended

1. Practical Chemistry -Giri, Bajpai and Pandey, S. Chand & Co. Ltd. New Delhi

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2. Laboratory Manuel in Organic Chemistry, R.K. Bansal, Willey Eastern
3. Experimental Organic Chemistry Vol.I & II, P.R. Singh, D.S. Gupta & K.S. Bajpai, Tata McGraw Hill.
4. Experiments in Physical Chemistry- J.C. Ghose, Bharti Bhawan
5. Experiments in General Chemistry, N.R. Rao & Agarwal, Eastern Press
6. Practical Chemistry- Suresh Ameta & P.B. Punjabi. Himanshu Publication.


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