

B.Sc. (Chemistry)



B. Sc. THIRD YEAR

SUBJECT : CHEMISTRY
PAPER NUMBER : FIRST
NAME OF PAPER : INORGANIC CHEMISTRY

Max. Marks:33

UNIT-I METAL-LIGAND BONDING IN TRANSITION METAL COMPLEXES

Limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal field parameters.

Thermodynamic and kinetic aspects of metal complexes.

A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes.

UNIT-II MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES

Types of magnetic Behaviour, methods of determining magnetic susceptibility, spin only formula. L-S coupling, correlation of μ_s 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 transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel-energy level diagram for d^1 and d^2 states, discussion of the electronic spectrum of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ complex ion.

UNIT-III ORGANOMETALLIC CHEMISTRY

Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn, & Ti. A brief account of metal-ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and nature of bonding in metal carbonyls.

UNIT-IV BIOINORGANIC CHEMISTRY

Essential and trace elements in biological processes, metalloporphyrin with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metals with special reference to Ca^{2+} nitrogen fixation.

UNIT-V HARD AND SOFT ACIDS AND BASES (HSAB)

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.

REFERENCE BOOKS:

1. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley
2. Concise Inorganic Chemistry, J.D. Lee, ELBS.
3. Concepts of models of Inorganic Chemistry, B. Douglas, D. McDaniel, John Wiley
4. Inorganic Chemistry, D.E. Shriver, P.W. Atkins and C.H. Langford, Oxford.
5. Inorganic Chemistry, W.W. Porterfield, Addison-Wesley.
6. Inorganic Chemistry, A.G. Sharp, ELBS.
7. Inorganic Chemistry, G.L. Miessler and D.A. Tarr, Prentice Hall.
8. Advanced Inorganic Chemistry, Satyas Prakash.
9. Advanced Inorganic Chemistry, Agarwal & Agarwal.
10. Advanced Inorganic Chemistry, Puri & Sharma, S. Naginchand
11. Inorganic Chemistry, Madan, S. Chand & Co.
12. Adhunik Akarbanic Rasayan, A.K. Shrivastav & P.C. Jain, Goel Pub.
13. Uchhattar Akarbanic Rasayan, Satya Prakash & G.D. Tuli, Shyamlal Prakashan
14. Uchhattar Akarbanic Rasayan, Puri & Sharma.

B. Sc. THIRD YEAR

SUBJECT : CHEMISTRY
PAPER NUMBER : SECOND
NAME OF PAPER : ORGANIC CHEMISTRY

Max. Marks:33

UNIT-I

A. ORGANOMETALLIC COMPOUNDS

Organomeganesium compounds: Grignard reagents-formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions.

B. Organosulphur Compounds

Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine

Organic Synthesis via Enolates

Active methylene group alkylation of diethylmalonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate.

UNIT-II BIOMOLECULES

A. Carbohydrates:

Configuration of monosaccharides, threo and erythro diastereomers. Formation of glycosides ethers and esters Determination of ring size of monosaccharides. Cyclic structure of D(+) glucose Structure of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose and polysaccharides starch and cellulose) without involving structure determination.

B. Proteins and Nucleic acids

Classification and structure of protein levels of protein structure, protein denaturation / renaturation. Constituents of amino acids Ribonucleic acids and Ribonucleotides. double helical structure of DNA.

UNIT-III

A. Synthetic Polymers

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.

B. 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.

UNIT-IV SPECTROSCOPY

A. Mass spectrometry: mass spectrum fragmentation of functional groups.

B. InfraRed Spectroscopy: IR absorption Band their position and intensity. Identification of IR spectra.

C. UV-Visible Spectroscopy: Beer Lambert's law. effect of Conjugation max Visible spectrum and colour.

D. Anthocyanin as natural colouring matter (Introduction only)

E. Application of Mass. IR. UV-Visible Spectroscopy to organic molecules.

UNIT-V

A. NMR Spectroscopy: Introduction to NMR. Shielding and Number of signals in PMR. Chemical shift and characteristic values, splitting of Signals and Coupling constant Application to organic molecules.

B. ¹³CMR Spectroscopy: Principal & Application.

C. Magnetic Resonance Imaging (MRI)- Introductory idea.

REFERENCE BOOKS:

1. Organic Chemistry, Morrison and Boyd, Prentice-Hall
2. Organic Chemistry, L.G. Wade Jr., Prentice-Hall
3. Fundamentals of Organic Chemistry, Solomons, John Wiley
4. Organic Chemistry, Vol.I, II, III, S.M. Mukherjee, S.P. Singh, Wiley-Eastern
5. Organic Chemistry, F.A. Carey, McGraw Hill
6. Introduction to Organic Chemistry, Streiweisser, Heathcock and Kosover, Macmillan
7. Organic Chemistry, P.L. Soni

B. Sc. THIRD YEAR

SUBJECT : CHEMISTRY
PAPER NUMBER : THIRD
NAME OF PAPER : PHYSICAL CHEMISTRY

Max. Marks:34

UNIT-I QUANTUM MECHANICS-I

Black body radiation. Plank's radiation law, photoelectric effect. Compton effect. De-Broglie's idea of matter waves, experimental verification Heisenberg's uncertainty principle, Sinusoidal 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.

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 and orbital and their characteristics. Hybrid orbital: SP , SP^2 , SP^3 , Calculation of coefficients and 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 Huckle theory to ethane propane etc.

UNIT-II SPECTROSCOPY-I

- A. Introduction, characterization of electromagnetic radiation. regions of the spectrum, representation of spectra width and intensity of spectral transition, rotational spectra of calculated diatomic molecules, energy level of rigid rotator, selection rule, determination of bond length qualitative description of non - rigid rotator isotopic effect.
- B. Vibrational spectra - Fundamental vibrational and there, symmetry, vibrating diatomic molecules, energy levels of simple harmonic oscillator. Selection Rule. Pure vibrational Spectrum, determination of force constant, diatomic vibrating operator. Anharmonic Oscillator.
- C. 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.

UNIT-IV SPECTROSCOPY-II

- A. **Electronic Spectra:** Electronic Spectra of diatomic molecule, Frank London principle, types of electronic transitions. Applications of electronic spectra.
- B. **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).

UNIT-V

- A. **Thermodynamics**
Energy referred to absolute zero, third law of thermodynamics, test of third law of thermodynamics Nernst heat theorem application and limitation of Nernst heat theorem.
- B. Physical properties and molecular structure: polarization of molecules, B. {Classius-Mosotti equation. orientation of dipoles in an electric field. Dipole moment, induced dipole moment, measurement of dipole moment. Temperature methods and refractivity methods. Dipole moment and molecular structure.
- C. **Magnetic Properties:** Paramagnetism diamagnetism, ferromagnetism. Determination C. of magnetic susceptibility, elucidation of molecular structure.

REFERENCE BOOKS:

1. Physical Chemistry, G.M. Barrow, International student edition, McGraw Hill
2. Basic programming with application, V.K. Jain, Tata McGraw-Hill
3. Computers & Common sense, R. Hunt & Shelly, Prentice-Hall
4. University general chemistry, C.N.R. Rao, Macmillan.
5. Physical Chemistry, R.A. Alberty, Wiley Eastern
6. The elements of Physical Chemistry, P.W. Atkins, Oxford
7. Physical Chemistry through problems, S.K. Dogra & S. Dogra, Wiley Eastern
8. Physical Chemistry, B.D. Khosla
9. Physical Chemistry, Puri & Sharma

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B. Sc. THIRD YEAR

SUBJECT : CHEMISTRY
PAPER NUMBER : FOURTH
NAME OF PAPER : LABORATORY COURSE

Max. Marks: 50

INORGANIC CHEMISTRY

Synthesis Analysis

- Preparation of Sodium trioxalato ferrate (III), $\text{Na}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ and determination of its composition by permanganometry.
- Preparation of Ni-DMG complex, $[\text{Ni}(\text{DMG})_2]$
- Preparation of copper tetra ammine complex, $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$.
- Preparation of cis-and trans-bioxalato diaqua chromate (III) ion.

Gravimetric Analysis

Analysis of Cu as CuSCN or CuO , Ni as $\text{Ni}(\text{DMG})_2$, Ba as BaSO_4 and Fe as Fe_2O_3

ORGANIC CHEMISTRY

Laboratory Techniques

- A Steam Distillation
Naphthalene from its suspension in water
Clove oil from cloves
Separation of ortho and para-nitrophenols.
- B. Column Chromatography
Separation of fluorescein and methylene blue
Separation of leaf pigments from spinach leaves
Resolution of racemic mixture of (+,-) mandelic acid.

Qualitative Analysis

Analysis of an organic mixture containing two solid components using water, NaHCO_3 , NaOH for separation and preparation of suitable derivatives.

Synthesis of Organic Compounds

- Acetylation of salicylic acid, aniline, glucose and hydroquinone. Benzoylation of aniline and phenol.
- Aliphatic electrophilic substitution- Preparation of iodoform from ethanol and acetone.
- Aromatic electrophilic substitution:
Nitration-Preparation of m-dinitrobenzene, p-nitroacetanilide
Halogenation- Preparation of p-bromoacetanilide, 2,4,6 tribromophenol
- Diazotization/Coupling- Preparation of methyl orange and methyl red
- Oxidation- Preparation of benzoic acid from toluene
- Reduction- Preparation of aniline from nitrobenzene, m-nitroaniline from m-dinitrobenzene.

PHYSICAL CHEMISTRY

Electrochemistry

- To determine strength of given acid conductometrically using standard alkali solution.
- To determine solubility and solubility product of a sparingly soluble electrolyte conductometrically.
- To study saponification of ethyl acetate conductometrically.
- Determine the ionization constant of a weak acid conductometrically.
- To titrate potentiometrically the given ferrous ammonium sulphate using $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ as titrant and calculate the redox potential of $\text{Fe}^{2+}/\text{Fe}^{3+}$ system on the hydrogen scale.

Refractometry and Polarimetry

- To verify law of refraction of mixtures (e.g. of glycerol and water) using Abbe's refractometer.
- To determine the specific rotation of a given optically active compound.

Molecular Weight Determination

- Determination of molecular weight of a non-volatile solute by Rast method/Beckmann freezing point method.
- Determination of the apparent degree of dissociation of an electrolyte (e.g., NaCl) in aqueous solution at different concentrations by ebullioscopy.

Colorimetry

To verify Beer-Lambert law for $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ and determine the concentration of the given solution of the substance.



REFERENCE BOOKS:

1. Vogel's qualitative Analysis, revised, Svehla, Orient Longman
2. Standard methods of chemical analysis, W.W. Scott, The Technical Press
3. Experimental Organic Chemistry, Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, tata McGraw Hill.
4. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern
5. Vogel's Text Book of Practical Organic Chemistry, B.S. Furnis, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchel, ELBS
6. Experiments in general chemistry, C.N.R. Rao & U.C. Agrawal
7. Experiments in Physical Chemistry, R.C. Das & Behra, Tata McGraw Hill
8. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.

PRACTICAL EXAMINATION

Five experiments are to be performed.

1. Inorganic - Two experiments to be performed. 08 marks
Gravimetric estimation compulsory (Manipulation 3 marks).

Anyone experiments from synthesis and analysis 04 marks

2. Organic-Two experiments to be performed. 08 marks
Qualitative analysis of organic mixture containing two solid components.
compulsory carrying (03 marks for each compound and two marks for
separation).
One experiment from synthesis of organic compound (Single step) 04 marks

3. Physical-One physical experiment carrying 12 marks

4. Sessional 04 marks

5. Viva Voce 10 marks

In case of Ex-Students one mark each will be added to Gravimetric analysis and Qualitative analysis of organic mixture and two marks in Physical experiment.

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