

**SEMESTER- IV**  
**CHEMISTRY-VIII**  
**INORGANIC CHEMISTRY-III**

**(Credits: Theory-04, Practicals-02)**  
**Theory: 60 Lectures**

**End Sem-60 marks**  
**Mid Sem- 15 marks**

**UNIT-I**  
**Coordination Chemistry**

Werner's theory, effective atomic number rule (EAN), stability of complex ion, stability constant, factor affecting the stability of complex ion. valence bond theory. IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect.

**(10 Lectures)**

**UNIT-II**  
**Transition Elements-I**

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & forst diagrams). Differences between the first, second and third transition series.

**(12 Lectures)**

**UNIT-III**  
**Transition Elements-II**

Chemistry of Ti, V, Cr, Mn, Fe and Co in various oxidation states. Metallurgy of V, Cr and Mn.

**(10 Lectures)**

**UNIT-IV**  
**Lanthanides and Actinides**

Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

**(6 Lectures)**

**UNIT-V**  
**Bioinorganic Chemistry**

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine.

Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron.

**(10 Lectures)**

**Reference Books:**

- Purcell, K.F & Kotz, J.C. Inorganic Chemistry W.B. Saunders Co, 1977.
  - Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
  - Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.
  - Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. Wiley-VCH, 1999
  - Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967.
  - Greenwood, N.N. & Earnshaw A., Chemistry of the Elements, Butterworth-Heinemann, 1997.
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**CHEMISTRY-C VIII LAB****(Expt. -15, Viva Voce- 6 & Lab. Record- 4)****Time – 3hrs****(Full Mark- 25)****Gravimetric Analysis:**

- i. Estimation of nickel (II) using Dimethylglyoxime (DMG).
- ii. Estimation of copper as CuSCN
- iii. Estimation of iron as Fe<sub>2</sub>O<sub>3</sub> by precipitating iron as Fe(OH)<sub>3</sub>.
- iv. Estimation of Al (III) by precipitating with oxine and weighing as Al(oxine)<sub>3</sub> (aluminium oxinate).

**Chromatography of metal ions**

Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

- i. Ni (II) and Co (II)
- ii. Fe (III) and Al (III)

**Reference Book:**

1. Vogel, A.I. A text book of Quantitative Analysis, ELBS 1986.
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**CHEMISTRY-C IX**  
**ORGANIC CHEMISTRY-III**

**(Credits: Theory-04, Practicals-02)**  
**Theory: 60 Lectures**

**End Sem-60 marks**  
**Mid Sem- 15 marks**

**UNIT-I**  
**Nitrogen Containing Functional Groups**

Preparation and important reactions of nitro and compounds, nitriles and isonitriles  
Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. **(12 Lectures)**

**UNIT-II**  
**Diazonium Salts**

Preparation and synthetic applications of diazonium compounds.

**Polynuclear Hydrocarbons**

Reactions of naphthalene phenanthrene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons. **(8 Lectures)**

**UNIT-III**  
**Heterocyclic Compounds**

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline. Skraup synthesis and Bischler-Napieralski synthesis.

Derivatives of furan: Furfural and furoic acid. **(20 Lectures)**

**UNIT-IV**  
**Alkaloids**

Natural occurrence, General structural features, Isolation and their physiological action

Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Nicotine and papaverin. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine. **(10 Lectures)**

**UNIT-V**

**(I) Terpenes:** Occurrence, classification, isoprene rule; Elucidation of structure and

synthesis of Citral and  $\alpha$ -terpineol.  
(II) **Vitamins:** Elucidations of structure of Vitamin-C.

(10 Lectures)

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### Reference Books:

- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
  - Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
  - Finar, I. L. *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
  - Acheson, R.M. *Introduction to the Chemistry of Heterocyclic compounds*, John Welly & Sons (1976).
  - Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
  - Kalsi, P. S. *Textbook of Organic Chemistry 1<sup>st</sup> Ed.*, New Age International (P) Ltd. Pub.
  - Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry*, Oxford University Press.
  - Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Parakashan (2010).
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### CHEMISTRY PRACTICAL-C IX LAB (Expt. -15, Viva Voce- 6 & Lab. Record- 4)

Time – 3hrs

(Full Marks -25)

Qualitative analysis of unknown organic compounds containing monofunctional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols etc. MP/BP determination and derivative preparation.

### Reference Books

- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
  - Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5<sup>th</sup> Ed.*, Pearson (2012)
  - Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*, University Press (2000).
  - Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis*, University Press (2000).
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**CHEMISTRY-C X**  
**PHYSICAL CHEMISTRY-IV**

**(Credits: Theory-04, Practicals-02)**  
**Theory: 60 Lectures**

**End Sem-60 marks**  
**Mid Sem- 15 marks**

**UNIT-I**

**Conductance-I**

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Walden's rules. **(12 Lectures)**

**UNIT-II**

**Conductance-II**

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

**(16 Lectures)**

**UNIT-III**

**Electrochemistry-I**

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. **(10 Lectures)**

**UNIT-IV**

**Electrochemistry-II**

Application of EMF measurements in determining free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone and glass electrodes.

**(8 Lectures)**

**UNIT-V**

**Electrochemistry-III**

Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation). Dipole moment and molecular polarizabilities and their measurements. Diamagnetism, paramagnetism, magnetic susceptibility and its measurement, molecular interpretation.

**(14 Lectures)**

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**Reference Books:**

- Atkins, P.W & Paula, J.D. *Physical Chemistry*, 9<sup>th</sup> Ed., Oxford University Press (2011).

- Castellan, G. W. *Physical Chemistry 4th Ed.*, Narosa (2004).
  - Mortimer, R. G. *Physical Chemistry 3rd Ed.*, Elsevier: NOIDA, UP (2009).
  - Barrow, G. M., *Physical Chemistry 5th Ed.*, Tata McGraw Hill: New Delhi (2006).
  - Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.*, Prentice-Hall (2012).
  - Rogers, D. W. *Concise Physical Chemistry* Wiley (2010).
  - Silbey, R. J.; Alberty, R. A. & Bawendi, M. G. *Physical Chemistry 4th Ed.*, John Wiley & Sons, Inc. (2005).
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**CHEMISTRY PRACTICAL-C X LAB**  
**(Expt. -15, Viva Voce- 6 & Lab. Record- 4)**

**Time – 3hrs**

**(Full Marks -25)**

**Conductometry**

Determination of cell constant

- I. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
- II. Perform the following conductometric titrations:
  - i. Strong acid vs. strong base
  - ii. Weak acid vs. strong base
  - iii. Strong acid vs. weak base

**Potentiometry**

- I. Perform the following potentiometric titrations:
  - i. Strong acid vs. strong base
  - ii. Weak acid vs. strong base
  - iii. Dibasic acid vs. strong base

**Reference Books:**

- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
  - Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
  - Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.*; W.H. Freeman & Co.: New York (2003).
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