

TITLE: CHEMISTRY-IV (GENERAL CHEMISTRY)

CREDIT HOURS: 3

COURSE OBJECTIVES

The objective of the course is for students

1. To learn the fundamentals of all basic concepts of chemistry.
2. To develop an understanding and appreciation of both structure and chemical transformation, chemical and physical properties of matter.
3. Will acquire basic concepts of electronic structure and be able to apply them to solve problems from various areas of organic chemistry, including stereochemistry, reactivity patterns and synthesis.
4. Improvements in learning strategies, critical-thinking, and problem-solving skills are an expected outcome.

COURSE CONTENT:

1. Quantum Mechanics and Atomic Structure:

Elementary treatment of Compton effect and photoelectric effect; Brief discussion of result of Bohr's Model and its defects; Sommerfeld's modification and evolution of azimuthal quantum number; Dual nature of matter; Verification of dual nature by Davisson and Germer's experiment; Detail of Heisenberg's uncertainty principle; Postulates of quantum mechanics; Brief introduction of operators; Derivation of time independent Schrodinger wave equation in terms of polar coordinates and derivation of principle quantum number; Energy equation for free motion of particle in one-dimensional box; Eigen values and Eigen functions; normalization of wave function; Probability functions; radial distribution, probability density functions.

2. Electrochemistry:

Electrolytic conduction and its measurement; Specific, equivalent and molar conductance, Determination of resistance; Cell content, conductance ratio, conduction of strong and weak electrolytes; Ionic motilities and their determination; Kohlrausch's law and its applications; Faraday's law (first and second) and their significance; Transport number; Hittort's rule; Determination of transference number by Hittort's method. Applications of conductance measurement; EMF of the chemical cells; Electrode potential and its measurement with reference to Weston standard, glass electrode, calomel electrode and quinhydrone electrode; Nerst equation; Thermodynamics of cells; Concentration of cells with liquid junction and without liquid junction.

3. Evaluation of Analytical Data and Essentials of Chemical Analysis:

Some fundamental concepts like mole, activity and activity co-efficient; Concepts of mean, median, accuracy, precision, significant figures; Various types of errors, their detection and elimination; Standard deviation; Relative standard deviation; Confidence limits; Rounding off the analytical data. Law of mass action and its

applications; precipitation and solubility product; common ion effect; Co-precipitation, fractional precipitation, concept of pH, buffers, working of indicators.

4. Spectroscopy:

Electromagnetic radiation and its interaction with matter; Nature of different transitions possible in atoms and molecules; Electronic, vibrational, rotational and other possible transitions by absorption of radiation by molecules and atoms. Development of spectroscopic analytical techniques employing various transitions. Classification of spectroscopic techniques on the basis of type of radiation, phenomenon occurring and the nature of the matter. Basic introduction to atomic and molecular spectroscopic techniques including flame emission, spectrophotometry, UV, IR spectroscopy.

5. Chemistry of Carbonyl Compounds:

Preparation of aldehydes and ketones by pyrolysis of calcium salts of acids, acylation of alkenes and arenes, reduction of acid halides and nitriles. Physical properties of aldehydes and ketones; Structure and reactivity of carbonyl group; Comparison of the reactivity of aldehydes and ketones; Nucleophilic additions of water, alcohols, ammonia and its derivatives, hydrogen cyanide, bisulfite, reduction and oxidation reactions; Aldol condensation and related reaction; Cannizzaro's reaction; Wittig reaction; Oxidation reactions, Chemical tests of aldehydes and ketones.

6. Chemistry of Carboxylic Acids and Their Derivatives:

Physical properties of carboxylic acids; Effects of different parameters on the acid strengths of aliphatic and aromatic carboxylic acids. Chemical properties like salt formation nucleophilic acyl substitution, reduction of carboxylic acids, decarbonylation, Hunsdiecker reaction, Kochi reaction, substitution at α -carbon. Preparations, properties and reactions of acid chlorides, acid anhydrides, amides, cyanides, and esters; Malonic and acetoacetic esters syntheses.

Evaluation Criteria

| Examination | Type | Marks |
|----------------------|----------------|-------|
| Internal Examination | Sessional Work | 15% |
| | Mid-Semester | 25% |
| External Examination | Final Semester | 60% |

Recommended Books:

1. Adamson A. W. "Understanding Physical Chemistry" 3rd Ed. Benjamin Cummings publishing company Inc.
2. Akhtar M.N. & Ghulam Nabi, "Textbook of Physical Chemistry" ilmi kutab khana, Lahore.
3. Bhatti H.N. and K. Hussain, "Principles of Physical Chemistry"; Carwan Book House, Lahore.

4. Shriver, D.F., P.W. Atkins and C.H. Langford, "Inorganic Chemistry"; Oxford, 2nd Ed. (1996).
5. Sharp, A.G. "Inorganic Chemistry", Longman, 3rd Edition (1992).
6. Rayner Canham, Gelof, "Descriptive Inorganic Chemistry" & Co. (1995).
7. Daniel R. Paller, "Experimental Organic Chemistry, John Willey & Sons" Inc., 2009.
8. James A. Moore, "Experimental methods in Organic Chemistry" Holt-Saunders Int. 1983.
9. R.L. Shriner, R.C. Fuson, D.IV. Curtin and T.C. Morrill "The systematic Identification of organic compounds, 6th ed. John Willey & sons, 1979.

CHEMISTRY LAB-IV (GENERAL CHEMISTRY)

CREDIT HOURS: 1

- 1) Verification of first law of Faraday by electroplating of CuSO_4 , NiSO_4 , $\text{Cr}_2(\text{SO}_4)_3$, Ag^+ and Au^+ ions.
- 2) Conductometric and potentiometric titration using conductivity bridge and pH meter.
- 3) Measurement of reduction potential using of Zn, Cu, Ag, Al etc. by using calomel electrode.
- 4) Verification of Langmuir Isotherm.
- 5) Thin layer chromatography.

Preparations:

- 1) Ferric Alum
- 2) Potassium tri-oxalato aluminate
- 3) Sodium Thiosulfate
- 4) Amm. Coppr (II) Sulphate

Iodometry:

- 1) Determination of iodide and KI in the given sample solution.
- 2) Standardization of $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ solution.
- 3) Determination of amount/ dm^3 of Cu^{2+} in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ using $\text{Na}_2\text{S}_2\text{O}_3$ and KI.
- 4) Determination of number water molecules (x) in $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$.

Preparation of Organic Compounds:

Preparation and techniques of purification of tribromophenol, nitrobenzene, aspirin, ethyl benzoate and benzoic acid from toluene, butyl chloride, acetanilide.

Estimations (volumetric):

- 1) Determination of molecular weight of a carboxylic acid.
- 2) Estimation of amide group and glucose.

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Recommended Books:

1. Crocleford H.D. H.W. Biard F.W. Getzen & J.W. Nowell, "Laboratory Maual of Physical Chemistry" 2nd Eddition John Wiley & Sons London.

2. Skoog, D.A., D.M. West and F.J. Holler, "Analytical Chemistry" 6th Ed. Saunders College Publications (1994).
3. Javed Iqbal Amin, "Theory and Practice of Chromatography", Higher Education Commission, Islamabad. (2002).
4. James A. Moore, "Experimental methods in Organic Chemistry", Holt-Saunders Int., 1983.
5. R.L. Shriner, R.C. Fuson D.V. Curtin and T.C. Morrill "The systematic identification of organic compounds, 6th Ed. John Wiley & Sons 1979.