Semester-III

UCB028: General Chemistry – I

L	T	P	Cr
3	1	2	4.5

Course Objective: The course aims at understanding the physical and chemical properties of atoms, molecules and ions.

Chemical Tools: Experimentation and Measurements: Significant figures, Rounding Numbers, Accuracy and precision, Mean and median, Average deviation, Standard deviation, Relative standard deviation, Sample mean and population mean, Q-test, F-test, T-test.

Atoms, Molecules and Ions: Recapitulation of basic concepts, An introduction to atomic and molecular spectroscopy, Beer-Lambert's Law.

Mass Relationships in Chemical Reactions: Representation of chemical reactions, Balancing chemical equations: Oxidation number and ion electron methods, Stoichiometric calculations: Amounts of reactants and products.

Reactions in Aqueous Solution: Recapitulation of basic concepts, Measuring the concentration in solutions: volumetric titration (acid-base, redox and complexometric), Instrument based titrations (conductometry, potentiometry and pH-metry).

Periodicity and Electronic Structure of Atoms: Electromagnetic radiations, Particle like behavior, Photoelectric effect, Black-body radiation, Plank's Postulate, Wave-particle duality, De Broglie's hypothesis, Heisenberg uncertainty principle, Quantum mechanical model of atom, Concepts of orbital and quantum numbers, Pauli's exclusion principle, Periodic trends: electronic configuration, Atomic radii.

Ionic Compounds: Periodic Trends and Bonding Theory: Electronic configuration of ions, Periodic trends:electronegativity and Electron affinity, Ionization energy, Formation of ionic bonds, Lattice energy of solids.

Covalent Bonding and Electron-Dot structures: Covalent bonding, Formation of covalent bond, Electron-dot structure, Concept of polarity and dipole moment.

Covalent Bonding: Bonding Theories and Molecular Structure: VSEPR model, Valence bond theory, Concept of hybridization, Molecular Orbital Theory, MO diagrams of diatomic molecules, MO diagrams of π-bonded systems, Conjugated systems, Huckel's rule.

Thermochemistry: Changes in internal energy, Enthalpy in chemical reactions, Exothermic and endothermic reactions, Concept of heat capacity, Kirchhoff's Equation, Hess's Law.

Gases: Their Properties and Behavior: Kinetic theory of gas, Collision and Mean free path, Maxwell-Boltzmann Distribution law of molecular velocities, Concept of ideal and real gases, Behavior of real gases: Van der Waal's equation.

List of Experiments:

1. To determine the amount of NaOH and Na_2CO_3 present in the same solution.
2. To find the temporary and permanent hardness of water sample by complexometric titration using standard EDTA solution.
3. To determine the copper content of a given sample solution of copper ore using 0.1 N sodium thiosulphate solution iodometrically.
4. To estimate the available chlorine in bleaching powder.
5. To determine the amount of Fe^{+2} and Fe^{+3} ions by permanganometry.
6. To find out the total alkalinity and sulphate content in a water sample.
7. To determine the strength of given sodium hydroxide solution by titration with standard hydrochloric acid conductometrically.
8. Determine pKa value of acetic acid by pH-metric titration.
9. Spectrophotometric determination of Fe^{2+} with 1,10-phenanthroline.
10. To titrate potentiometrically FAS solution against potassium permanganate and to determine the standard electrode potential of Fe^{2+} / Fe^{3+} system.

Course Learning Outcomes: The students will be able to reflect on:

1. concepts of accuracy, precision, error analysis during experimentation and measurements; fundamentals of atomic and molecular spectroscopy.
2. periodicity, electronic structure and behavior of atoms.
3. mass relationships and chemical reactions in aqueous solution.
4. concepts of ionic and covalent bondings, VSEPR Model, valence bond theory and molecular orbital theory.
5. thermochemistry, properties of gases and their behavior.
6. laboratory techniques like pH metry, potentiometry, colourimetry, conductometry and volumetry.

Text Books:

1. Timberlake, K.C.; Timberlake, W., *Basic Chemistry*, Pearson Education, (2019) 5th ed.
2. Lee, J.D., *Concise Inorganic Chemistry*, ELBS, (2008) 5th ed.
3. Skoog, D.A., West, D.M., Holler, F.J., and Crouch, S.R., *Fundamentals of Analytical Chemistry*, Brooks/Cole (2013) 9th ed.
4. Pavia, D.L.; Lampman, G.M.; Kriz, G.S.; Vyvyan, J.R., *Introduction to Spectroscopy*, Cengage Learning India Pvt. Ltd., (2015), 5th ed.

Reference Books:

1. Timberlake, K.C., *Chemistry: An Introduction to General, Organic and Biological Chemistry*, Pearson Education, (2019) 13th ed.
2. Zumdahl, S. S.; DeCoste, D. J.,*Introductory Chemistry: A Foundation*, Cengage Learning India Pvt. Ltd., (2019), 9th ed.
3. Housecroft, C., *Inorganic Chemistry*, Pearson Education (2018) 5th ed.
4. Atkins, P.W., *Physical Chemistry*, W.H. Freeman (2018) 11th ed.

Evaluation Scheme:

MST	EST	Sessional (May include Quizzes/Assignments/Lab Evaluation)
25	40	35