Course: Discipline Specific Core 3

Semester	**2**
Paper Number	**HCHCR2032T (60 MARKS) & HCHCR2032P (40 MARKS)**
Paper Title	**CORE COURSE 3: INORGANIC CHEMISTRY**
No. of Credits	**Theory-04, Practicals-02**
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 3
Name of Faculty member(s)	Dr. Sanjib Ganguly Dr. Rahul Sharma
Course description/objective	***Theory:*** ***1. To have basic knowledge about the corpuscular and wave mechanical model of an atom, the concept of Atomic Orbital and ground state terms.*** ***2. To develop the idea of periodic table and periodic properties*** ***3. To build up basic concepts about redox chemistry and their applications in several inorganic reactions as well as in quantitative analysis.*** ***4. To develop the concepts of several theories of acids and bases.*** ***5. To have the ideas of ionic equilibrium and the concept of solubility product as well as their applications.*** ***Practical:*** ***1. To develop skills and to understand the underlying principles in acid-base titrimetric analysis.*** ***2. To understand the principles involved in redox titrimetric analysis as well as to develop the skills to perform it.***
Syllabus	Annexure Core Course: 3
Texts	
Reading/Reference Lists	**Theory:** 1. Douglas, B.E. and McDaniel, D.H. *Concepts & Models of Inorganic Chemistry* Oxford, 1970. . 2. Atkin, P. *Shriver & Atkins' Inorganic Chemistry,* 5th Ed., Oxford University Press (2010). 3. Cotton, F.A., Wilkinson, G. and Gaus, P.L., *Basic Inorganic Chemistry 3rd Ed.;* Wiley India. 4. Sharpe, A.G., *Inorganic Chemistry*, 4th Indian Reprint (Pearson Education) 2005. 5. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed.,* Harper Collins 1993, Pearson,2006. 6. Mingos, D.M.P., *Essential trends in inorganic chemistry*. Oxford University Press (1998). 7. Winter, M. J., The Orbitron, http://winter.group.shef.ac.uk/orbitron/ (2002). An illustrated gallery of atomic and molecular orbitals. 8. Burgess, J., *Ions in solution: basic principles of chemical interactions.* Ellis Horwood (1999). **Practical:** 1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis* 6th Ed., Pearson, 2009.

Evaluation	**Theory: 60 marks**	**Practical: 40 marks** *(Continuous Assessment)*
	CIA: 10 End-Sem: 50	Internal Assessment Exams: 30 Viva (End Sem): 8 Attendance: 2
Paper Structure for the End Sem **Theory Exam** (50 marks)	6 (SIX) Questions (each of 10 marks) will be set and the students will have to answer any 5 (FIVE). Each of the Questions (10 marks) will consist of 2 or 3 parts (of 2/ 3/ 4/ 5)	

Annexure Core Course (CC): 3

(Credits: Theory-04, Practicals-02)

CC: 3 (Theory) 52 Lectures

Module 1: Extra nuclear Structure of atom & Chemical periodicity (24 Lectures)

Bohr's theory, its limitations and atomic spectrum of hydrogen atom; Sommerfeld's Theory. 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. 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 rules and multiplicity, Exchange energy, Aufbau principle and its limitations, Ground state Term symbols of atoms and ions for atomic number upto 30.

Modern IUPAC Periodic table, Effective nuclear charge, screening effects and penetration, Slater's rules, atomic radii, ionic radii (Pauling's univalent), covalent radii, lanthanide contraction. Ionization potential, electron affinity and electronegativity (Pauling's, Mulliken's and Allred-Rochow's scales) and factors influencing these properties, group electronegativities. Group trends and periodic trends in these properties in respect of s-, p- and d-block elements. Secondary periodicity, Relativistic Effect, Inert pair effect.

Module 2: Acid-Base reactions, Redox and precipitation reactions (28 Lectures)

Acid-Base concept: Arrhenius concept, theory of solvent system (H2O, NH3, SO2 and HF), Bronsted-Lowry's concept, relative strength of acids, Pauling's rules. Lux-Flood concept, Lewis concept, group characteristics of Lewis acids, solvent levelling and differentiating effects. Thermodynamic acidity parameters, Drago-Wayland equation. Superacids, Gas phase acidity and proton affinity; HSAB principle. Acid-base equilibria in aqueous solution (Proton transfer equilibria in water), pH, buffer. Acid-base neutralisation curves; indicator, choice of indicators.

Ion-electron method of balancing equation of redox reaction. Elementary idea on standard redox potentials with sign conventions, Nernst equation (without derivation). Influence of complex formation, precipitation and change of pH on redox potentials; formal potential. Feasibility of a redox titration, redox potential at the equivalence point, redox indicators. Redox potential diagram (Latimer and Frost diagrams) of common elements and their applications. Disproportionation and comproportionation reactions.

Solubility product principle, common ion effect and their applications to the precipitation and separation of common metallic ions as hydroxides, sulfides, phosphates, carbonates, sulfates and halides.

CC: 3 (Practical) 42 Lectures

Acid and Base Titrations:

1. Estimation of carbonate and hydroxide present together in mixture
2. Estimation of carbonate and bicarbonate present together in a mixture.
3. Estimation of free alkali present in different soaps/detergents.

Oxidation-Reduction Titrimetric

1. Estimation of Fe(II) using standardized $KMnO_4$ solution
2. Estimation of Fe(III) and Ca(II) in a given mixture using standardized KMnO4 solution
3. Estimation of Fe(II) and Fe(III) in a given mixture using $K_2Cr_2O_7$ solution.
4. Estimation of Fe(III) and Mn(II) in a mixture using standardized KMnO4 solution
5. Estimation of Fe(III) and Cu(II) in a mixture using $K_2Cr_2O_7$.
6. Estimation of Fe(III) and Cr(III) in a mixture using $K_2Cr_2O_7$.