Semester	**4**
Course	**Major**
Paper Code	C2CH230421T
Paper Title	Physical Inorganic Chemistry 3
No. of Credits	Theory: 2
Theory / Practical / Composite	Theory
Minimum No. of preparatory hours per week a student has to devote	12
Number of Modules	04
Syllabus	**Gr. A: Physical Chemistry 3** **Module I: Chemical Equilibrium 12 L** 1. Chemical potential of a component in a mixture 2. Scales of chemical potential 3. Thermodynamics of mixing of ideal gases 4. Gibbs equations for system with variable composition 5. Conditions of spontaneity and equilibrium in terms of internal energy, Enthalpy, Gibbs and Helmholtz free energy 6. Molar Gibbs free energy and its change in a reacting system and its thermodynamic expression 7. Concept of standard state free energy change of a reaction in pressure and concentration scale 8. Equilibrium constant: partial pressure, concentration and mole fraction scale and their inter-relation 9. Activity and concentration: equilibrium constant in activity scale 10. Effect of temperature and pressure on equilibrium constants 11. Equilibrium in heterogeneous reaction 12. Perturbing the state of equilibrium: Le Chatelier principle 13. Solubility equilibria 14. Salt effect 15. Nernst distribution law and generalized Distribution equilibrium **Module II: Quantum Mechanics III 12 L** 1. Particle on a Ring 2. Concept of the effective potential 3. Particle on a sphere: coordinate system 4. Form of Schrodinger equation in polar coordinates 5. Form of Schrodinger equation for a two particle system in Cartesian co-ordinates and reduction to one particle system 6. The diatomic rigid rotor: solution of theta and phi part (derivation) 7. Generation and properties of the Spherical Harmonics. 8. Expression of L^2, L_z in polar coordinate, physical significance 9. Shift Operators and their significance.

	10. Concept of effective potential 11. Central force problem and formulation of the Schrödinger equation for hydrogen atom
Learning Outcomes	Theory: 1. Concept of chemical potential is developed showing that it is a particular case of properties called partial molar quantities. Then it explores how to use the chemical potential of a substance to describe the physical properties of mixtures. The concept of chemical potential is used to account for the equilibrium composition of chemical reactions. The former corresponds to a minimum in the Gibbs energy plotted against the extent of reaction. The thermodynamic formulation of equilibrium enables one to establish the quantitative effects of changes in the conditions like temperature and pressures. 2. Quantum mechanical application for quantisation of rotational motion will be discussed. The corresponding equation for a particle in s spherically symmetric Coulomb potential and the possible solutions will be analysed. The treatment will be extended to hydrogenlike systems.
Reading/Reference Lists	1. Glasstone, S, Thermodynamics for Chemists, EWP. 2. Zemansky, M. W. & Dittman, R.H. Heat and Thermodynamics, Tata McGraw-Hill. 3. Denbigh, K. The Principles of Chemical Equilibrium, Cambridge University Press. 4 Nag, A. K, Physical Chemistry Vol. 1, 2, Mcgraw Hill. 5. Klotz, I.M., Rosenberg, R. M. Chemical Thermodynamics: Basic Concepts and Methods, Wiley. 6. Sears, F. W., Salinger, G. L., Thermodynamics, Kinetic Theory, and Statistical Thermodynamics (Addison-Wesley Principles of Physics Series), Pearson; 3rd edition. 7. Metiu, H., Physical Chemistry: Thermodynamics, Taylor and Francis. 8. Kaufman, M., Principles of Thermodynamics, Taylor and Francis 9. Honig, J. M., Thermodynamics, Academic Press. 10. Levine, I. N. Quantum Chemistry, PHI. 11. Atkins, P. W. and Friedman, Molecular Quantum Mechanics, Oxford. 12. Eisberg, R., Resnick, R, Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, 2ed, Wiley. 13. Griffiths, D. J., Introduction to Quantum Mechanics, Cambridge India.
Syllabus	**Gr. B: Inorganic Chemistry 3** **Module I: Redox Chemistry and Applications 12 L** 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. **Module II: Acid-Base and solubility equilibria 12 L** Acid-base equilibria in aqueous solution (proton transfer equilibria in water); pH, hydrolysis of salt, buffer; acid-base neutralization curves; indicators, choice of indicators. 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.
Learning Outcomes	Theory: 1. To build up basic concepts about redox chemistry and their applications in several inorganic reactions as well as in quantitative analysis. 2. To have the ideas of ionic equilibrium and the concept of solubility product as well as their applications.
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). 9. Pfennig, B. W. (2015), Principles of Inorganic Chemistry. John Wiley & Sons. 10. Housecraft, C. E.; Sharpe, A. G., (2018), Inorganic Chemistry, 5th Edition, Pearson. 11. Wulfsberg, G (2002), Inorganic Chemistry, Viva Books Private Limited. Practical: 1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009. 2. Harris, D. C.; Lucy,C. A.(2016), Quantitative Chemical Analysis, 9th Edition, Freeman and Company

Evaluation	Theory: 100 Internal: 30 (CIA:20, Other mode of Assesment:5, Attendance: 5) Semester Exam:70
Paper Structure for Theory Semester Exam	For each group, there will be a compulsory section of 5 marks. Also, THREE questions of 10 marks each should be attempted out of FOUR questions