ARSD College, University of Delhi

Model Course Handout/Lesson Plan

Course Name : B.Sc. physical Science with Chemistry						
Semester	**Course Code**	**Course Title**	**Lecture (L)**	**Tutorial (T)**	**Practical (P)**	**Credit (C)**
IV	CC – C4: CORE COURSE CHEMISTRY-4	Chemistry of s- and p-Block Elements, States of Matter and Chemical Kinetics	4	0	0	4
Teacher/Instructor(s)		Dr. Preeti Chaudhary (sharing with Dr. Nidhi Dureja)				
Session		2021-22				

Course Objective:

The objective of this paper is to provide basic understanding of the fundamental principles of metallurgy through study of the methods of extraction of metals, recovery of the by-products during extraction, applications of metals, alloy behaviour and their manufacturing processes. The course illustrates the diversity and fascination of inorganic chemistry through the study of properties and utilities of s- and pblock elements and their compounds. The students will learn about the properties of ideal and real gases and deviation from ideal behaviour, properties of liquid, types of solids with details about crystal structure. The student will also learn about the reaction rate, order, activation energy and theories of reaction rates.

Course Learning Outcomes:

By the end of the course, the students will be able to:
• Understand the chemistry and applications of s- and p-block elements.
• Derive ideal gas law from kinetic theory of gases and explain why the real gases deviate from ideal behaviour.
• Explain Maxwell-Boltzmann distribution, critical constants and viscosity of gases.
• Explain the properties of liquids especially surface tension and viscosity.
• Explain symmetry elements, crystal structure specially NaCl, KCl and CsCl
• Define rate of reactions and the factors that affect the rates of reaction.
• Understand the concept of rate laws e.g., order, molecularity, half-life and their determination • Learn about various theories of reaction rates and how these account for experimental observations.

Lesson Plan:

Unit No.	Learning Objective	Lecture No.	Topics to be covered
3	Kinetic Theory of Gases : (Lectures: 10)	1	Kinetic Theory of Gases Postulates of kinetic theory of gases and derivation of the kinetic gas equation
		2	Kinetic Theory of Gases Postulates of kinetic theory of gases and derivation of the kinetic gas equation
		3	deviation of real gases from ideal behaviour, compressibility factor,
		4	causes of deviation, van der Waals equation of state for real gases.
		5	Boyle temperature (derivation not required), critical phenomena, critical constants and their calculation from van der Waals equation,
		6	Andrews isotherms of CO2, Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.
		7	Andrews isotherms of CO2, Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.
		8	Temperature dependence of these distributions, most probable, average and root mean square velocities (no derivation),collision cross section,
		9	collision number, collision frequency, collision diameter and mean free path of molecules,
		10	viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).
4	Liquids(Lectures: 3)	11	Liquids Surface tension and its determination using stalagmometer,
		12	Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer,
		13	effect of temperature on surface tension and

			coefficient of viscosity of a liquid (qualitative treatment only).
5	Solids, (Lectures: 6)	14	Solids Forms of solids, symmetry elements, unit cells, crystal systems,
		15	Bravais lattice types and identification of lattice planes. Laws of crystallography - law of constancy of interfacial angles.
		16	Law of rational indices, Miller indices
		17	X–ray diffraction by crystals, Bragg's law
		18	structures of NaCl, KCl and CsCl (qualitative treatment only), defects in crystals
		19	Glasses and liquid crystals.
6	Chemical Kinetics : (Lectures: 11)		
		20	The concept of reaction rates,
		21	effect of temperature, pressure, catalyst and other factors on reaction rates.
		22	Order and molecularity of a reaction,
		23	integrated rate equations for zero
		24	integrated rate equations for zero
		25	derivation of, half–life of a reaction, general methods for determination of order of a reaction,
		26	Concept of activation energy and its calculation from Arrhenius equation.
		27	Concept of activation energy and its calculation from Arrhenius equation.
		28	Theories of reaction rates: Collision theory and activated complex theory of bi
		29	Theories of reaction rates: Collision theory and activated complex theory of bi
		30	Comparison of the two theories (qualitative treatment only)

Evaluation Scheme:

No.	Component	Duration	Marks
1.	Internal Assessment • Quiz • Class Test • Attendance • Assignment		25
2.	End Semester Examination	3.5 hr	75

Details of the Course		
Unit	**Contents**	**Contact Hours**
1	**<u>Section A: Inorganic Chemistry (Lectures:30)</u>** General Principles of Metallurgy Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy with	4

	reference to cyanide process for silver and gold, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, van Arkel-de Boer process, Mond's process and Zone Refining.	
2	s- and p- block elements Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Muliken, and Allred-Rochow scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group., compounds of s- and p-block elements, diborane and concept of multicentre bonding. Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial and environmental chemistry. Hydrides of nitrogen (NH3, N2H4, N3H, NH2OH) Oxoacids of P, S and Cl, Halides and oxohalides: PCl3, PCl5, SOCl2 and SO2Cl2.	26
3	**Section B: Physical Chemistry (Lectures:30)** Unit 3 Kinetic Theory of Gases Postulates of kinetic theory of gases and derivation of the kinetic gas equation, deviation of real gases from ideal behaviour, compressibility factor, causes of deviation, van der Waals equation of state for real gases. Boyle temperature (derivation not required), critical phenomena, critical constants and their calculation from van der Waals equation, Andrews isotherms of CO2, Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions, most probable, average and root mean square velocities (no derivation), collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules, viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).	10
4.	Liquids Surface tension and its determination using stalagmometer, Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer, effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).	3
5.	Solids Forms of solids, symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of crystallography - law of constancy of interfacial angles. Law of rational indices, Miller indices. X–ray diffraction by crystals, Bragg's law, structures of NaCl, KCl and CsCl (qualitative treatment only), defects in crystals.Glasses and liquid crystals.	6
6.	Chemical Kinetics The concept of reaction rates, effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction, derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants), half–life of a reaction, general methods for	11

	determination of order of a reaction, Concept of activation energy and its calculation from Arrhenius equation. Theories of reaction rates: Collision theory and activated complex theory of bi-molecular reactions. Comparison of the two theories (qualitative treatment only)	
	Total	**60**

Suggested Books:

Sl. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
1	Lee., J. D., A new Concise Inorganic Chemistry, Pearson Education.	2010
2	Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. ,Shriver and Atkin's Inorganic Chemistry, Oxford.	2010
3	Miessler, G. L.; Tarr, D.A, Inorganic Chemistry, Pearson	2014
4	Cotton, F.A.; Wilkinson, G.; Gaus, P.L., Basic Inorganic Chemistry, 3rd Edition,Wiley India.	1995
5	Castellan, G. W,Physical Chemistry, Narosa..	2004
6	Kapoor, K.L.,A Textbook of Physical Chemistry, Vol.1, 6th Edition, McGraw Hill Education.	2015
7	Kapoor, K.L.,A Textbook of Physical Chemistry, Vol.5,3rd Edition, McGraw Hill Education.	2015
8	B.R.Puri, L.R.Sharma, M.S.Pathania, Principles of Physical Chemistry, Vishal Publishing Co	2017

Mode of Evaluation:	Internal Assessment / End Semester Exam