



University of Kerala

Discipline	CHEMISTRY				
Course Code	UK1DSCCHE101				
Course Title	FUNDAMENTALS OF CHEMISTRY I				
Type of Course	DSC				
Semester	I				
Academic Level	100 – 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. Higher secondary level science knowledge				
Course Summary	The course covers fundamental principles in the periodic classification of elements, chemical bonding, thermodynamics and thermochemistry, analytical principles, and lab safety, providing students with a comprehensive understanding of key concepts in chemistry. Through both theoretical learning and hands-on practicals in volumetric analysis, students develop essential skills for analytical chemistry and gain practical experience in experimental techniques.				

Detailed Syllabus:

Module	Unit	Contents	Hrs
		FUNDAMENTALS OF CHEMISTRY I	75
I		PERIODIC CLASSIFICATION OF ELEMENTS	9
	1	Quantum numbers and their significance, Concept of orbitals.	2
	2	Orbital wise electron configuration, energy sequence rule – Pauli's principle, Hund's rule, stability of filled and half-filled orbitals	2
	3	Electronic configuration and classification of elements in to s, p, d and f blocks.	1
	4	Periodic properties, Ionisation energy, Electronegativity and Electron affinity. Diagonal relationship.	2
	5	Important characteristics of representative elements: valency, oxidation states, ionic and covalent bond formation Important characteristics of transition elements: variable valency and oxidation states, formation of Complex compounds.	2
II		CHEMICAL BONDING	9
	6	Energetic of bond formation – Types of Chemical bonds – Energetics of ionic bond formation – Lattice energy – Born Haber Cycle - Fajan's rules.	2

	7	Polarity of covalent bond its relation with electronegativity - Electro negativity scale – Pauling approach, Dipole moment – its relation to geometry.	2
	8	Hydrogen bond – inter and intra molecular – its consequences on boiling point, volatility and solubility.	1
	9	Concept of Hybridisation– sp , sp^2 , sp^3 , dsp^2 , dsp^3 , sp^3d^2 , and sp^3d^3 with examples Explanation of bond angle in water and ammonia- VSEPR theory, geometry of molecules with bond pairs of electrons, bond pairs and lone pairs of electrons, limitations of VSEPR Theory.	2
	10	A brief review of molecular orbital approach, LCAO method – bond order, bond distance and stability of O_2 , O_2^{2+} , O_2^{2-} , NO , NO^+ , CO and HF .	2
III	THERMODYNAMICS AND THERMOCHEMISTRY		18
	11	First law of thermodynamics, mathematical form, intrinsic energy, enthalpy, reversible, process and maximum work, work of expansion of an ideal gas in reversible isothermal process.	3
	12	Heat capacity of gases at constant volume and constant pressure, derivation of $C_p - C_v = R$.	2
	13	Second law of thermodynamics, entropy and free energies Significance of ΔG , ΔH and available work Criteria of equilibrium, and spontaneity on the basis of entropy and free energy, Gibbs - Helmholtz equation.	4
	14	Enthalpies of formation, combustion, neutralization, solution and hydration	2
	15	Relation between heat of reaction at constant volume and constant pressure Variation of heat of reaction with temperature- Kirchoff's equation	3
	16	Hess's law and application – bond dissociation energies and bond energies of different types of bonds, their calculation and enthalpies of reaction	4
IV	ANALYTICAL PRINCIPLES & LAB SAFETY		9
	17	Analytical methods in Chemistry – Principles of volumetric analysis, primary standard, standard solution, Calculation of normality, molality and molarity of solutions	2
	18	Theory of acid - base titrations: Strong acid - Strong Base, Strong acid - weak base, Weak acid Strong base and weak acid-strong base (Explanation with titration curves) Redox titrations: Permanganometry- Fe^{2+} and $KMnO_4$ and dichrometry - Fe^{2+} and $K_2Cr_2O_7$, Theory of acid – base and redox indicators.	2
	19	Inorganic qualitative analysis, common ion effect- solubility product-precipitation and inter group separation of cations. Salting out process	2
	20	Chromatography- principle and applications of paper and thin layer chromatography,	2
	21	Lab safety - Risk, Hazard, Chemical Hazard.	1
V	VOLUMETRIC ANALYSIS		30

22	Section A: Volumetric Analysis (5 Experiments (double titration) from Section A are compulsory) <ol style="list-style-type: none"> Preparation of standard solutions. Neutralization Titrations <ol style="list-style-type: none"> Strong acid – Strong base Strong acid – Weak base Weak acid – Strong base Redox Titrations - Permanganometry <ol style="list-style-type: none"> Estimation of oxalic acid. Estimation of $\text{Fe}^{2+}/\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$/Mohr's salt. 	15
23	Section B (Open ended: Any 3 experiments are to be conducted - May be selected from the list or the teacher can add related experiments) <ol style="list-style-type: none"> Dichrometry Iodometry & Iodimetry Complexometry Colorimetry 	15

References

- B.R Puri, L R Sharma K C Kalia, *Principles of Inorganic Chemistry*, Sobhanlal Nagin Chand & Co. New Delhi
- Manas chanda, *Atomic structure and Chemical bonding in molecular spectroscopy*, Tata Mc Graw Hill.
- S Glasstone, *Thermodynamics for Chemists*, Affiliated East West Publishers
- J D Lee, *Concise Inorganic Chemistry*, ELBS.
- R P Rastogi and R R Misra, *An Introduction to Chemical Thermodynamics*, Vikas Publishing House Pvt Ltd, Sixth Edition, 2018.
- D.A Skoog, D M West, F J, Holler, S R Crouch, *Fundamentals of Analytical Chemistry*, 8th Edn., Brookes/Cole, Thomson Learning, Inc, USA, 2004.
- Day and Underwood, *Quantitative analysis: Laboratory manual*.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Analyse the electronic configuration of elements and interpret periodic trends to explain the chemical behaviour, bonding patterns, and unique properties of representative and transition elements.	An	PSO - 1

CO-2	Analyze the nature, formation, geometry, polarity, and stability of chemical bonds using concepts of bond energetics, hybridization, VSEPR theory, molecular orbital theory, and related empirical rules.	An	PSO - 1
CO3	Evaluate thermodynamic principles, including the laws of thermodynamics, enthalpy and entropy changes, heat capacities, free energy functions, and their interrelations, to predict spontaneity, equilibrium, and energy transformations in chemical processes.	E	PSO – 1,2,3
CO 4	Critically design, perform, and analyze volumetric and redox titrations, apply principles of qualitative inorganic analysis and chromatography, and implement comprehensive laboratory safety protocols to solve complex chemical problems innovatively and accurately.	C	PSO – 1,2,3
CO 5	Design and perform standard volumetric and instrumental analytical experiments to prepare solutions, estimate analytes through acid-base, redox, and complexometric titrations, and apply suitable methods for quantitative chemical analysis with scientific reasoning.	C	PSO – 1,2,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FUNDAMENTALS OF CHEMISTRY I

Credits: 3:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO- 1,6 PSO - 1	An	F, C	L	-
2	CO-2	PO – 1,6 PSO - 1	An	F, C	L	-
3	CO3	PO-1,2,6 PSO – 1,2,3	E	F, C	L	-

4	CO 4	PO-1,6 PSO – 1,2,3	C	F, C	L	-
5	CO 5	PO-1,2,6 PSO – 1,2,3,4	C	F, C, P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	2	-	-	-	-	1	-	-	-	-	2	-	-
CO 2	2	-	-	-	-	1	-	-	-	-	2	-	-
CO 3	2	1	3	-	-	1	1	-	-	-	2	-	-
CO 4	2	3	2	-	-	1	-	-	-	-	2	-	-
CO 5	1	2	3	2	-	1	2	-	-	-	2	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓		✓	✓
CO 2	✓		✓	✓
CO 3	✓	✓		✓
CO 4	✓			✓
CO 5	✓	✓		✓