University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK1DSCCHE100**				
Course Title	**INORGANIC 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	This course provides an understanding of atomic structure, chemical bonding theories, environmental chemistry focusing on air, water, and soil pollution, and basics of analytical chemistry including volumetric analysis techniques. Through theoretical concepts, practical experiments, and case studies, students gain knowledge and skills essential for addressing complex issues in chemistry and environmental science.				

Detailed Syllabus:

Module	Unit	Content INORGANIC CHEMISTRY I	Hrs 75
I	**ATOMIC STRUCTURE & PERIODICITY**		**9**
	1	Introduction to structure of atom, Rutherford and Bohr model of atom	1
	2	Dual nature of electron-de Broglie equation-matter waves and electromagnetic waves. Experimental verification by Davis and Germer method, Heisenberg's uncertainty principle- expression and significance.	1
	3	Wave mechanical concept of the atom-Schrodinger equation and its significance (derivation not required.)	1
	4	Quantum numbers- Pauli's Exclusion principle- Aufbau Principle- Hund's rule- Electronic configuration of atoms, classification of elements into s, p, d and f blocks	2
	5	Electronegativity- Pauling's scale, Mulliken and Allred- Rochow scale (including numerical problems),	2
	6	Effective nuclear charge, Slaters rule and its applications, diagonal relationship and anomalous behaviour of first element with other elements	2
II	**CHEMICAL BONDING**		**15**

	7	Overview of Chemical Bonding Theories: - Definition of chemical bonding. - Importance of understanding chemical bonding in chemistry and related fields.	1
	8	Valence Shell Electron Pair Repulsion (VSEPR) Theory - Explanation of VSEPR theory. - Predicting molecular geometry for molecules with bond pairs only. - Predicting molecular geometry for molecules with both bond pairs and lone pairs. - Application of VSEPR theory in predicting molecular properties.	2
	9	Valence Bond Theory (VBT) - Conditions of overlapping in VBT. - Types of overlapping (sigma, pi, delta). - Hybridization in molecules: sp, sp^2, sp^3, sp^3d, sp^3d^2. - Limitations of VBT and its application to simple molecules.	2
	10	Molecular Orbital (MO) Theory - Introduction to MO theory. - Linear Combination of Atomic Orbitals (LCAO) method. - Formation of molecular orbitals in homonuclear diatomic molecules (C_2, B_2, N_2, O_2) and ions (O_2^+, O_2^-). - Formation of molecular orbitals in heteronuclear diatomic molecules (HF, NO, CO). - Calculations of bond order and its applications.	3
	11	Ionic Bonding - Explanation of ionic bonding, Ionic lattice energy of ionic compounds. - Bond-Lande equation and Born-Haber cycle. - Solvation energy and solubility of ionic solids. - Covalent character of ionic bonds. - Fajan's rules and their applications. - Polarity of covalent bonds. - Dipole moment and percentage of ionic character. - Relationship between dipole moment and molecular structure.	3
	12	Metallic Bonding - Overview of metallic bonding. - Free electron theory and band theory. - Explanation of conductance and malleability in metals.	1
	13	Secondary Forces - Explanation of hydrogen bonding. - Inter and intramolecular hydrogen bonding. - Applications of hydrogen bonding in biology, chemistry, and materials science. - Intermolecular interactions: ion-dipole interactions, van der Waals forces (dispersion forces, dipole-dipole interactions, ion-induced dipole interactions, dipole-induced dipole interactions).	2

	14	Case studies and Problem-solving Session Group problem-solving exercises related to molecular geometry, hybridization, bond calculations, and properties of molecules based on their bonding.	1
III	**ENVIRONMENTAL CHEMISTRY- AIR, WATER AND SOIL POLLUTION**		**9**
	15	Air pollution- Air pollution caused by fireworks, harmful effects of fireworks, acid rain, greenhouse effect, smog-classic and photochemical smog Ozone layer depletion, ozone hole, protection of ozone umbrella. Management of air pollution.	2
	16	Water pollution: causes- heat, industrial waste, sewage water, detergents, agricultural pollutants Treatment of industrial waste water- Activated charcoal, synthetic resins, reverse osmosis and electro dialysis (Mention Only), Quality of drinking water- Indian Standard and WHO standard- Dissolved oxygen- BOD, COD.	3
	17	Soil pollution: pesticides, fertilizers, Industrial waste, Plastic. Control of Plastic threat- importance of Plastic identification codes and Plastic recycling, use of biodegradable plastics (PGA, PLA and PHBV (mention only)	2
	18	Control of pollution. Pollution Control Board – Duties and responsibilities Mention environmental movements (Plachimada, Silent valley, movement against Endosulfan, *Narmada Bachavo Andolan* and Chipko movement)	2
IV	**BASICS OF ANALYTICAL CHEMISTRY**		**12**
	19	Measurement of physical properties: International system of units and definitions, scientific notation, significant figures.	2
	20	Mole concept and molar mass, Concentration of solutions: Molarity, Normality, Molality, Mole fraction.	2
	21	Principles of volumetric analysis, primary standard, secondary standard, standard solution. Accuracy, precision, sensitivity, and selectivity	1
	22	Theory of Acid- Base titration: Acidimetry, Alkalimetry: Basic concepts, principle and illustration with suitable example. Theory of acid-base indicators	3
	23	Definition of Redox Reactions, Balancing of redox equations, Theory of Redox titration: Titration of Fe^{2+} with $KMnO_4$ and $K_2Cr_2O_7$ and theory of redox indicators.	2
	24	Theory of complexometric titration: metal ion-EDTA titration. Theory of metallochromic indicators Precipitation titration: NaCl- $AgNO_3$ titration and use of potassium chromate as adsorption indicator.	2
V	**VOLUMETRIC ANALYSIS**		**30**
	25	**Section A: Volumetric Analysis (5 Experiments (double titration) from Section A are compulsory)** 1. Preparation of standard solutions. 2. Neutralization Titrations a. Strong acid – Strong base b. Strong acid – Weak base	15

		c. Weak acid – Strong base 3. Redox Titrations - Permanganometry a. Estimation of oxalic acid. b. Estimation of Fe^{2+}/$FeSO_4.7H_2O$/Mohr's salt.	
	26	**Section B (Open ended: Any 3 experiments are to be conducted - May be selected from the list or the teacher can add related experiments)** 1. Dichrometry 2. Iodometry & Iodimetry 3. Complexometry 4. Colorimetry	15

References:

1. B.R. Puri L.R. Sharma, K.C. Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers, New Delhi, 2010.
2. J.D. Lee, *Concise Inorganic Chemistry*, 5th Edn., Wiley India Pvt. Ltd., 2008.
3. R. Gopalan, V.Ramalingam, *Concise Coordination Chemistry*, 1st Edn.,Vikas Publishing House, New Delhi, 2001.
4. S. Prakash, G. D. Tuli, S. K. Basu, R. D. Madan, *Advanced Inorganic Chemistry*, 5th Edn., Vol. I, S Chand, 2012.
5. G. S. Manku, *Theoretical Principles of Inorganic Chemistry*. McGraw-Hill Education; New edition (1 August 1982)
6. M.C. Day, J. Selbin, *Theoretical Inorganic Chemistry*, East West Press, New Delhi, 2002.
7. J. E. Huheey, E.A. Keitler, R. L. Keitler, *Inorganic Chemistry-Principles of Structure and Reactivity*, 4th Edn., Pearson Education, New Delhi,2013.
8. B.K. Sharma, *Industrial chemistry*, 11th Edn., Goel publishing House, Meerut, 2000.
9. M.N. Greenwood, A. Earnshaw, *Chemistry of elements*, 2nd Edn., Butterworth,1997.
10. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, *Vogel's Text Book of Quantitative Chemical Analysis*, 6th Edn., Pearson Education, Noida, 2013.
11. D. A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, *Fundamentals of Analytical Chemistry*, 8th Edn., Brooks/Cole, Thomson Learning, Inc., USA, 2004.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Critically analyse atomic structure theories, quantum mechanical concepts, periodic properties, and periodic classification to predict and explain the electronic configuration, chemical behaviour, and trends in the properties of elements using theoretical models, principles,	An	PSO -1

	and numerical applications.		
CO-2	Analyze the fundamental and advanced chemical bonding theories—including VSEPR, VBT, MO theory, and bonding models for ionic, metallic, and secondary forces—to predict molecular structure, properties, and reactivity through case studies and problem-solving approaches.	An	PSO -1,2,3
CO-3	Critically evaluate the causes, effects, and control strategies of air, water, and soil pollution, assess national and global standards for environmental quality, and appraise the significance of environmental movements and regulatory frameworks in sustainable pollution management.	E	PSO -1,2,3
CO-4	Design and perform quantitative analytical procedures by applying fundamental principles of solution chemistry, titrimetric methods, and relevant indicators with accuracy, precision, and scientific rigor.	C	PSO -2,3,4
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 -2,3.4

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

Name of the Course: INORGANIC CHEMISTRY 1

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 PSO -1	An	F, C	L	-
2	CO-2	PO -1, 2, 3, 6 PSO -1,2,3	An	F, C	L	-
3	CO-3	PO – 1, 2, 6 PSO -1,2,3	E	F, C	L	-
4	CO-4	PO – 2,3,8	C	F, C	L	-

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

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	✓		✓	✓