

KU1DSCCHE115: BASICS OF STRUCTURAL & ANALYTICAL CHEMISTRY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100	KU1DSCCHE115	4	75

Learning Approach (Hours/ Week)		Marks Distribution			Duration of ESE (Hours)
Lecture/ Tutorial	Practical/ Internship	CE	ESE	Total	
3	2	35	65	100	1.5

Course Description: Foundation course on atomic structure and chemical bonding. Course includes modules on atomic structure, periodic properties, chemical bonding, basics of coordination chemistry, analytical techniques, and quantitative analysis

Course Prerequisite: Elementary knowledge in PUC level Chemistry

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Attain basic information on atomic structure and theories associated with it and understand the periodic properties of elements	U
2	Get insight about the concept of chemical bonding and theories to explain bonding in various molecules	A
3	Get awareness about various types of molecules including coordination compounds and organic molecules.	U

4	Acquire proficiency in analytical chemistry techniques, they will also demonstrate knowledge of qualitative and quantitative analysis methods and be able to apply them in practical scenarios	U
5	To provide practical experience on various titrimetric analysis	A

**Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

Course Contents for Classroom Transaction:

M O D U L E	U N I T	DESCRIPTION	HOURS
1	ATOMIC STRUCTURE AND PERIODIC PROPERTIES OF ELEMENTS		10
	1	Bohr atom Model (No derivation) – Atomic Spectra of Hydrogen – limitations	
	2	Wave mechanical concept of atom – Heisenberg's Uncertainty Principle – Dual nature of electrons – de Broglie equation, quantum numbers. Orbit and orbitals.	
	3	The periodic table – periods and groups-s, p, d and f block elements – modern concept – periodic trends – atomic radii, ionic radii & covalent radii – effective nuclear charge and screening effect – Ionization potential – electro negativity and electron gain enthalpy	

2	CHEMICAL BONDING		10
	1	Types of chemical bonds-Ionic, covalent and co-ordinate bonds (Definitions and example)-Lattice energy of ionic compounds.	
	2	VSEPR theory and its applications- Shape of molecules BeF ₂ , BF ₃ , CH ₄ , NH ₃ , H ₂ O, NH ₄ ⁺ , SF ₆	
	3	Orbital overlapping – Hybridization sp, sp ² , sp ³ , sp ³ d, sp ³ d ² , d ² sp ³ and dsp ² hybridization.	

	4	Valence bond theory- Explain with examples H_2 , N_2 , CH_4 , $CH_2=CH_2$	
	5	MO theory- Formation of N_2 and O_2 molecules	
	6	Hydrogen bonding, types of hydrogen bonding – examples.	

	BASICS OF COORDINATION CHEMISTRY		10
3	1	Introduction-Double salts and Coordination compounds	
	2	Werner's coordination theory- Classification of coordination compounds and various types of ligands	
	3	Nomenclature of coordination compounds- Application of coordination compounds in qualitative and quantitative analysis.	
	4	VBT- Square planar and octahedral complexes	

	ANALYTICAL CHEMISTRY AND GOOD LABORATORY PRACTICES-1		15
4		Accuracy and precision. Errors-classification. Concept of molarity, Normality, Molality (numerical problems expected). Principle of volumetric analysis – Acidimetry and alkalimetry. Theory of acid-base indicators.	
		Types of analytical methods –Qualitative and Quantitative analysis Inorganic Qualitative analysis	
		Safe laboratory practices and Lab safety signs; Personal protective equipment (PPE) in Chemical laboratory, Awareness of Material Safety Data Sheet (MSDS). Hazardous Symbols and Signs (Physical, Chemical, Environmental and Health), Lab accidents and safety measures.	
		Simple first aids: Electric shocks, fire accidents, burn by chemicals, cut by glass and inhalation of poisonous gases.	

		TEACHER SPECIFIC MODULE-QUANTITATIVE ANALYSIS I-PRACTICALS	30
5	1	*A minimum of eight experiments to be conducted Two burette method (As per Green Chemistry Protocol) may be preferred for the titrations. Out of eight experiments one virtual lab experiment is open-ended and is subjected to teacher's choice.	
	2	1)Preparation of standard solutions (minimum 2) 2)Dilute solutions from Stock solutions in lab (minimum 2)	
	3	3)Acidimetry and Alkalimetry (minimum 3) a) Estimation of NaOH/KOH using standard Na ₂ CO ₃ . b) Estimation of HCl/H ₂ SO ₄ /HNO ₃ using standard oxalic acid.	
	4	4)Use of Online Educational Resources (OER's) like Phet.Colarado.edu as a learning tool for "Build a molecule", "Chemical Bonding" and "Virtual titration tool"	

Essential Readings:

1. J D Lee, Concise Inorganic Chemistry, 5th Edition, Oxford University Press New Delhi, 2008.
2. F A Cotton and Wilkinson, Advanced Inorganic Chemistry, Wiley India Pvt.Ltd., 2008.
3. J E Huheey, Inorganic Chemistry, Derling Kindersley (India) Pvt. Ltd., 2006.
4. Shriver and Atkins, Inorganic Chemistry, W. H Freeman, and Company, 2006.
5. G D Christian, Analytical Chemistry, John Wiley, and Sons.
6. G H Jeffery, J Bassett, J Mendham, R C Denny, Vogel's Textbook of Quantitative Chemical Analysis
7. D A Skoog, D M West, Analytical Chemistry, An Introduction, 4th Edn., CBS Publishing Japan Ltd., 186.

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation (ESE)		65 (50T+15P)
Continuous Evaluation (CCA)		35 (25T+10P)
Theory		25
a)	Test Paper*	10
b)	Assignment	5
c)	Viva-Voce	5
d)	Seminar	5
Practical		10
a)	Skill	4
b)	Record	4
c)	Punctuality	2
Total		100

*Average mark of the best two written tests may be considered for internal mark.