KU1DSCCHE111 - FUNDAMENTALS OF THEORETICAL AND NUCLEAR CHEMISTRY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100	KU1DSCCHE111	4	75

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

Course Description: The course comprises of modules on atomic structure, periodic properties, chemical bonding, nuclear chemistry, analytical techniques, and quantitative analysis. Completing the course will develop a deep understanding of molecular behaviour, nuclear chemistry, laboratory practices, and quantitative analysis skills essential for a career in chemistry and related fields.

Course Prerequisite: Elementary knowledge in PUC level Chemistry

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Develop basic idea regarding atomic structure and atom models.	U
2	Analyse the periodicity and predict the properties of elements	An
3	Describe various theories of chemical bonding and explain the structure of simple molecules based on the theories.	A
4	Understand the concept of nuclear chemistry	U
5	Acquire the knowledge to follow efficient and safe operating procedures skilfully in the laboratory and to prevent health and environment hazards in using chemicals.	A

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

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	3	1	2	0	2	2	2
CO 2	3	1	2	0	2	2	2
CO 3	3	1	2	0	2	2	2
CO 4	3	1	2	1	2	2	2
CO 5	3	1	2	0	3	2	2

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION	HOURS
1		**ATOMIC STRUCTURE AND PERIODICITY OF ELEMENTS**	**10**
	1	Bohr atom Model (No derivation) – Atomic Spectra of Hydrogen – limitations – wave mechanical concept of atom	
	2	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	
	4	Ionization potential – electro negativity and electron gain enthalpy-– effective nuclear charge and screening effect	

2		**CHEMICAL BONDING**	**10**
	1	Types of chemical bonds-Ionic, covalent and co-ordinate bonds. Lattice energy of ionic compounds- VSEPR theory and its applications-Shape of molecules CO_2, BeF_2, BF_3, CH_4, NH_3, H_2O, NH_4^+, PCl_5, SF_6, ClF_3	
	2	Orbital overlapping – Hybridization: sp, sp^2, sp^3, sp^3d, sp^3d^2, d^2sp^3 and dsp^2 hybridization -Shapes of organic molecules like methane, ethane, ethylene and acetylene.	
	3	Valence bond theory- Explain with examples H_2, N_2, CH_4, $CH_2=CH_2$ MO theory- Formation of B_2, C_2, N_2 and O_2 molecules-	

	4	Hydrogen bonding-types of hydrogen bonding – examples	

3	**NUCLEAR CHEMISTRY**		**10**
	1	Concept of nuclides – representation of nuclides – isobars, isotopes and isotones with examples -Detection of isotopes using Aston's mass spectrograph	
	2	Separation of isotopes by diffusion methods – stability of nucleus – n/p ratio- Liquid drop model	
	3	Radioactivity – natural and artificial- Decay constant and half-life period-Radioactive series – Group displacement law- Radio isotopes and their applications in structural elucidation, in agriculture and in industry –Radiocarbon dating	
	4	Nuclear fission and nuclear fusion-Problems associated with the nuclear waste disposal- Derivation of decay constant – Atom bomb and hydrogen bomb-Mass defect- nuclear binding energy	

4	**ANALYTICAL CHEMISTRY AND GOOD LABORATORY PRACTICES**		**15**
	1	Accuracy and precision-Errors-classification- Concept of molarity, normality, molality (numerical problems expected)	
	2	Principle of volumetric analysis – Acidimetry and alkalimetry- Theory of acid-base indicators.	
	3	Types of analytical methods –Qualitative and Quantitative analysis	
	4	**Good Laboratory Practices**	
		a) Safe laboratory practices and Lab safety signs- Personal Protective Equipment (PPE) in Chemical laboratory- Awareness of Material Safety Data Sheet (MSDS)	

		b) Hazardous Symbols and Signs (Physical, Chemical, Environmental and Health), Lab accidents and safety measures	
		c) Simple first aids: Electric shocks, fire accidents, burn by chemicals, cut by glass and inhalation of poisonous gases	

	TEACHER SPECIFIC MODULE	**30**
	PRACTICALS - QUANTITATIVE ANALYSIS I*	
	*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 is virtual lab experiment and is subjected to teacher's choice.	
5	1)Preparation of standard solutions (minimum 2) 2)Dilute solutions from Stock solutions in lab (minimum 2)	
	3)Acidimetry and Alkalimetry (minimum 3) a) Estimation of NaOH/KOH using standard Na_2CO_3. b) Estimation of $HCl/H_2SO_4/HNO_3$ using standard oxalic acid.	
	5. 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. B R Puri, L R Sharma, K C Kalia, Principles of Inorganic Chemistry, Milestone publishers, New Delhi.
2. J D Lee, Concise Inorganic Chemistry, 5th Edition, Oxford University Press New Delhi, 2008.
3. F A Cotton and Wilkinson, Advanced Inorganic Chemistry, Wiley India Pvt.Ltd., 2008.
4. J E Huheey, Inorganic Chemistry, Derling Kindersley (India) Pvt. Ltd., 2006.
5. Shriver and Atkins, Inorganic Chemistry, W. H Freeman and Company, 2006.
6. G D Christian, Analytical Chemistry, John Wiley and Sons.
7. G H Jeffery, J Bassett, J Mendham, R C Denny, Vogel's Textbook of Quantitative Chemical Analysis, 5th Edn., ELBS, 1989.
8. Vogel's Textbook of Quantitative Chemical Analysis
9. D A Skoog, D M West, Analytical Chemistry, An Introduction, 4th Edn., CBS Publishing Japan Ltd., 1986.

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 of best two test papers

Employability for the Course: The course enhances employability of the students by equipping them with essential knowledge and practical skills in Chemistry