KU2CHEDSC112: PRINCIPLES OF PHYSICAL CHEMISTRY AND ENVIRONMENTAL CHEMISTRY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	DSC	100	KU2CHEDSC112	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: This discipline specific course offers an enriching exploration of fundamental physical chemistry and environmental and water chemistry concepts in the first four modules. Practical chemistry provides knowledge regarding the analytical tools like redox titration and colourimetry.

Course Prerequisite: Should be aware of characteristics of acids and bases, thermodynamic terms and concepts like energy and heat, reaction rate environmental aspects of chemistry and fundamentals of titration**.**

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Understand thermodynamic principles and analyse the spontaneity of a particular reaction.	U
2	Classify the compounds based on their acidic and basic properties and calculate the pH of a solution	A
3	Understand the surface phenomenon and properties and applications of colloids.	U
4	Familiarize the principles of redox titration and investigate the principles of colorimetry	A
5	Describe the significance of Environmental Chemistry and recommend the importance of protection of environmental segments.	C
6	Employ the applications of redox titrations and chromatographic techniques in practice.	An

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

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	0	0	0	0	0	0
CO2	0	3	0	0	0	0	1
CO3	0	0	3	0	0	0	0
CO4	0	1	0	3	0	0	1
CO5	0	0	0	0	3	1	0
CO6	0	0	0	0	0	3	2

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION	HOURS
1		**THERMODYNAMICS AND IONIC EQUILIBRIUM**	**15**
	1	**Thermodynamics -** Basic concepts– System – surroundings – open, closed and isolated systems -Process- Isothermal – isochoric and isobaric process	
	2	Work – heat – energy – internal energy- Heat capacity at constant volume (Cv) and at constant pressure (Cp) – relation between Cp and Cv	
	3	First law of thermodynamics – The second law of thermodynamics – Enthalpy-Entropy-and Free energy- Criteria for reversible and irreversible process- Gibbs –Helmholtz equation (no derivation) concepts of spontaneous and non-spontaneous processes	
	4	**Ionic Equilibrium-** Concepts of Acids and Bases-Arrhenius, Lowry-Bronsted and Lewis concepts	
	5	Ionization of weak electrolytes. pH and pOH values. Buffer solutions and calculations of their pH- Henderson equation (numerical problems expected). Hydrolysis of salt – degree of hydrolysis and hydrolytic constant	

2		**ENVIRONMENTAL CHEMISTRY**	**10**

	1	Environmental segments: Lithosphere, Hydrosphere, Atmosphere and Biosphere- Hydrosphere- Chemical composition of water in water bodies –(Ground water, river water and lake water, sea water wetlands)- Hydrological cycle	
	2	Water pollution -Water resources, - water pollution – sources – Industrial effluents – agriculture discharge oil spills – heavy metals – pesticides – detergents	
	3	Eutrophication – biomagnifications and bioaccumulation – experimental determination of Dissolved oxygen, BOD and COD – Thermal Pollution – Control of water pollution –ISI/BSI standards of drinking water.	
	4	Hardness of water – causes and effects –methods of estimation – removal of hardness- Domestic water treatment – Sewage –Sewage analysis -Sewage treatment.	

3	**SURFACE CHEMISTRY AND COLLOIDS**		**10**
	1	Physical and chemical adsorption – Adsorption isotherms – use and limitation. B.E.T. equations (B.E.T. no derivation)	
	2	Freundlich adsorption isotherm –effect of temperature on adsorption. Langmuir adsorption isotherm -thermodynamic derivation	
	3	Gibbs adsorption equation (no derivation)-Surface films - Determination of surface area using Langmuir equations.	
	4	COLLOIDS-Classification – preparation – structure and stability – The electrical double layer – zeta potential–	
	5	Properties of Colloids – Tyndall effect – Brownian movement- Coagulation of colloidal solution – Hardy-Schultz rule – Flocculation value.	

	6	Protective colloids – Gold number –Emulsions – oil in water and water in oil type emulsions – Emulsifying agents – Gels –imbibition – syneresis – applications of colloids in food, medicine and industry.	

4	**ANALYTICAL CHEMISTRY AND CHROMATOGRAPHY**		**10**
	1	**Redox titrations –** Permanganometry and Dichrometry- redox indicators. Iodometry and Iodimetry -Indicators – theory of adsorption indicators	
	2	Introduction - Adsorption and partition chromatography – Principle and applications of column, thin layer, paper, Liquid and gas chromatography	
	3	HPLC, Ion Exchange chromatography (IEC)	
	4	Rf value – Relative merits of different techniques	

5	**TEACHER SPECIFIC MODULE- PRACTICALS-QUANTITATIVE ANALYSIS -II***		**30**
	*A minimum of six experiments must be done. Two burette method (As per Green Chemistry Protocol) may be preferred for the titrations. Out of the six experiments one is to be open-ended and is subjected to teacher's choice.		
	Quantitative Analysis- Redox Titrations **1 Permanganometry** a. Estimation of oxalic acid. b. Estimation of Fe^{2+} c. Estimation of Nitrite		

	2. Dichrometry a. Estimation of Fe^{2+} -using internal and external indicator b. Estimation of Fe^{3+} - reduction by $SnCl_2$ - internal indicator **Open ended** **3**. Iodometry and Iodimetry a. Estimation of Cu^{2+} /$CuSO_4$ $5H_2O$. b. Estimation of potassium dichromate. **4. Colorimetry** a. Verification of Beer-Lambert law for $KMnO_4$, b. Determination of the concentration of the given solution.	

Essential Readings:

1.P. W. Atkins and Julio de Paula, "Physical Chemistry," Oxford University Press

2.Brian P. Atkins and Julio de Paula, "Principles of Physical Chemistry," Oxford University Press

3.Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing Co.

4. A Textbook of Physical Chemistry: A S Negi and S C Anand, New Age International Publishers.

5. A Textbook of Physical chemistry: K. L. Kapoor, Volumes 2 &3, Macmillan India Ltd

6. Textbook of Physical Chemistry: Samuel Glasstone, McMillan Press

7. Advanced Physical Chemistry: Gurdeep Raj, Goel Publishing House, Meerut.

8. Physical Chemistry: W.J. Moore, Orient Longmans.

9. Physical Chemistry: N. Kundu & S.K. Jain, S.Chand & Company.

10. Chemical Thermodynamics: J.Rajaram and J.C.kuriacose,Pearson.

11. Physical Chemistry: A Molecular Approach by Donald A Mc Qurrie

12. Physical chemistry by G W Castellan.

13. Environmental Chemistry, A.K.De.

14. Douglas A. Skoog, F. James Holler, and Stanley R. Crouch, "Principles of Instrumental Analysis," Cengage Learning