

SEMESTER V

KU5DSCCHE301: PHYSICAL CHEMISTRY-II

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSC	300	KU5DSCCHE301	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: The course comprises of modules on Chemical equilibrium, Colloids, Surface chemistry, Chemical Kinetics, catalysis, Phase rule and Physical Chemistry Practicals. Learning the course will develop a deep understanding of the above said topics and good practical skills.

Course Prerequisite: NIL

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Understand the basic principles of chemical equilibrium, Le-Chatlier principle and its application in industries.	U
2	Understand basic principles of surface chemistry and its application in various fields.	U
3	Correlate the types of colloids with their properties and to explore the applications in day today life.	A
4	Apply scientific principles of kinetics to simple, complex, enzymatic, and surface reactions	U

5	Construct phase diagrams and study the equilibrium that exists between various states of matter. And apply principles of phase diagram to separation processes and for property modification of different types of system in laboratory experiments.	A
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**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
CO 1	3	3	2	2	1	1	0
CO 2	3	3	2	2	1	1	1
CO 3	3	3	2	2	1	1	0
CO 4	3	3	2	2	1	1	1
CO 5	3	3	2	2	1	1	0

Course Contents for Classroom Transaction:

M O D U L E	U N I T	DESCRIPTION	HOURS
1	CHEMICAL EQUILIBRIUM		8
	1	Law of mass action-Equilibrium constant – Relation between K_p , K_c and K_x -Thermodynamic treatment of the law of mass action	

	2	Vant Hoff reaction isotherm-Temperature dependence of the equilibrium constant-The Van't Hoffs isochore– Pressure dependence of the equilibrium constant K_p	
	3	Study of heterogeneous equilibria -Heterogeneous equilibria – Dissociation of solid calcium carbonate and decomposition of solid NH_4HS	
	4	Factors that change the state of equilibrium- Le –Chatelier's principle and its application to chemical and physical equilibria-Mention homogeneous gaseous equilibria having zero, positive and negative values of Δn -Calculation of degree of dissociation and K_p	
COLLOIDS AND SURFACE CHEMISTRY			13
2	1	Colloids, Classification – preparation-structure and stability – The electrical double layer –Zeta potential (no derivation)	
	2	Properties of Colloids – Tyndall effect – Brownian movement– Coagulation of colloidal solution – Hardy – Schulze rule – Flocculation Value Electro kinetic properties – Electrophoresis – Electro-osmosis – Protective colloids – Gold number	
	3	Emulsion – Oil in water emulsion and water in oil emulsion – Emulsifying agents – Gels –Micelles-CMC Donnon membrane equilibrium (basic idea only)	
	4	Physical and chemical adsorption – Adsorption isotherms – Freundlich adsorption isotherm – effect of temperature on adsorption – Langmuir adsorption isotherm – use and limitation.	
	5	B.E.T. equations (B.E.T. no derivation) – Gibbs adsorption equation (no derivation)-Surface films - Determination of surface area using Langmuir equations.	
CHEMICAL KINETICS AND CATALYSIS			12
3	1	The rates of chemical reactions – Experimental techniques – rate laws and rate constant – Order and molecularity of reactions – Methods of determining the order of reaction	
	2	Integrated rate laws of zero order, first order and second order reactions — General integrated rate equation for nth order reaction- Zero and	

	fractional order reactions - Half life- Types of complex reactions consecutive parallel and opposing reactions-their derivation (first order only)- Temperature dependence of reaction rates – Arrhenius equation – Interpretation of parameters	
3	Steady state approximation – Kinetics of unimolecular reactions – Lindemann's Theory-Theories of reaction rates — Collision theory – Derivation of rate equation for second order reaction from collision theory- Thermodynamic approach of transition state theory – Entropy activation	
4	Catalysis – Homogeneous and Heterogeneous catalysis – examples – Features of homogeneous catalysis — Langmuir isotherm- Enzymes – Michalis – Menten mechanism. Heterogenous catalysis – Kinetics of unimolecular surface reactions-2nd order surface reactions- Hinshelwood mechanism	
PHASE RULE		12
1	Statement of phase rule and explanation of terms (component, degree of freedom, phase)-thermodynamic derivation	
	One component system – water system and sulphur system (including meta stable equilibrium	
2	Two component systems – reduced phase rule --- simple eutectic systems—lead-silver system --- desilverisation of lead--- KI –water system --- freezing mixtures	
3	Systems involving the formation of compounds with congruent and incongruent melting points—ferric chloride water system and Na ₂ SO ₄ water system- Solid-gas equilibria - decomposition of CuSO ₄ .5H ₂ O — deliquescence and efflorescence	

	4	Nernst distribution law- thermodynamic derivation Limitations- modifications under special conditions- Applications of distribution law to study association and dissociation of salts, solvent extraction, hydrolysis of salts and equilibrium constant of the reaction $KI + I_2 \rightleftharpoons KI_3$	
	TEACHER SPECIFIC MODULE PHYSICAL CHEMISTRY PRACTICALS -II Minimum 4 experiments to be done and recorded		30
	1	Chemical Kinetics - Hydrolysis of methyl acetate using HCl acid	
	2	Phase diagram Critical Solution Temperature (C.S.T) a) Critical solution temperature of phenol - water system b) Concentration (% composition) of NaCl/ KCl by C.S.T Measurements	
5	3	Adsorption experiments- (open ended) Suggestions a) Verification of Freundlich and Langmuir adsorption isotherms- charcoal—acetic acid system b) Determination of concentration of given acetic acid solution using the isotherms c) Verification of Freundlich and Langmuir adsorption isotherms- charcoal—acetic acid system d) Determination of concentration of given acetic acid solution using the isotherms	

Essential Readings:

1. Physical Chemistry: P.W. Atkins, Oxford University
2. Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing Co.
3. A Textbook of Physical Chemistry: A S Negi and S C Anand, New Age International Publishers.
4. A Textbook of Physical chemistry: K. L. Kapoor, Volumes 2 &3, Macmillan India Ltd
5. Textbook of Physical Chemistry: Samuel Glasstone, McMillan Press
6. Physical Chemistry: Gurdeep Raj, Goel Publishing House, Meerut

7. Physical Chemistry: W.J. Moore, Orient Longmans
8. Physical Chemistry: K. J. Laidler, John H.Meiser
9. Physical Chemistry: N. Kundu & S.K. Jain, S. Chand& Company
10. Chemical Kinetics: K.J. Laidler, Pearson Education.
11. Chemical Thermodynamics: J. Rajaram and J. C. Kuriakose, Pearson

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.