

KU4DSCCHE203: PHYSICAL CHEMISTRY –I

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	DSC	200	KU4DSCCHE203	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 solutions, gaseous state, liquid state, ionic equilibrium and Physical Chemistry practical-I. The course will develop a good understanding about the topics covered in the different modules and quantitative analysis skills essential for a career in chemistry and related fields.

Course prerequisite: Basic knowledge on solutions and colligative properties

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Identify and distinguish the types of solutions	U
2	Explain colligative properties of dilute solution and determine the molecular weight of a solute	A
3	Recognize and relate the properties of ideal and real gases	A
4	Describe the properties of liquids.	U
5	Understand the basic principle of ionic equilibrium and its application in laboratories	U
6	Acquire practical skill in physical chemistry experiments such as Cryoscopy, Transition temperature, Viscosity, CST, etc.	A

***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
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CO 1	3	0	0	0	0	0	0
CO 2	3	0	0	0	0	0	0
CO 3	3	0	0	0	0	0	0
CO 4	3	0	0	0	0	0	0
CO 5	3	0	0	0	0	0	0
CO 6	3	0	0	0	0	0	0

Course Contents for Classroom Transaction:

M OD UL E	U N I T	DESCRIPTION	HOURS
1		SOLUTIONS	15
	1	Types of solutions and methods for expressing concentration – Liquid systems — Completely miscible- Ideal and non- ideal solutions – Raoult's Law – Vapour pressure – composition diagrams-Azeotropic mixtures– Temperature – composition curves – Partially miscible liquids – Upper and Lower Critical solution temperature –Immiscible liquids – Steam distillation – Molar mass from steam distillation – Dilute Solutions	
	2	Colligative properties –Lowering of vapour pressure and Raoult's law – Calculation of molar mass. Elevation of boiling point – relation to lowering of vapour pressure – – Calculation of molar mass – Depression of freezing point – – Calculation of molar mass – Measurement by Beckmann's method Thermodynamic derivation of colligative properties	

	3	Osmotic pressure – Measurement by Berkely and Hartley’s method – Laws of Osmotic pressure – Van’t Hoff equation – Calculation of molar mass – Abnormal molar mass – Van’t Hoff factor – Degree of dissociation and association and their calculation from colligative properties. Gas Liquid system — Henry’s Law	
	GASEOUS STATE		15
2	1	Gas laws – The general gas equation– The Kinetic model of gases – gas laws from the kinetic theory of gases-Molecular Speeds – Maxwell’s distribution of molecular speeds – Most probable velocity, average velocity and root mean square velocity — Collision diameter – Mean free path, Collision number and collision frequency	
	2	Degrees of freedom of a gaseous molecule – Principle of equipartition of energy and contribution towards heat capacity of an ideal gas. Real gases – Molecular attractions -The compressibility factor – virial equation of state	
	3	Van der waals equation expressed in virial form – calculation of Boyle’s temperature – Isotherm of real gases and their comparison with Van der waals isotherms – continuity of states	
	4	Critical phenomenon – critical constants of a gas and its determination, derivation of relationship with van der waal constants	
	5	Determination of molecular mass by limiting density method – Principle of corresponding states – Liquefaction of gases by Joule Thomson effect	
	LIQUID STATE		7
3	1	Theories of Liquids state, Vacancy Theory and Free volume theory.	
	2	Properties of liquids– vapour pressure- Heat of vaporisation- Trouton’s Rule, Surface tension and its determination by capillary rise method and by using stalagmometer	
	3	Interfacial tension – surface active agents –effect of temperature on surface tension	

	4	Parachor and its applications – Viscosity - determination of coefficient of viscosity and its variation with temperature	
	5	Refractive index– specific and molar refraction– Measurement of refractive index– Abbe’s refractometer Optical activity and its measurement using polarimeter	
	IONIC EQUILIBRIUM		8
4	1	Ionic product of water – Dissociation constants of acids and bases – pH and its determination – Heat of neutralization	
	2	Incomplete neutralization – Hydrolysis of different types of salts – Degree of hydrolysis and hydrolytic constant – and its relationship with pH and pOH	
	3	Buffer solution – pH of Buffer solution – Henderson’s equation – Buffer capacity – Application of buffer – Preparation of a buffer (one example)	
	4	Acid – base indicators –Theory of acid – base indicators	
	TEACHER SPECIFIC MODULE-PHYSICAL CHEMISTRY PRACTICALS-I		
	<i>Directions: A minimum of 6 experiments (2 from CST, 2 from cryoscopy) must be done. Out of the seven experiments 2 are open ended and can be selected by the teacher.</i>		30
5	1.CST a) Critical solution temperature of phenol - water system b) Concentration (% composition) of NaCl/KCl by C.S.T Measurements		
	2.Cryoscopy Cryoscopy Using Solid Solvent a) Cryoscopic constant of solid solvent using a solute of known molar mass (cooling curve method) Solid solvents/solutes given: Naphthalene, Biphenyl, diphenyl amine. b) Molar mass of the given solute, using solvent of known K_f . Solid solvents/solutes given: Naphthalene, Biphenyl, diphenyl amine.		30

	Teacher specific /open ended experiments (suggestions) 3. Transition temperature. Transition Experiments (cooling curve method) a) Transition point, depression constant (KT) of the given Salt hydrate, using solute of known molar mass. salt hydrates: $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ / $\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$. Solutes: Urea, Glucose, b) Molar mass determination of given solute using salt hydrates of known (KT) Salt hydrates and solutes as a 4. Viscosity, Surface Tension determination Viscosity-Ostwald viscometer Surface tension –Measurement using Stalagmometer	
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Essential Readings:

1. Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing Co.
2. Physical Chemistry: P.W. Atkins, Oxford University Press
3. Physical Chemistry: W.J. Moore, Orient Longmans.
4. Physical Chemistry: N. Kundu & S.K. Jain, S.Chand & Company
5. Textbook of Physical Chemistry: Samuel Glasstone, McMillan Press Ltd.
6. Advanced Physical Chemistry: Gurdeep Raj, Goel Publishing House, Meerut.
7. Physical Chemistry: W.J. Moore, Orient Longmans

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.