University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK3DSCCHE201**				
Course Title	**ESSENTIALS OF PHYSICAL CHEMISTRY**				
Type of Course	**DSC**				
Semester	3				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. Higher secondary level science knowledge 2. First & second semester DSCs (chemistry) offered by UoK (preferable) 3. Basic knowledge in mathematics.				
Course Summary	The course gives students a thorough understanding of the fundamentals of physical chemistry and how they are applied in real-world situations. Topics covered include chemical and ionic equilibrium, electrochemistry, crystalline states, dilute solutions, and binary liquid systems. Students have practical experience in conducting physical chemistry experiments and analyzing experimental data through practical activities that help them build important laboratory skills.				

Detailed Syllabus:

Module	Unit	Content	Hrs
		ESSENTIALS OF PHYSICAL CHEMISTRY	**75**
I		**CHEMICAL AND IONIC EQUILIBRIUM**	**9**
	1	Reversible reactions – K_P, K_C, and K_X and inter relationships – Free energy change and chemical equilibrium (thermodynamic derivation)	2
	2	Influence of pressure and temperature on the following reactions. (i) $N_2 + 3H_2 \rightarrow 2NH_3$ (ii) $PCl_5 \rightarrow PCl_3 + Cl_2$ (iii) $2SO_2 + O_2 \rightarrow 2SO_3$ Le Chatelier's principle and the discussion of the above reactions on its basis.	2
	3	Concepts of Acids and Bases, Arrhenius, Lowry-Bronsted, and Lewis concepts. HSAB Principle. Levelling effect.	1
	4	pH and its determination by potentiometric method. Buffer solutions – Henderson equation, Acidic and basic buffers-examples.	2

	5	Hydrolysis of salts – degree of hydrolysis and hydrolytic constant, Derivation of relation between K_w and K_h for salts of strong acid – weak base, weak acid - strong base and weak acid – weak base.	2
II	**ELECTRO CHEMISTRY**		**9**
	6	Application of conductance measurements. Conductometric titrations involving strong acid – strong base, strong acid – weak base, weak acid – strong base and weak acid – weak base.	2
	7	EMF – Galvanic cells, measurement of emf, cell and electrode potential, IUPAC sign convention, Reference electrodes, SHE and calomel electrode, standard electrode potential,	2
	8	Nernst equation, anion and cation reversible electrodes, redox electrode with examples, quinhydrone electrode, glass electrode	3
	9	Concentration cell without transference, potentiometric titration, Fuel cells – H_2 – O_2 and hydrocarbon – O_2 type.	2
III	**CATALYSIS AND PHOTO CHEMISTRY**		**9**
	10	General Characteristics of catalytic reactions. Different types of catalysis – examples	2
	11	Theories of catalysis (Outline of intermediate compound formation theory and adsorption theory).	2
	12	Enzyme catalysis – Michaelis-Menten mechanism.	2
	13	Photo Chemistry: - Laws of Photo Chemistry, Grothus – Drapter law, Beer Lambert's law, Einstein's laws, quantum yield, H_2 – Cl_2 reaction, H_2 – Br_2 reaction	2
	14	Fluorescence and phosphorescence, chemiluminescence and photo sensitization	1
IV	**DILUTE SOLUTIONS AND BINARY LIQUID SYSTEMS**		**18**
	15	Molarity, molality, Normality and mole fraction Colligative property – relative lowering of vapour pressure – elevation in boiling point – depression in freezing point – osmotic pressure – experimental determination of osmotic pressure – Isotonic solution – reverse osmosis	5
	16	Abnormal molecular mass - van't Hoff factor. (Numerical Problems to be worked out)	4
	17	Completely miscible liquid pairs, vapour pressure - composition curve, boiling point composition curve	3
	18	Ideal and non- ideal solutions, fractional distillations, azeotropes	3
	19	Partially miscible liquids - CST, phenol- water, nicotine-water system- Effect of impurities on miscibility and CST, Immiscible liquid pairs.	3
V	**PRACTICALS: PHYSICAL CHEMISTRY EXPERIMENTS**		**30**
		A minimum of 5 practical experiments out of which at least one each from sections I, II and III must be performed and reported.	
	20	**I. Conductometry**	5
		1. Determination of cell constant 2. Conductometric titration of NaOH using HCl	
	21	**II. Potentiometry**	6

		3. Potentiometric titration of Fe^{2+} versus $Cr_2O_7^{2-}$ 4. Potentiometric titration of KMnO4 versus KI	
	22	**III. Experiments with Partially miscible liquid pairs**	3
		5. Critical solution temperature of phenol –water system 6. Influence of KCl (impurity) on the miscibility temperature of Phenol-water system. Determination of concentration of given KCl solution	
	23	**IV. Adosrption Experiments**	6
		7. Freundlich and Langmuir isotherms for adsorption of oxalic acid on active charcoal. 8. Determination of unknown concentration of oxalic acid using isotherm.	
	24	**V. Calorimetry**	5
		9. Determination of water equivalent of Calorimeter and heat of neutralization of strong acid and strong base.	
	25	**VI. Partition experiments**	5
		10. Partition coefficient of iodine between CCl_4 and H_2O or Partition coefficient of ammonia between $CHCl_3$ and H_2O	

References

1. P L Soni, O P Dharmarsha, U N Dash, *Textbook of Physical Chemistry*, 23rd Edn, Sultan Chand & Sons, New Delhi, 2011.
2. Gurudeep Raj, *Advanced physical chemistry*
3. F Daniel and R A Albert, *Physical chemistry*
4. N.M. Kapoor, *Physical Chemistry.*
5. J. B. Yadav *Advanced Practical Physical Chemistry*, Krishna Prakashan Media (P) Ltd

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand and apply the principles of chemical equilibrium, acid-base theories, and buffer systems to predict and interpret the behavior of chemical systems under varying conditions of pressure, temperature, and composition.	An	PSO-1,2,3
CO-2	Understand and apply the principles of electrochemistry to analyze conductance and electrode processes; perform and interpret conductometric and potentiometric titrations; explain the working of reference electrodes, concentration cells, and fuel cells; and utilize the Nernst equation to	An	PSO-1,2,3