Semester	Subject	Category		Instruction Hours				Credits	
	Code		Lecture		Theory		Practical		
			Per	Per	Per	Per	Per	Per	
			Week	Semester	Week	Semester	Week	Semester	
Ι	21CPCH1C	Core	4	60	4	60	0	0	4

PAPER-III: CHEMICAL KINETICS AND ELECTROCHEMISTRY

COURSE OBJECTIVES

- To understand the kinetics of chemical kinetics and explore the reaction kinetics of fast reactions.
- ✤ To learn the various techniques, mechanism of involved in catalysis and understanding of the Ionic activity, ionic interactions, Debye-Hückel-Bjerrum model, Debye-Hückel limiting law, Debye-Hückel theory of strong electrolytes, electrical double layer, electrocapillary phenomena, surfactants, design and applications of the batteries, Fuel Cells, Corrosion and its Protection.

COURSE OUTCOMES:

> On the successful completion of course, students will be able to

СО	CO statement	Knowledge
Number		level
CO1	Learn the reaction rate theories and reactions in solution and to	K2 & K4
	explore the knowledge in kinetics	
CO2	Solve problems on rate/rate constants/efficiency for unimolecular	K2 & K4
	and bimolecular reactions and Plot equations and functions	
	representing kinetic behaviour.	
CO3	Gain clear concepts about transition in Jablonski diagram and photo	K2 &K3
	catalysis reaction	
CO4	Acquire knowledge about strong electrolytes and based on Debye-	K3 & K4
	Huckel limiting law certain problems can be solved.	
CO5	Understand the designs of batteries, Fuel cells and ion selective	K2 & K3
	electrodes	

* CO-Course Outcomes

Knowledge level K1-Remember; K2-Understand; K3-Apply; K4-Analyze

MAPPING WITH PROGRAM OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	М	S	S	М
CO2	М	S	S	М	М	S
CO3	М	М	S	М	М	М
CO4	М	М	М	S	М	М
CO5	М	М	S	S	S	М

UNIT-I: CHEMICAL KINETICS

Effect of temperature on reaction rates - collision theory of reaction rate: Lewis rigid sphere theory - molecular beams - collision cross sections - effectiveness of collisions -Potential energy surfaces - partition function and activated complex -Absolute reaction rate theory -Thermodynamic terms-Significance of entropy and volume of activation – Reactions in solution: factors determining reaction rates in solutions, effect of dielectric constant and ionic strength, -Bronsted –Bjerrum equation – Primary and Secondary salt effect, influence of solvent on reaction rates.

UNIT-II: CHEMICAL DYNAMICS AND CATALYSIS

Acid base catalysis - Mechanism of acid base catalyzed reaction, Bronsted Catalysis Law - Enzyme catalysis and its mechanism, Michaelis - Menten equation, effect of pH and temperature on enzyme catalysis - Mechanism of enzyme inhibition kinetics of surface reactions -Unimolecular reactions-Bimolecular reactions-Langmuir Hinshelwood and Elay-Rideal mechanism, Rice - Ramsperger - Kassel (RRK) theory. Rice-Ramsperger - Kassel - Marsus (RRKM) theory.

Study of fast reactions by stopped flow techniques - relexation method, flash photolysis and the nuclear magnetic resonance method.

Linear free energy relationship – Hammett equation – Taft equation-Separation of polar, resonance and steric effects.

UNIT-III: INTRODUCTION TO PHOTOCHEMISTRY

Jablonski diagram, Primary and Secondary Processes, quantum yield and its determination - chemical actinometer. Excimers and exciplexes - Kinetics of collisional quenching - Stern Volmer equations. Photochemical reactions - photoredox, photosubstitution, photoisomerization and photosensitized reactions - photovoltaic and photogalvanic cells. Chemiluminescence, Photoassisted electrolysis of water, Photosynthesis, solar energy conversions. Semiconductor photocatalysis - lasers.

Radiation Chemistry – linear energy transfer, G – value, dosimeters, radiolysis of water, solvated electrons.

UNIT IV: ELECTROCHEMISTRY – I

Deviation from ideal behavior ion – solvent and ion – ion interactions – Debye– Hückel – Bjerrum model, Ion association and triple ion formations - Expression for the mean activity coefficient - Debye - Hückel limiting law and its applications - Diverse ion effect - Van't Hoff factor and its relation to colligative properties – Debye – Hückel theory of strong electrolytes – Debye – Hückel length and potential around a central ion and its interpretation – Transport of ions in Solution: Electrolytic conduction- Debye - Hückel - Onsager treatment of strong electrolytesionic atmosphere- Anomalous conductance of nonaqueous electrolytes.

12 hours

12 hours

12 hours

12 hours

UNIT V: ELECTROCHEMISTRY- II

12 hours

Diffusion – Fick's law of diffusion – electrokinetic phenomena-membrane potential. Electrical double layer – Electrocapillary phenomena – Surfactants – Lipmann's equation – Electrokinetic phenomena – Zeta potential and its applications – Structure of electrical double layer – Helmholtz – Perrin, Guoy – Chapmann and Stern models – Butler –Volmer equation for one electron transfer reaction - equilibrium and exchange current densities and symmetry factor – transfer coefficient – Corrosion and passivation of metals – Pourbaix diagram – Evans diagram –Batteries and Fuel cells-Ion selective electrodes.

Distribution of Marks: Theory-80% and Problems-20%

S.No	Authors	Title	Publishers	Year of publication
1.	R. G. Frost and Pearson	Kinetics and Mechanism	Wiley New York,	1961
2.	C. Capellos and B. H. J. Bielski,.	Kinetic Systems	Wiley Interscience, New York	1968.
3.	K. J. Laidler	Chemical Kinetics	Harper and Row, New York,	1987
4.	Rajaram and J.C.Kuriacose	Kinetics and mechanism Of Chemical Transformations	Macmillan India Ltd.	1993
5.	G. M. Harris	Chemical Kinetics	D. C. Healthand Co,	1966
6.	A. W. Anderson	Physical Chemistry of Surfaces	Wiley - Interscience, Newyork	1990
7.	Paula, Peter Atkins and Julio de	Elements of Physical chemistry	5th Ed, Oxford U. P	2012
8.	John O'M Bockris, Amula K. N. Reddy, and Maria Gamboa–Aldeco	Modern Electrochemistry 2A, 2nd Ed,	Kluwer Academic / Plenuim Publishers, NewYork	2000
9.	Mordechay Schlesinger	Modern Aspects of Electrochemistry	Issue 43, Springer, Netherlands	2009
10.	G. L. Agarwal	Basic Chemical Kinetics	Tata McGraw Hill	1990
11.	K. J. Laidler	Chemical Kinetics	Tata Mc Graw Hill	1990
12.	Robert J Silbey, Robert A Alberty and Moungi G Bawendi	Physical Chemistry	4 th Ed,NJ Hoboken: Wiley	2015

TEXT BOOKS

13.	N. J. Turro	Modern molecular	Benjamin/Cummings,	1978
		photochemistry	Menlo Park,	
			California	
14.	Revise G. W.	Physical Chemistry	Narosa publishing	2011
	Castellan,		House ,New Delhi, Ed,	
15.	Gordon. M. Barrow	Physical Chemistry	Tata McGraw Hill	2011
			Edition, New York,	
16.	L. R. Puri, Y. R.	Principles of Physical	Vishal Publishing Co,	2012.
	Sharma and R. S.	Chemistry	4th edition edition	
	Pathania,			
17.	J. N. Gurtu and A.	Advanced Physical	Pragathi Prakashan,	2014
	Gurthu,	Chemistry	Meerut, Revised,	

REFERENCE BOOKS

S.No	Authors	Title	Publishers	Year of
				publication
1.	S.Glasstone	Introduction To	Affliated East West	1960
		Electrochemistry	Press, New Delhi,	
2.	J.O.M.Bokris and	Electrochemistry,	New York,	1977
	A.K.N.Reddy	Vols.1 and 2		
		Plenum		

TEACHING METHODOLOGY:

- PowerPoint presentation
- Group discussion
- Seminar and Assignments
- Animated videos
- Board and chalk

SYLLABUS DESIGNERS:

- 1. Dr. T. Gomathi, Assistant Professor, Department of Chemistry
- 2. Mrs. J. Saranya, Assistant Professor, Department of Chemistry
- 3. Dr. D. Shakila, Assistant Professor, Department of Chemistry