Subject Code: 02CY0451

Subject Name: Physical Chemistry-II

M.Sc. Sem. - II

Objectives:

- The course presents advanced concept of statistical thermodynamics in order to provide a soiled foundation for students.
- The course provides an introduction to chemical kinetics. Some of the fundamental concepts used in understanding mechanism of chemical reactions, optimization of rate of reaction.
- Basic knowledge of physical phenomena taking place in case of non-electrolyte solutions. Thermodynamic aspects of mixing.
- Introduction to electrolytic conductance. Physical significance of activity coefficient and mean ionic activity coefficient.

Credits Earned: 6 Credits

Course Outcomes: After completion of this course, student will be able to

- Identify, select and explain which concepts are involved and the way of theoretical framework of statistical thermodynamics.
- Identify, describe and explain the kinetics of simple as well as complex chemical reactions.
- Understand the application of non-electrolyte solution to different areas of industrial applications.
- Able to apply the basic concept of electrochemistry.

Pre-requisite of course: NA.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA	CSE	Viva (V)	Term Work (TW)	
4	-	3	6	50	30	20	25	25	150

Marwadi UNIVERSITY

Syllabus for Master of Science

Physical Chemistry-II

Contents

Unit	Topics	Contact Hours
1	**Statistical Thermodynamics** Introduction, Basic Terms: thermodynamic probability and entropy, cell, phase space, micro andmacro states, thermodynamic probability, statistical weight factor, assembly,ensemble and its classification and statistical equilibrium. Derivation of Boltzmann-Maxwell, Bose-Einstein and Fermi- Dirac statistics, Partition function and derivationsof translational, rotational, vibrational and electronic partition functions andthermodynamic functions such as internal energy, heat capacity, entropyetc. Partition function and third law ofthermodynamics. Applications of partition function to mono-atomic gases, diatomic-molecules andnumerical.	20
2	**Chemical Kinetics** Chemical equilibrium and the equilibriumconstant: Equilibrium in homogeneous gaseous systems. Homogeneous reactions inliquid solutions. 'Absolute reaction rate' theory and its comparison with 'collision' theory. Homogeneous reactions in dilute solutions. Chemical equilibria inheterogeneous systems. Free energy change in chemical reactions: The reactionisotherm, standard free energy of reaction, the direction of chemical change.Variation of equilibrium constant with pressure and temperature. Influence oftemperature on heterogeneous reactions. Integration of the Van't Hoff equation.Variation of standard free energy with temperature. Simultaneous equilibria.Formation of standard free energies and entropy changes and their applications.Problems.	20
3	**Solutions of Non-Electrolytes** Introduction, basic concept of solution and non-electrolyte. Liquid-liquid solution, Raoult's law, ideal solution and non-ideal solution. Thermodynamics of ideal solution, Free energy, volume and entropy changes in ideal mixing. Vapour pressure, fractional distillation, azeotropic mixture, UCST and LCST. Solution of gases in liquids, Henry's law, factors influencing solubility of gas in liquid.	10
4	**Electrochemistry - I** Introduction to electrolytic conductance, definitions, effect with dilution, ionic mobility, transport number. Kohlrausch's law and its application. Ostwald's dilution law. The Debye-Huckel theory of ionic activity coefficient, derivation of the 'limiting law', extended forms of the law.Physical significance of activity coefficient and mean ionic activity coefficient. The Debye-Huckel-Onsager (DHO) theory of electrolyticconduction.Applications of the DHO theory.	10
	Total Hours	**60**

References:

1. Principles of physical chemistry; B.R. Puri, L.R. Sharma, M.S. Pathania.
2. A Textbook of Physical Chemistry - Applications of Thermodynamics - Vol. 3, 1, 5; K. L. Kapoor.
3. Thermodynamics: Statistical Thermodynamics and Kinetics; Thomas Engel.
4. Statistical Thermodynamics; M. C. Gupta.
5. Physical Chemistry: A Molecular Approach; D. A. McQuarrie, J. D. Simon.
6. Physical Chemistry; P. W. Atkins, J. de Paula.
7. Physical Chemistry; G. W. Castellan
8. An Introduction of Physical Chemistry, D. K. Chakrabarty.
9. Modern Electrochemistry 2A: Fundamentals of Electrodics; John O'M.Bockris,Amulya K.N. Reddy, Maria E.Gamboa-Aldeco.

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
30%	25%	15%	15%	10%	5%

Suggested List of Experiments:

Experiments involving (i) analytical procedures related to kinetics and equilibrium(ii) polarimetry (iii) conductometry (iv)potentiometry (v) pH-metry(vi) colorimetry,(vii) surface phenomena (viii) viscosity, excluding types/experiments performed in previoussemester

A. Conductometric method

(i) To determine the equivalent conductance of a strong electrolyte and hence to verify the Onsagar's equation.

(ii) To determine the equivalent conductance and dissociation constant of a weak electrolyte and hence to verify Ostwald's dilution law.

B. Potentiometric method

(iii) To determine the concentration and dissociation constant of Acetic acid by potentiometry.

(iv) To determine the standard oxidation potential of the Quinhydrone electrode.

C. pH metric method

(v) Determination of hydrolysis constant of a salt with the help of a pH meter.

D. Kinetic study

(vi) Kinetic study of the iodination of acetone.

(vii) To study the kinetics of the reaction between $S_2O_8^{2-}$ and I^- by colorimetric method.

E. Ostwald viscometer

(viii) Determination of viscosity coefficient of a given liquid/solution with Ostwald viscometer.

Reference Books:

1. An Advanced Course in Practical Chemistry, A. K. Nad, B. Mahapatra and A. Ghoshal, New Central Book Agency (P) Ltd.
2. Practicals in Physical Chemistry, P. S.Sindhu, Macmillan.
3. Experimental Physical Chemistry: A Laboratory Textbook, Arthur Halpern, George McBane, W. H. Freeman.
4. Physical Chemistry; R. S. Berry, S. A. Rice, J. Ross.
5. Physical Chemistry; T. Engel, P. Reid.
6. Chemical Kinetics; K. J. Laidler.

Instructional Method:

a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

e. Use of hazardous/toxic chemicals should be avoided as far as possible in laboratory.

f. All students in the laboratory must wear safety goggles and lab coats during lab session.

Supplementary Resources:

1. http://www.nptel.ac.in/courses/104103069/#
2. http://ocw.mit.edu/courses/chemistry/
3. http://vlab.amrita.edu/index.php?sub=2
4. http://www.vlab.co.in/ba_labs_all.php?id=9

5. https://www.youtube.com/user/TMPChem
6. https://www.youtube.com/playlist?list=PL166048DD75B05C0D
7. https://www.youtube.com/channel/UCqk-dmk3AOFtikaFDpsZorg