BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
Instruction Division

FIRST SEMESTER 2016-2017

Course Handout (Part II)

Date: 02 Aug., 2016

In addition to Part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No : **CHEM F312**
Course Title : **Physical Chemistry IV**
Instructor-in-charge : **S.C SIVASUBRAMANIAN**
Instructor(s) : S. C. Sivasubramanian

1. Course Description:

Weak forces; surface chemistry: interphase region, thermodynamics, surface films on liquids, adsorption of gases on solids, colloids, micelles, and reverse micellar structures; transport processes: kinetics, thermal conductivity, viscosity, diffusion, sedimentation; electrical conductivity in metals and in solutions; reaction kinetics, measurement of rates; integrated rate laws; rate laws and equilibrium constants for elementary reactions; reaction mechanisms; temperature dependence of rate constants; rate constants and equilibrium constants; rate law in non ideal systems; uni, bi and tri molecular reactions, chain reactions, free-radical polymerizations; fast reactions; reactions in solutions; heterogeneous and enzyme catalysis; introduction to statistical mechanics; theories of reaction rates; molecular reaction dynamics.

2. Scope and Objective of the course:

This is the last one of the four Physical Chemistry courses named for M.Sc. (Hons.) Chemistry Programme. The course mainly covers chemical changes in terms of chemical kinetics, surface and interfacial phenomena, and the associated theories. The objective is to understand the chemical changes and also to be able to connect these changes to structure and equilibrium properties learnt in the previous courses.

3. Text Book :

T1. Levine Ira N., *Physical Chemistry*, 6th ed., Tata McGraw-Hill, New Delhi, 2011.

Reference Book :

R1: Peter Atkins and Julio de Paula, *Atkins' Physical Chemistry*, 9th Ed., Oxford University Press, Oxford, 2010.

4. Course Plan : [Topics in () correspond to computer applications; depending on time available a tutorial introduction followed by take home problems from these topics will be assigned for computer solving.]

Lecture No.	Topic	Learning Objectives	Ref. to Text Book/Ref. book
1-4	Statistical Mechanics	Partition function, thermodynamic information from canonical partition function.	**T1**: 21.2 – 21.4
5-7	"	Molecular partition function, equilibrium constants	**T1**: 21.6 – 21.8
8-10	Rates of chemical reactions; Integrated rate laws; Finding of rate law.	Definition of rate, derivation of concentration time relationship for simple reactions, determination of rate law, half-life of reactions, reactions approaching equilibrium, Exptl. Procedures to obtain rate laws.	**T1**: 16.1 - 16.4 (16.7)

11-13	Elementary reactions, Mechanisms	Elementary reactions, composite reactions, steady-state approximation, rate determining step, rate constants and equilibrium constants; rate laws for non-ideal systems.	**T1**: 16.5 - 16.6, 16.9-16.10
14	Temperature effects on rates	Concept of activation energy	**T1**: 16.8
15-16	Unimolecular and Trimolecular reactions	Lindemann-Hinshelwood mechanism	**T1**: 16.11 - 16.12
17-18	Chain reactions	Polymerization kinetics, free-radical polymerization reactions	**T1**: 16.13
19-21	Fast reactions and reactions in solutions	Concepts of relaxation, diffusion controlled reactions	**T1**: 16.14 - 16.15
22-23	Homogeneous catalysis	Enzyme catalysis, Michaelis-Menton equation	**T1**: 16.16 - 16.17
24-25	Adsorption of gases on solids	Extent of adsorption, Physisorption and chemisorptions, Adsorption isotherms	**T1:** 16.18
26-27	Heterogeneous catalysis	Rates of surface processes	**T1**: 16.19
28	Theories of reaction rates	Collision Theory	**T1**: 22.1,
29-30	"	Reaction trajectory; Molecular reaction Dynamics	**T1**: 22.2-22.3
31-32	"	Transition State Theory	**T1:** 22.4, 22.6-22.7
33	Reactions in solution	Extending the gas phase theories to the solution phase	**T1**: 22.8
34	Weak forces	Electric dipole moment, Polarization, Interaction between dipoles, Interaction between induced dipoles, Hydrogen bonding, Total attractive and repulsive interactions	**R1**:17.5 - 17.6 **T1**: 13.14, 21.10
35-36	Surface Chemistry	Molecular interactions in gases, Liquid-vapour interface, surface films, Thermodynamics of surface layers	**T1**: 7.6 - 7.8 **R1**: 17.9 – 17.10
37-38	Colloids, micelles, and reverse micellar structures	Classification, Preparation, Structure & stability of colloids, Micelle formation, Reverse micellar structures, bilayers, Determination of size & shape	**R1**: 18.6 – 18.9 (b) **T1**: 7.9
39-40	Transport processes	Kinetics, viscosity, diffusion, sedimentation, electrical conductivity of solids and electrolyte solutions	**T1**: 15.1 - 15.7

5. Evaluation Scheme:

Components	Duration	Marks	Date & Time	Venue	Remarks
Mid-Sem-Test Tutorials Comprehensive Examination	1½ hrs 20 mts 3 hrs.	60 60 80	4/10 10:00 - 11:30 AM Continuous 3/12 FN	To be announced	- @ Partly OB

@ **Tutorials:** The tutorial hour will be used for a quick review of the highlights of the material covered in the lectures, clarification of doubts and problem solving. Further, a set of problems will be assigned periodically, of which the Instructor will specify one to be solved by the students in the tutorial hour of the following week. **Students must bring the tutorial problem sheets to the subsequent tutorial session without fail; they should not write anything on those sheets except their name and Id no.** Some problem sets may require usage of computer software during solving; evaluation of such problems will be done differently (by viva voce for example). The second method of evaluation in tutorial will be of a short quiz based on the lectures covered recently. Totally there will be six such tutorial evaluations out of which the best five will be accounted. Each tutorial evaluation will be for 12 marks.

6. Chamber Consultation Hour: Friday 9th Hour (4-4:50pm) at 3165(CAHU).

7. Makeup Policy: See Part I for details. However, it may be noted that there will be no make up for tutorials since the best five out of six evaluations are only taken into account.

8. Notices: Notices, if any, concerning the course will be displayed on the notice board of Chemistry Department only.

Instructor-in-Charge
(CHEM F312)