

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**  
**HYDERABAD CAMPUS**  
**FIRST SEMESTER 2020-21**  
**Course Handout (Part II)**

Date: 17/08/2020

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.** : CHE F214  
**Course Title** : Engineering Chemistry  
**Instructor-in-charge** : Karthik Chethan V.

**Tutorial Instructors** : Karthik Chethan V.

**1. Scope and Objective of the Course:**

The objective of the course is to introduce the interdisciplinary nature of science and engineering to Chemical Engineering undergraduate students. It gives a basic understanding of aspects of chemistry such as reaction mechanisms and processes, physical chemistry, electrochemistry, analytical methods and materials in the context of engineering applications.

**Course Outcomes (CO):**

CO1. To learn and gain some insights in real world chemistry and its association in engineering products (familiarity with reactions, processes, problem solving, product development and characterization of materials that are commonly encountered in adhesive, composite, aerospace, defence, soap, food, chemical and biotechnology industries).

CO2. To conduct hypothesis based discussions to solve chemistry and engineering based issues in a confident and feasible manner by combining conceptual, numerical and design based solutions learnt during the course of the semester. The issues can be research, product development, process, quality control and application related.

CO3. To inculcate the skill of coupling micro and macro aspects of chemistry and engineering, and to apply interdisciplinary skills of science and engineering in problem-solving. The course will attempt to cover various case studies in engineering chemistry.

**Student Learning Outcomes (SLO):** SLOs are outcomes (a) through (k) plus any additional outcomes that may be articulated during the course.

- (a) an ability to learnt to alleviate and manage fear (fear of failure, embarrassment, grades etc.) which rears its ugly head in learning and learn to connect and collaborate with peers and faculty in and out of classrooms. To develop into thinking (how and why) and collaborative individuals.
- (b) an ability to apply knowledge of science and engineering.
- (c) an ability to design and conduct characterization experiments, as well as to analyze and interpret results.
- (d) an ability to select and apply relevant characterization techniques to meet specific desired needs within realistic constraints such as availability, expertise and economics.
- (e) an ability to function on teams.
- (f) an ability to identify, formulate, and solve engineering problems.

- (g) an understanding of professional and ethical responsibility.
- (h) an ability to communicate effectively.
- (i) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (j) a recognition of the need for, and an ability to engage in life-long learning
- (k) a knowledge of contemporary issues
- (l) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

## 2. Text Book:

**T1.** Dr Suba Ramesh and others, Engineering Chemistry, Wiley India, , 2011,1st Ed.

## Reference Books:

R1. P. W. Atkins, Elements of physical chemistry, 8<sup>th</sup> edition, Oxford University Press.

R2. T. W. Graham Solomons and Craig B. Fryhle, Organic Chemistry, 9<sup>th</sup> edition, John Wiley and sons.

## 3. Course Plan:

Lect. No.	Topic	Learning Objectives	Ref. Chap./ Sec.Book)
1-2	<b>Introductory concepts</b>	Atom and its constituents, electronic configuration, octet pair, electronegativity, dipoles, hydrogen bonding, hybridization, bonding and molecular orbitals (A QUICK REVIEW OF SOME KNOWN STUFF)	TB- CH 1
3-5	<b>Organic Chemistry:</b>  Important Functional groups and some reactions	Alcohols, carboxylic acids, amines, aldehydes and ketones, ethers. (FUNCTIONAL GROUPS IN REAL WORLD, BOTH BIOLOGICAL AND SYNTHETIC SCENARIOS)	TB- CH 9
6-9	Some real world product based reactions used in adhesives, aerospace and defence composite products, soaps, food, textiles, paints etc.	Epoxy-catalysis and crosslink reaction, phenolics, silane based reactions, soap making, hydrogenation of oils, Fridel-Craft acylation, Aldol condensation, Cannizzaro reaction, Hofmann rearrangement	TB- CH 9 and classroom

		and protein reactions.	
10-13	<b>Physical Chemistry</b> Thermo-physical and thermo dynamic properties	Understanding, entropy, enthalpy and free energy in a conceptual and tangible context, its association with real engineering properties. (Heat capacity, Enthalpy of vaporization and fusion, thermal conductivity, thermal diffusivity and thermal expansion and surface tension properties)	TB- CH 4
14-15	Phase diagrams and its engineering relevance	Phase diagram, one-component and two component systems	TB- CH 6
16-18	Adsorption in engineering (membranes, chromatography etc.)	Introduction to adsorption process, Adsorption isotherms, Equilibrium relation for adsorbents, Breakthrough concentration curves, Applications of Adsorption.	TB- CH 8
19-22	Electrochemistry	Types of electrolytes, Electrochemical cells, Electrode potential, Galvanic cells, Nerst equation, Measurement of EMF, types of electrodes, concentration cells, Batteries.	TB- CH 7
23-25	<b>Analytical Chemistry</b> Chemical Methods of analysis	Volumetric analysis, Neutralization titrations, Redox titrations, Complexometric titrations	TB- CH 11
26-30	Instrumental Methods of analysis	Infrared spectroscopy, NMR spectroscopy, UV-Visible spectroscopy, Chromatography and particle size analyzer	TB- CH 12
31-33	<b>Industrial &amp; Engineering Chemistry</b> Engineering Materials	Intro to ceramics and its properties	TB- CH 14

	(ceramics)		
34-35	Engineering Materials (metals)	Intro to metals and its properties	TB- CH 15
36-39	Engineering Materials (polymers)	Intro to polymers, classification of polymers, types of polymerization, molecular weight of polymers, plastics, some important commercial thermoplastics and thermosetting resins, Elastomers, Synthetic rubbers, Fibres.	TB- CH 13
40-42	Nano science	Introduction to nanoscience and nanomaterials, synthesis, characterization and applications.	TB- CH 14

#### 4. Evaluation Scheme:

Component	Duration	Weightage	Date & Time	Remarks
Test 1	30 mins	15%	September 10 – September 20 (During scheduled class hour)	Open Book
Test 2	30 mins	15%	October 09 –October 20 (During scheduled class hour)	Open Book
Test 3	30 mins	15%	November 10 – November 20 (During scheduled class hour)	Open Book
Continual Evaluation*	NA	30%		Open Book
Comprehensive Exam.	3 hours	25 %	TBA	Open book

\*Continual evaluation will involve brainstorming and interacting in class, hands-on experimental and modeling or numerical work, video demos and discussions, reading case studies and presenting and problem solving assignments.

**Chamber Consultation Hour:** To be announced later.

**Notices:** All notices related to the course will be uploaded in CMS.

**Make-up Policy:** Make-up will be granted for genuine cases with prior approval.

**Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**Karthik Chethan V.**  
**INSTRUCTOR-IN-CHARGE**

