BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
HYDERABAD CAMPUS
FIRST SEMESTER 2022-23
Course Handout (Part II)

Date: 29/08/2022

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:

Engineering chemistry is what I would consider as a highly interdisciplinary course that permeates into all branches of chemistry, physics, thermodynamics, materials science, materials characterization, nanoscience and engineering and product development.

The main advantage about a course such as this is that every student will find something that will suit his aptitude and sensibilities and in turn the disadvantage would be the breadth and rigor that is required to undertake this learning adventure. The key is not to be overwhelmed but to learn in an integrated manner wherein the points of intersection between topics and the huge number of similarities between concepts and the rules governing the same are identified. This is possible with a commitment to creative analogies and project based learning. In short, the approach is to reorient an academic subject such as engineering chemistry into a real-world based problem-solving and product development 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 reactions and processes, physical chemistry, electrochemistry, analytical chemistry and materials science 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, , 2013, 2nd Ed. (https://www.wileyindia.com/wiley-engineering-chemistry-second-edition.html)
ISBN: 9788126543205, available on Amazon, Flipkart and Kindle

Reference Books:
R1. P. W. Atkins, Elements of physical chemistry, 8th edition, Oxford University Press.
R2. T. W. Graham Solomons and Craig B. Fryhle, Organic Chemistry, 9th edition, John Wiley and sons.

3. Course Plan:

Lect. No.	Topic	Learning Objectives	Chapter in the Text Book
1-2	**Introductory concepts**	Atom and its constituents, electronic configuration, octet pair, electronegativity, dipoles, hydrogen bonding, hybridization, bonding and molecular orbitals (A QUICK REVIEW WITH DAY TO DAY EXAMPLES)	TB- CH 1
3-4	**Organic Chemistry:** Important Functional	Alcohols, carboxylic acids, amines, aldehydes and ketones, ethers.	TB- CH 9

	groups and some reactions		
5	Identifying functional groups in our lives (environment and our bodies), in household items and industry products	(FUNCTIONAL GROUPS IN REAL WORLD, BOTH BIOLOGICAL AND SYNTHETIC SCENARIOS)	Classroom with experiential learning
6-7	Name reactions	Fridel-Craft acylation, Aldol condensation, Hofmann rearrangement and protein reactions.	TB- CH 9 and classroom
8-9	Some real world product based reactions used in adhesives, aerospace and defence composite products, soaps, food, textiles, paints etc.	Epoxy-crosslink, epoxy-catalysis, phenolics reaction, grafting on natural rubber and silicone rubber reaction (to develop core-shell nano rubber)	Classroom with experiential learning
10-12	**Physical Chemistry** Thermo-physical and thermo dynamic properties	Understanding, entropy, enthalpy and free energy in a conceptual and tangible context. (Heat capacity, Enthalpy of vaporization and fusion, thermal conductivity, thermal diffusivity and thermal expansion and surface tension properties)	TB- CH 4, lab visit and experiential learning activities
13	Thermo-physical and thermo dynamic properties	To learn to identify engineering properties in thermodynamics	Classroom with experiential learning activities
14-15	Phase diagrams and its engineering relevance	Phase diagram, one-component and two component systems	TB- CH 6
16-17	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, lab visit and experiential learning activities
18	Membrane technology	Membrane materials, membrane making and	Classroom with

		electrospinning	experiential learning activities
19-21	Electrochemistry	Types of electrolytes, Electrochemical cells, Electrode potential, Galvanic cells, Nerst equation, Measurement of EMF, types of electrodes, concentration cells, Batteries.	TB- CH 7
22	Novel research trends in batteries	Development of solid polymer electrolyte and its characterization and performance	classroom
23-24	**Analytical Chemistry** Chemical Methods of analysis	Intro, Volumetric analysis, Neutralization titrations, Redox titrations, Complexometric titrations	TB- CH 11, lab visit and experiential learning activities
25-28	Instrumental Methods of analysis	Infrared spectroscopy, NMR spectroscopy, UV-Visible spectroscopy and Chromatography	TB- CH 12 and lab visits and experiential learning activities
29-30	Instrumental Methods of analysis	Mass spectrometry, dynamic laser scattering (DLS) and thermal gravimetric analysis (TGA)	TB- CH 12, classroom and lab visits and experiential learning activities
31-33	**Industrial & Engineering Chemistry** Engineering Materials (ceramics)	Intro to ceramics and its properties. To collect and study various ceramic products in campus in regards to composition and some important properties	TB- CH 14 and experiential learning activities
34-35	Engineering Materials (metals)	Intro to metals and its properties. To collect and study various metallic products in campus in regards to composition and some important properties	TB- CH 15 and experiential learning activities
36-37	Engineering Materials (polymers)	Intro to polymers, classification of polymers, types of	TB- CH 13 and experiential

		polymerization, molecular weight of polymers. To collect and study various polymeric products in campus in regards to composition and some important properties	learning activities
38-39	Engineering Materials (polymers)	Polymers (both bio and synthetic) for 3D printing and biopolymers for adhesives and binders	Classroom, lab visit and experiential learning activities
40	Nano science	Introduction to nanoscience and identifying common nanomaterials and products in campus	TB- CH 14 and experiential learning activities
41-42	Nanoscience	Development of core-shell nano rubber modified epoxy for defence and aerospace applications	Classroom and lab visit and experiential learning activities

4. Evaluation Scheme:

Component	Duration	Weightage	Date & Time	Nature of Component
Midterm	90 mins	20%	31/10 9.00 - 10.30AM	Open Book
Continual Evaluation*	NA	45%		Open Book
Comprehensive Exam.	3 hours	35 %	17/12 FN	Open book

*Continual evaluation will involve brainstorming and interacting in class, hands-on experimental and modeling or numerical work as part of problem solving assignments followed by video presentations and discussions and lab visits. Each student will work on a minimum of 2 short hands-on activities and 1 group project for the semester. For a fair continual evaluation, attending classes and interacting in class and conducting activities is imperative.

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