Course Handout (2021-22 EVEN SEMESTER)

Subject Name/Code : ENGINEERING CHEMISTRY(BTBS-T-BS-002) Branch/Sem/Batch :

Name of Faculty : Manoranjan Behera , Siba Sankar Nayak , Gitisudha Giri

Scope & Objective -:

The purpose of this course is to emphasize the relevance of fundamentals andapplications of chemical sciences in the field of engineering. The course attemptsto address the principles of general chemistry and specific topics relevant tovarious engineering disciplines, so that the students can apply the knowledge intheir respective areas of expertise

Pre-Requisite -:

Detailed Syllabus:

Module#	CO	Topics	Hours
Module-1	CO-1	Water Treatments: Types of hardness-Units, Alkalinity of water and itssignificance, Softening methods and Numerical problems based on thesemethods; Membrane-based processes; Dissolved Oxygen, Problems withBoiler feed water and its treatments.	10
Module-2	CO-2	Corrosion Science: Definition and scope of corrosion, Dry and wetcorrosion; Direct chemical corrosion, Electrochemical corrosion and itsmechanisms; Types of electrochemical corrosion, (differential aeration,galvanic, concentration cell); Typical Electrochemical corrosion like Pitting,Inter-granular, Soil, Waterline; Factors affecting corrosion, Protection ofcorrosion.	7
Module-3	CO-3	nstrumental Techniques: Fundamentals of Spectroscopy; Principlesand applications of molecular spectroscopy (such as UV-visible, IR andmicrowave).	8
Module-4	CO-4	Energy Sciences: Types of fuels, Calorific value, Determination of Calorificvalue, Combustion and its calculations, Solid fuel: Coal analysis (Proximateand ultimate analysis), Elementary ideas on some gaseous fuels (Naturalgas, Water gas, Producer gas, LPG) (Synthesis is excluded), Liquid fuels:IC engine fuel, concept of knocking, antiknocking, octane No and cetaneNo, Fractional Distillation of petroleum, Cracking of heavy oils; Batterytechnology – Fundamentals of primary & Secondary cells, Rechargeablebatteries: Lead acid storage battery, Lithium ion battery, Fuel cells: principles,applications. Elementary idea on Photovoltaics.	10
Module-5	CO-5	Nanochemistry: Nanomaterials, Classification of nanomaterials, Synthesisof noble metal nanoparticles (e.g., Gold /silver) and oxide basednanoparticles (e.g., cuprous oxide/zinc oxide) using green synthetic route,Stabilization of nanoparticles using capping agents, Elementary ideas oncharacterization of nanoparticles (X-ray Diffraction (XRD) and electronicspectroscopy), applications of nanomaterials	7
		Total	42 Hours

#	Topic	Module	Chapter	Course Coverage	No of Classes
1	Prerequsite: Basic knowledge on Normality, Molarity, mole concept, types of chemical reactions; Elementary idea on electrochemistry.	Module-1		TRUE	1
2	Water treatment: Types of hardness, various units, advantages & disadvantages of hardwater	1		TRUE	1

3	Numerical on hardness	1		TRUE	1
4	Alkalinity of water and its significance	1		TRUE	1
5	Softening methods - lime & soda process	1		TRUE	1
6	Numerical problems based on 'Lime & soda' methods	Module-1		TRUE	1
7	Membrane-based processes-Method1	Module-1		TRUE	1
8	Membrane process-Method2	Module-1		TRUE	1
9	Numrical based on membrane process.	1		TRUE	1
10	Problems due to hardness of water & its treatment	1		TRUE	1
11	Corrosion Science: Definition and scope of corrosion, dry&wet corrosion	Module-2		TRUE	1
12	Chemical corrosion	2		TRUE	1
13	Electrochemical corrosion and its mechanisms	Module-2		TRUE	1
14	Types of electrochemical corrosion (differential aeration, galvanic, concentration cell)	Module-2		TRUE	1
15	Typical Electrochemical corrosion like Waterline	Module-2		TRUE	1
16	Factors affecting corrosion	Module-2		TRUE	1
17	Protection of corrosion	Module-2		TRUE	1
18	Question discussion of mid-semester examination.			FALSE	1
19	Instrumental Techniques: Fundamentals of Spectroscopy; Principles and applications of UV-visible spectroscopy	3		TRUE	1
20	Numerical based on UV- visible spectroscopy	3		TRUE	1
21	IR spectroscopy: Principle, concept of Vibrational energy	3		TRUE	1
22	Problems on energy ,Applications of IR spectroscopy	3		TRUE	1
23	Numerical based on IR spectroscopy	3		TRUE	1
24	Microwave spectroscopy- its principle, concept of rotational energy	3		TRUE	1
25	energy calculation, Applications of Microwave spectroscopy	3		TRUE	1
26	Numerical based on Microwave spectroscopy	3		TRUE	1
27	Energy Sciences: Types of fuels, Calorific value, Determination of Calorific value	4		TRUE	1
28	Combustion and its calculations	4		TRUE	1
29	Solid fuel: Coal analysis - Proximate analysis	4		TRUE	1
30	Ultimate analysis of coal	4		TRUE	1
31	Elementary ideas on some gaseous fuels (Natural gas, Water gas, Producer gas, LPG) (Synthesis is excluded)	4		TRUE	1
32	Liquid fules: IC engine fuel, concept of knocking and antiknocking	4		TRUE	1
33	Octane Number and Cetane number	4		TRUE	1
34	Fractional Distillation of petroleum	4		TRUE	1
35	Cracking of heavy oils	4		TRUE	1
36	Battery technology – Fundamentals of primary & Secondary cells Rechargeable batteries: Lead acid storage battery	4		TRUE	1
37	Lithium ion battery, Fuel cells: principles, applications, elementary idea on photovoltaic cell.	4		TRUE	1
38	Nanochemistry: Nanomaterials, Synthesis of noble metal nanoparticles (e.g., Gold /silver) using green synthetic route	5		TRUE	1
39	Synthesis of oxide based nanoparticles (e.g., cuprous oxide/zinc oxide) using green synthetic route	5		TRUE	1

40	Stabilization of nanoparticles using capping agents	5		TRUE	1
41	Elementary ideas on characterization of nanoparticles -X-ray Diffraction (XRD),Scanning Electron Microscopy (SEM)	5		TRUE	1
42	Electronic spectroscopy, Applications of nanomaterials.	5		TRUE	1
43	Discussion of important questions for end semestar examination.			FALSE	1

Total no. of classes : 43

Text Book

Jain & Jain,Engineering Chemistry, 16thEdition, Dhanpat Rai Publishing Company, 2015, ., .
Wiley-India Editorial Team,Engineering Chemistry, 2ndEdition, Wiley India, 2011., ., .
C. N. Banwell,Fundamentals of Molecular Spectroscopy, 4thEdition, McGraw Hill Education, 2017, ., .

Reference Book

S. S. Dara,Engineering Chemistry, 12thEdition, S. Chand Publisher, 2014, ., .
G. A. Ozin & A. C Arsenault,Nanochemistry - A Chemical Approach to Nanomaterials, 2ndEdition,RSC Publishing, 2008., ., .
J. M. Lehn, L. Cademartiri,Concepts of Nanochemistry, 1stEdition, Wiley-VCH, 2009., ., .
Y. R. Sharma,Elementary Organic Spectroscopy, S Chand & Co Ltd., 2013, ., .

Online Reference Material(s):

https://chem.libretexts.org/Core/AnalyticalChemistry/Electrochemistry/Exemplars/Corrosion/CorrosionBasics
https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/spectrpy/infrared/infrared.htm
http://nptel.ac.in/courses/103105110/ - Fuel & Combustion
http://nptel.ac.in/courses/105104102/hardness.htm
http://nptel.ac.in/courses/105106112/1introduction/5corrosion.pdf
https://alison.com - Spectroscopic Technique, Colorimetry

Course Outcome:

CO-1	Exploit the concept of hardness in softening hard water and determining the hardness ofwater.
CO-2	Utilize the knowledge of electrochemistry and corrosion science in preventing engineeringequipments from corrosion.
CO-3	Apply the concept of molecular spectroscopy to analyze organic compounds usingspectrophotometer.
CO-4	Classify various fuels based on combustion parameters and understand the working principleof various batteries
CO-5	Acquire knowledge on synthesis & characterization of oxide based & noble metal nanoparticlesthrough green synthetic route.

Program Outcomes Relevent to the Course:

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping of CO's to PO's: (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO-1	2	2	1	1	1	2	1	1
CO-2	3	2	1	1	1	2	1	
CO-3	2	2	1	1	2	2	1	1
CO-4	2	2	1	1	1	1	1	
CO-5	2	2	1	1	2	2	1	1