BMS COLLEGE OF ENGINEERING, BANGALORE-560 019
Department of Chemistry
BATCH 2018-19 Onwards

Course Title: **ENGINEERING CHEMISTRY**	**Course Code**: 18CY1BSCHY/18CY2BSCHY	**Credits**: 05
L:T:P: 4:0:1	**Contact Hours**: 48	**Hours/Week**: 06

Course Objectives:
To impart the knowledge of Chemistry involved in water treatment, electrochemistry, corrosion and its control, conventional energy sources, electrochemical and renewable sources of energy, polymers, nanomaterials and instrumental methods of analysis.

Course Content:

UNIT-I

Water Treatment: Introduction, hardness of water, types, determination of hardness by EDTA method, disadvantages of hard water - boiler scales - formation, disadvantages and prevention, removal of hardness by ion exchange method, Desalination of water - reverse osmosis, forward osmosis and electro dialysis. Dissolved oxygen, BOD and COD - introduction and their significance in waste water treatment, experimental determination of COD of waste water, treatment of waste water - aerobic and anaerobic oxidation, primary, secondary and tertiary treatment methods, numerical problems on hardness & COD. Applications of NTO and Ag NP in waste water treatment. 09hrs

UNIT-II

Electrochemistry and Corrosion:

Electrodes and cells – Introduction, classification of cells-primary, secondary and concentration cells, reference electrodes–calomel electrode and Ag/AgCl electrode, ion-selective electrode - glass electrode, determination of pH using glass electrode, determination of pKa of weak acids, numerical problems on concentration cells and pH determination.

Corrosion – Definition of chemical corrosion, electrochemical theory of corrosion, types of corrosion - differential metal, differential aeration (pitting and water line corrosion) and stress corrosion, factors affecting the rate of corrosion, corrosion control: inorganic coatings – anodizing and phosphating, metal coatings - galvanization, tinning and electroplating of chromium, cathodic protection. 10hrs

UNIT-III

Energy: Sources, Conversion and Storage:

Chemical fuels - Introduction, calorific value - definition, gross and net calorific values, determination of calorific value of a solid / liquid fuel using Bomb calorimeter and problems on calorific value, petroleum cracking - fluidized bed catalytic cracking, Octane number, reformation of petrol, synthetic petrol – Fischer-Tropsch's process, power alcohol, biodiesel and hydrogen as a fuel – advantages, production and storage.

Photovoltaic cells – Production of solar grade silicon, physical and chemical properties of silicon relevant to photovoltaics, doping of silicon, construction and working of a PV cell and advantages.

Batteries - Basic concepts, classification of batteries – primary and secondary batteries, battery characteristics, modern batteries - construction, working and applications of zinc–air, nickel-metal hydride and Li-ion batteries (one example).

Fuel cells - Introduction, construction and working of methanol-oxygen fuel cell with acid electrolyte. 11hrs

UNIT-IV

Polymer Chemistry:

Polymers - Introduction, mechanism of coordination polymerization (Ziegler - Natta polymerization), methods of polymerization – bulk, solution, suspension and emulsion

polymerization, number average and weight average molecular weight, numerical problems, glass transition temperature, structure and property relationship of polymers. **Plastics** - Definition of resins and plastics, synthesis, properties and applications of PMMA and UF resin. **Elastomers** – Synthesis, properties and application of butyl rubber and nitrile rubber. **Polymer composites** – Composites as structural material, fiber glass, Kevlar, Carbon based composites. **Conducting polymers** - Introduction, synthesis of polyaniline and mechanism of conduction in it and uses. **Biodegradable polymers**- Introduction, polyglycolic acid-synthesis, degradation and uses. 9hrs

UNIT-V

Nanomaterials and Instrumental methods of analysis :

Nanomaterials: Introduction, size dependent properties (Surface area, Electrical, Optical, Catalytic and Thermal properties). Synthesis of nanomaterials: Top down and bottom up approaches, Synthesis by solgel, hydrothermal and chemical vapour deposition methods. Nanoscale materials: Carbon nanotubes and graphene – properties and applications.

Instrumental methods of analysis: Principle, instrumentation and applications of Colorimetry, Flame Photometry, Potentiometry and Conductometry (mixture of strong acid and a weak acid with a strong base). 9hrs

LIST OF EXPERIMENTS

No.	Name of the experiment	Skills / Learning ability
1.	Determination of percentage of copper in brass using standard sodium thiosulphate solution (brass solution to be prepared by weighing brass-making up method).	Alloy composition
2.	Determination of total hardness of a sample of water using disodium salt of EDTA.	Estimation hardness of water
3.	Determination of chemical oxygen demand (COD) of the given industrial waste water sample.	Estimation of Pollutant level in industrial waste water
4.	Determination of pKa of a weak acid using pH meter.	Determination of strength of weak acid
5.	Potentiometric estimation of FAS using standard $K_2Cr_2O_7$ solution.	Application of different electrodes
6.	Determination of percentage of iron in the given rust solution (using potassium dichromate) by external indicator method.	Corrosion product analysis
7.	Determination of calorific value of a solid fuel using Bomb calorimeter.	Fuel characteristics
8.	Synthesis of polyaniline and its conductivity measurement	Synthesis of conducting polyaniline
9.	Estimation of copper by colorimetric method.	Absorption spectroscopy
10.	Conductometric estimation of HCl + CH_3COOH using standard sodium hydroxide solution	Analysis of acid mixture
11.	Estimation of sodium in water by flame photometric method	Emission spectroscopy

Text Books:

1. A Text book of Engineering Chemistry - by P. C. Jain and Monica Jain, Dhanapatrai Publications, New Delhi, 2011, 16th Edition, 1404 pages.
2. Engineering Chemistry - by Chandra Shekara B M and Basavaraju B C, Banbayalu (publications), Bengaluru, 2014, 294 pages.

Reference Books:

3. Wiley's Engineering Chemistry (Wiley India), 2nd Edition, 2013, 1026 pages.
4. Engineering Chemistry: Fundamentals and Applications - by Shikha Agarwal, Cambridge University Press, New Delhi, 2016, 1179 pages.

e-books:

5. Electrochemistry basics by LibreTexts of UCDavis:

https://chem.libretexts.org/LibreTexts/University_of_California_Davis/UCD_Chem_002C/UCD_Chem_2C%3A_Larsen/Chapters/Unit_1%3A_Electrochemistry

6. Introduction to Chemistry - Tracy Poulsen; 250 pages; ISBN-13: 9781478298601; ISBN-10: 147829860X.

NPTEL/SWAYAM/MOOCs:

7. **http://nptel.ac.in/**
8. **https://swayam.gov.in/**

Reference Book: (Laboratory)

9. Engineering Chemistry Lab Manual, written by faculty, Dept. of Chemistry, BMSCE, Bangalore.

Course outcomes: On completion of the course, the student will have the ability to:	
CO 1	Understand and explain the principles of chemistry involved in water treatment, electrochemistry, corrosion and its control, conventional energy sources, electrochemical and renewable sources of energy, polymers, nanomaterials and instrumental methods of analysis.
CO 2	Apply the acquired knowledge to solve the Engineering Chemistry problems.
CO 3	Analyse the Engineering Chemistry problems and draw meaningful inferences
CO4	Conduct, analyse and interpret the data and results from Engineering Chemistry experiments.

Scheme of Evaluation:

Component	**Type of assessment**	**Max. Marks**	**Weightage**	**Total**	**Total Marks**
CIE - Theory	Quiz	20	5	25*	50 (CIE)
	Test 1	40	10		
	Test 2	40	10		
CIE - Lab	Class Performance as per manual & record	10+10	10	25*	
	Lab Test	50	15		
SEE	End Exam	100	50		50 (SEE)
Grand Total Marks					**100**
*** minimum CIE marks (Theory as well as Lab) ≥ 10.0 to gain eligibility to write the SEE**					