

**ENGINEERING CHEMISTRY**

[As per Choice Based Credit System (CBCS) scheme]  
(Effective from the academic year 2017 -2018)

SEMESTER - I/II

Subject Code	17CHE12/17CHE22	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS - 04

**Course objectives:**

To provide students with knowledge of engineering chemistry for building technical competence in industries, research and development in the following fields

- Electrochemistry & Battery Technology.
- Corrosion & Metal Finishing.
- Fuels & Solar energy.
- Polymers.
- Water Technology & Nano Materials.

**Module - 1****Teaching Hours****Electrochemistry and Battery Technology****10 hours**

**Electrochemistry:** Introduction, Derivation of Nernst equation for electrode potential. Reference electrodes: Introduction, construction, working and applications of calomel and Ag / AgCl electrodes. Measurement of electrode potential using calomel electrode. Ion selective electrode: Introduction; Construction and working of glass electrode, determination of pH using glass electrode. Concentration cells: Electrolyte concentration cells, numerical problems.

**Battery Technology:** Introduction, classification - primary, secondary and reserve batteries. Characteristics - cell potential, current, capacity, electricity storage density, energy efficiency, cycle

<p>life and shelf life. Construction, working and applications of Zinc-Air, Nickel- metal hydride batteries. Lithium batteries: Introduction, construction, working and applications of Li-MnO<sub>2</sub> and Li-ion batteries.</p> <p><b>Fuel Cells:</b> Introduction, difference between conventional cell and fuel cell, limitations &amp; advantages. Construction, working &amp; applications of methanol-oxygen fuel cell with H<sub>2</sub>SO<sub>4</sub> electrolyte.</p>	
<p><b>Module -2</b></p>	
<p><b>Corrosion and Metal Finishing:</b></p> <p><b>Corrosion:</b> Introduction, electrochemical theory of corrosion, galvanic series. Factors affecting the rate of corrosion: ratio of anodic to cathodic areas, nature of metal, nature of corrosion product, nature of medium – pH, conductivity, and temperature. Types of corrosion- Differential metal, differential aeration (Pitting and water line) and stress. Corrosion control: Inorganic coatings-Anodizing of Al and phosphating; Metal coatings-Galvanization and Tinning. Cathodic protection (sacrificial anodic and impressed current methods).</p> <p><b>Metal Finishing:</b> Introduction, Technological importance. Electroplating: Introduction, principles governing-Polarization, decomposition potential and overvoltage. Factors influencing the nature of electro deposit-current density, concentration of metal ion &amp; electrolyte; pH, temperature &amp; throwing power of plating bath; additives- brighteners, levellers, structure modifiers &amp; wetting agents. Electroplating of Nickel (Watt's Bath) and Chromium(decorative and hard). Electro less plating: Introduction, distinction between electroplating and electro less plating, electro less plating of copper &amp; manufacture of double sided Printed Circuit Board with copper.</p>	<p><b>10hours</b></p>
<p><b>Module - 3</b></p>	

<p><b>Fuels and Solar Energy:</b></p> <p><b>Fuels:</b> Introduction, classification, calorific value- gross and net calorific values, determination of calorific value of fuel using bomb calorimeter, numerical problems. Cracking: Introduction, fluidized catalytic cracking, synthesis of petrol by Fishcher-Tropsch process, reformation of petrol, octane and cetane numbers. Gasoline and diesel knocking and their mechanism, anti knocking agents, power alcohol &amp; biodiesel.</p> <p><b>Solar Energy:</b> Introduction, utilization and conversion, photovoltaic cells- construction and working. Design of PV cells: modules, panels &amp; arrays. Advantages &amp; disadvantages of PV cells. Production of solar grade silicon: Union carbide process, purification of silicon (zone refining), doping of silicon-diffusion technique (n&amp;p types).</p>	<p><b>10 hours</b></p>
<p><b>Module - 4</b></p>	
<p><b>Polymers:</b></p> <p>Introduction, types of polymerization: addition and condensation, mechanism of polymerization- free radical mechanism taking vinyl chloride as an example. Molecular weight of polymers: number average and weight average, numerical problems. Glass transition temperature (<math>T_g</math>): Factors influencing <math>T_g</math>-Flexibility, inter molecular forces, molecular mass, branching &amp; cross linking and stereo regularity. Significance of <math>T_g</math>. Structure property relationship: crystallinity, tensile strength, elasticity &amp; chemical resistivity. Synthesis, properties and applications of PMMA (plexi glass), Polyurethane and polycarbonate. Elastomers: Introduction, synthesis, properties and applications of Silicone rubber. Adhesives: Introduction, synthesis, properties and applications of epoxy resin. Polymer Composites: Introduction, synthesis, properties and applications of Kevlar. Conducting polymers: Introduction, mechanism of conduction in Poly aniline and applications of conducting poly aniline.</p>	<p><b>10 hours</b></p>

<b>Module-5</b>	
<p><b>Water Technology and Nanomaterials:</b></p> <p><b>Water Technology:</b> Introduction, boiler troubles with disadvantages &amp; prevention methods-scale and sludge formation, priming and foaming, boiler corrosion(due to dissolved O<sub>2</sub>, CO<sub>2</sub> and MgCl<sub>2</sub>). Determination of DO, BOD and COD, numerical problems on COD. Sewage treatment: Primary, secondary (activated sludge method) and tertiary methods. Softening of water by ion exchange process. Desalination of sea water by reverse osmosis &amp; electro dialysis (ion selective)..</p> <p><b>Nano Materials:</b> Introduction, properties (size dependent). Synthesis-bottom up approach (sol-gel, precipitation, gas condensation &amp; chemical vapour condensation processes). Nano scale materials- carbon nano tubes, nano wires, fullerenes, dendrimers, nano rods, &amp; nano composites.</p>	<b>10 hours</b>
<p><b>Course outcomes:</b></p> <p>On completion of this course, students will have knowledge in:</p> <ul style="list-style-type: none"> <li>• Electrochemical and concentration cells. Classical &amp; modern batteries and fuel cells.</li> <li>• Causes &amp; effects of corrosion of metals and control of corrosion. Modification of surface properties of metals to develop resistance to corrosion, wear, tear, impact etc. by electroplating and electro less plating.</li> <li>• Production &amp; consumption of energy for industrialization of country and living standards of people. Utilization of solar energy for different useful forms of energy.</li> <li>• Replacement of conventional materials by polymers for various applications.</li> <li>• Boiler troubles; sewage treatment and desalination of sea water, and</li> <li>• Over viewing of synthesis, properties and applications of nanomaterials.</li> </ul>	

**Question paper pattern:**

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be **2** full questions(with a **maximum** of **four** sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer **5** full questions, selecting one full question from each module.

**Text Books:**

1. B.S.Jai Prakash, R.Venugopal, Sivakumaraiah & Pushpa Iyengar., **“Chemistry for Engineering Students”**, Subhash Publications, Bangalore.
2. R.V.Gadag & A.Nityananda Shetty., **“Engineering Chemistry”**, I K International Publishing House Private Ltd. New Delhi.
3. P.C.Jain & Monica Jain.,**“Engineering Chemistry”**, Dhanpat Rai Publications, New Delhi.

**Reference Books:**

1. O.G.Palanna,**“Engineering Chemistry”**,Tata McGraw Hill Education Pvt. Ltd. New Delhi, Fourth Reprint.
2. G.A.Ozin & A.C. Arsenault, **“Nanochemistry A Chemical Approach to Nanomaterials”**, RSC publishing, 2005.
3. **“Wiley Engineering Chemistry”**, Wiley India Pvt. Ltd. New Delhi. Second Edition.
4. V.R.Gowariker, N.V.Viswanathan & J.Sreedhar., **“Polymer Science”**, Wiley-Eastern Ltd.
5. M.G.Fontana., **“Corrosion Engineering”**, Tata McGraw Hill Publishing Pvt. Ltd. New Delhi.