

# **ENGINEERING CHEMISTRY**

## **SYLLABUS FOR THE YEAR 2009– 2010**

**Sub Code: 09CY1ICCHY / 09CY2ICCHY**

**L-T-P: 4-0-1**

**Credits : 05**

**Hours / Week: 06**

Learning Objectives: The students will learn the following:

The three main issues while dealing with energy problems:

i) The need to restrict increase in energy consumption ii) The need to evolve alternative energy sources as a substitute to conventional energy sources. iii) The evolution of how far these new energy sources can serve as replacement for conventional energy sources.

The process involved in the interconversion of electrical energy and chemical energy.

The idea of deterioration of metal / alloy due to electrochemical interaction of metal / alloy with its environment, ill effects of corrosion, types and corrosion control by various methods.

Information about better things for better living - through polymers.

The instrumental methods of analysis are now being extensively used for the qualitative analysis and identification of organic compounds.

Learning Outcomes: After the completion of the course, students will have acquired:

Pros and cons of using fossil fuels as energy sources, development of alternative sources of energy like synthetic petrol, power alcohol, biodiesel, solar cells, etc.

Better understanding of electro chemistry, different types of batteries, fuel cells and their applications in transportation, in the defense sector, for communication systems, radio sector, emergency signals, detonators, submarines and space crafts, utility items like flash lights, wrist-watches, tape recorders, photo flash devises, hearing aids, pace makers, etc.

Technological information about corrosion, corrosion control by galvanization, tinning, electroplating methods and electroless plating in developing printed circuit boards.

Synthesis of polymers like plastics, rubbers, fibers, adhesives, composites and conducting polymers which find immense applications in engineering field.

Foundation needed to understand the principles of various spectroscopic and analytical technics like conductometry, colorimetry, potentiometry, flame- photometry, thin layer chromatography and their applications.

## Unit – I : Chemical Energy Sources

**Fuels** - Definition, classification, 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, reformation of petrol, octane number, cetane number, knocking – mechanism, prevention of knocking, anti-knocking agents, unleaded petrol, synthetic petrol – Fischer-Tropsch's process, power alcohol and biodiesel.

**Solar Energy** – introduction, photovoltaic cell-definition, importance, working of a PVcell, solar grade silicon, physical and chemical properties of silicon relevant to photovoltaics, production of solar grade (crystalline) silicon, doping of silicon.

11 hours

## Unit – II: Electrochemical Energy Systems

**Electrode potential and cells** - single electrode potential - definition, origin, sign conventions, derivation of Nernst equation, standard electrode potential -definition. classification - primary, secondary and concentration cells, reference electrodes – calomel electrode, numerical problems on electrode potential and cell potential, ion-selective electrode- glass electrode, determination of pH using glass electrode.

**Batteries** - basic concepts, battery characteristics, classification of batteries– primary, secondary and reserve batteries, classical batteries – construction, working and applications of lead –acid battery and nickel–cadmium battery, modern batteries - construction, working and applications of zinc–air, nickel-metal hydride and Li-MnO<sub>2</sub> batteries.

**Fuel cells** - introduction, types of fuel cells - alkaline, phosphoric acid, molten carbonate, solid polymer electrolyte and solid oxide fuel cells, construction and working of H<sub>2</sub>-O<sub>2</sub> and Methanol-Oxygen fuel cell.

10 hours

## Unit – III: Corrosion Science and Metal Finishing

**Corrosion** – Definition of chemical corrosion, electrochemical theory of corrosion, types of corrosion - differential aeration corrosion (pitting and water line corrosion), Differential metal corrosion stress corrosion, factor affecting the rate of corrosion.

**Corrosion control:** inorganic coatings – anodizing and phosphating, metal coatings – galvanization and tinning, corrosion inhibitors, cathodic protection.

**Metal finishing** - technological importance of metal finishing, significance of polarization, decomposition potential and over-voltage in electroplating processes.

**Electroplating** – process, effect of plating variables on the nature of electro-deposit, surface preparation, electroplating of Cr and Au.

**Electroless plating** - distinction between electroplating and electroless plating, advantages of electroless plating, electroless plating of copper on PCB and Nickel.

11 hours

## Unit-IV : High Polymers

**Polymers** - Definition, classification, types of polymerization - addition and condensation with examples, mechanism of polymerization - free radical mechanism (ethylene as an example), methods of polymerization – bulk and solution polymerization, suspension and emulsion polymerization, glass transition temperature, structure and property relationship of polymers, compounding of resins.

**Plastics**- synthesis, properties and applications of teflon, PMMA and phenol – formaldehyde resin.

**Elastomers** -synthesis and application of neoprene and butyl rubber.

**Adhesives** - preparation and applications of epoxy resins.

Polymer composites.

**Conducting polymers** – definition and applications of conducting polymers. Synthesis, structure and mechanism of conduction and uses of polyacetylene and Polyaniline.

11 hours

## Unit-V : Elements of Spectroscopy and Chromatography

Electromagnetic Spectrum- Energy, Wavelength, frequency and their relationships and corresponding spectral techniques. Emission Spectra, Absorption Spectra, Molecular Spectra, Vibration Spectra, Electronic band Spectra, Problems. NMR-overview, Flame Photometry and atomic Spectra-their meaning and their applications with reference to water analysis. Chromatography-Introduction to Chromatography. Details of thin layer Chromatography.

09 Hours

### Text Books

1. A Text book of Engineering Chemistry – by Jain and Jain, Dhanapatrai Publications, New Delhi.
2. Engineering Chemistry by Dr. S Satyanarayana and H C Shashidhara
3. Engineering Chemistry by Gadag and Nityananda Shetty
4. Engineering Chemistry by Jai Prakash and others.

### Reference Books

1. Principles of Physical Chemistry B.R. Puri, L.R.Sharma and M.S Pathania, S.Nagin
2. Text book of Polymer Science by F.W.Billmeyer, John Wiley and Sons 1994. Horwood series in Physical Chemistry, New York. (P. No. 106 – 142)
3. Corrosion Engineering – by M G Fontana, Mc Graw Hill Publications.
4. Advanced Chemistry by Philip Mathews
5. Text book of polymer Science by Gowrikar
6. Elements of Spectroscopy by William Kemp
7. Instrumental methods of analysis by Skoog and West
8. Instrumental methods of analysis by Chatwal and Anand
9. Chemistry for Engineers – Vol I & II by Kuriacose and Rajaram

## 10. Introduction to Molecular Spectroscopy by Banwell

## **ENGINEERING CHEMISTRY LABORATORY**

**SYLLABUS for the year 2012-2013**

### **LIST OF EXPERIMENTS**

#### **PART – A**

1. Determination of total hardness of a sample of water using disodium salt of EDTA.
2. Determination of percentage of copper in brass using standard sodium thiosulphate solution.
3. Determination of iron in the given sample of haematite ore solution (using potassium dichromate) by external indicator method.
4. Determination of chemical oxygen demand (COD) of the given industrial waste water sample.

#### **PART – B**

1. Potentiometric estimation of FAS using standard  $K_2Cr_2O_7$  solution.
2. Colorimetric determination of copper.
3. Colorimetric determination of iron.
4. Conductometric estimation of HCl using standard NaOH solution.
5. Determination of  $R_f$  value of a compound by thin-layer chromatography
6. Determination of pka of a weak acid using pH meter.
7. Determination of viscosity coefficient of a given liquid using Ostwald's viscometer.



# TECHNICAL CHEMISTRY

## SYLLABUS FOR THE YEAR 2009 – 2015

**Sub Code: 09CY3DCCEM**

**L-T-P: 4-0-1**

**Credits : 05**

**Hours / Week: 06**

### Unit – I : REACTION MECHANISMS-I

Bond cleavage- homolytic and heterolytic bond cleavage; concept of reactive intermediates- carbocations, carbanions and free radicals. Formation, Structure and Stability of Reactive Intermediates with suitable examples. Electron displacements in molecules -Inductive effect  
Resonance effect , conjugation effect Hyperconjugation effect and electromeric effect with examples.  
Nucleophilic aliphatic substitution reactions. – 1Hr - SN1 reactions- Mechanism, kinetics, stereochemistry of the products with suitable examples, SN2 Reaction- Mechanism, kinetics, stereochemistry of the product- Walden Inversion evidences in favour. Factors affecting SN1 and SN2 reactions.

**8hrs**

### UNIT-II - REACTION MECHANISMS-II

Elimination reactions-Dehydrohalogenation. E1 and E2 mechanisms. Discussion of mechanism, Kinetics and geometry of the product. Factors favouring E reactions versus substitution reaction. Electrophilic addition reactions.  
Electrophilic aromatic substitution reactions. (Benzene): Mechanism of Nitration & sulphonation Halogenation and Friedel -Crafts alkylation and acylation reactions.  
Orientation influence of the substituent in the benzene ring on further substitution.

**8hrs**

### UNIT- III

#### ACTIVE METHYLENE COMPOUNDS AND ORGANOMETALLICS

Definition of active methylene group and compounds with example.  
**Malonic ester** :Preparation and properties synthetic application, Synthesis of mono carboxylic acids-butyrac acids ,dicarboxylic acids unsaturated acids, crotonic ,cinnamic acid, ketonic acid-acetoacetic acid, heterocyclic compounds.  
**Acetoacetic ester**: Ketoenol tautomerism Ketonic and acid hydrolysis Preparation and properties, basis for synthetic application synthesis of mono and dialkylderivatives, monocarboxylic acid –propionic acid, dicarboxylic Acid –succinic acid unsaturated acids crotonic acid, Cinnamic heterocyclic compounds  
**Organometallic Compounds**: Definition and examples. Grignard reagent, preparation synthetic application, synthesis of alkane, aldehydes , ketones alcohols (Primary, Secondary Tertiary)

**8hrs**

## UNIT-IV

**INSECTICIDES:** Introduction, classification into contact, stomach, systematic and fumigant. Insecticides explanation with example Organochlorine insecticides – DDT and BHC Cyclopentadienes - Aldrin and Dieldrin – Organophosphates malathion

**DYES:** Classification of dyes by structure and by method of application colour and constitution-chromophore, auxochrome theory, Modern theory of colour, Synthesis of azo dyes, congo red. Synthesis of triaryl methane dyes- alizarin. Synthesis of vat dye, indigo

**8hrs**

## UNIT V

**OILS AND FATS:** Introduction as triglycerides, properties and uses, vegetable oils examples analysis of oil- Acid value, saponification value and iodine value- their determination

**SOAPS AND DETERGENTS:** soaps definition, types manufacture of soap, Detergents definition, various constituents of a detergent, Surfactants-anionic, cationic, zwitterionic and non ionic, builders, Sud regulators, softeners and other additives, Cleansing action of detergent, advantages of detergents over soaps

**8hrs**

### Text Books & Reference Books

1. A Text book of Technical Chemistry – by BAHL & BAHL.
2. Technical Chemistry - by IL Finar
3. Technical Chemistry – by Pearson
4. Technical Chemistry – by Clayden, Greeves & Wareen



**BMS College of Engineering, Bengaluru-560 019  
(An Autonomous Institution under VTU)**

**Title: Technical Chemistry Laboratory**

**Title: 09CY3DCCEM**

**LIST OF EXPERIMENTS**

- 1. Nitration of nitrobenzene to m - dinitrobenzene**
- 2. Acetylation of aniline by acetic anhydride**
- 3. Preparation of benzoic acid from benzaldehyde**
- 4. Bromination of acetanilide to p - bromoacetanilide**
- 5. Diazotization of aniline and coupling with phenol**
- 6. Estimation of alcohol by acetylation**
- 7. Estimation of amino group by acetylation**
- 8. Estimation of phenol by bromination**
- 9. Estimation of esters by hydrolysis**
- 10. Estimation of carboxylic acid by iodometri titration**
- 11. Reduction of o-nitro aniline to o- phenylene diamine**