ENGINEERING CHEMISTRY LABORATORY

[As per Choice Based Credit System (CBCS) scheme]

(Effective from the academic year 2017 -2018)

SEMESTER - I/II

Laboratory Code	17CHEL17/17CHEL27	IA Marks	40
Number of Lecture Hours/Week	3 (1 hr Tutorial +2 hrs lab)	Exam Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS - 02

Course objectives:

- To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.

Instrumental Experiments

1. Estimation of FAS potentiometrically using standard $K_2Cr_2O_7$ solution.
2. Estimation of Copper colorimetrically.
3. Estimation of Acids in acid mixture conductometrically.
4. Determination of pKa of weak acid using pH meter.
5. Determination of Viscosity co-efficient of the given liquid using Ostwald's viscometer.
6. Estimation of Sodium and Potassium in the given sample of water using Flame Photometer.

Volumetric Experiments

1. Estimation of Total hardness of water by EDTA complexometric method.
2. Estimation of CaO in cement solution by rapid EDTA method.
3. Determination of percentage of Copper in brass using standard sodium thiosulphate solution.
4. Estimation of Iron in haematite ore solution using standard $K_2Cr_2O_7$ solution by External Indicator method.
5. Estimation of Alkalinity (OH^-, CO_3^{--} & HCO_3^-) of water using standard HCl solution.
6. Determination of COD of waste water.

Course outcomes:

On completion of this course, students will have the knowledge in,

- Handling different types of instruments for analysis of materials using small quantities of materials involved for quick and accurate results, and
- Carrying out different types of titrations for estimation of concerned in materials using comparatively more quantities of materials involved for good results

Conduction of Practical Examination:

1. All experiments are to be included for practical examination.
2. One instrumental and another volumetric experiments shall be set.
3. Different experiments shall be set under instrumental and a common experiment under volumetric.

Reference Books:

1. G.H.Jeffery, J.Bassett, J.Mendham and R.C.Denney, **"Vogel's Text Book of Quantitative Chemical Analysis"**
2. O.P.Vermani & Narula, **"Theory and Practice in Applied Chemistry"**, New Age International Publisers.
3. Gary D. Christian, **"Analytical chemistry**", 6th Edition, Wiley India.

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 20 Number of Lecture Hours/Week 04 Exam Marks 80 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 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 10 hours life and shelf life. Construction, working and applications of ZincAir, Nickel- metal hydride batteries. Lithium batteries: Introduction, construction, working and applications of Li-MnO_2 and Li-ion batteries. Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell with H_2SO_4 electrolyte.

Module -2 Corrosion and Metal Finishing: Corrosion: 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 coatingsAnodizing of Al and phosphating; Metal coatings-Galvanization and Tinning. Cathodic protection (sacrificial anodic and impressed current methods). Metal Finishing: 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 & electrolyte; pH, temperature & throwing power of plating bath; additives- brighteners, levellers, structure modifiers & 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 & manufacture of double sided Printed Circuit Board with copper. 10hours

Module - 3 Fuels and Solar Energy: Fuels: 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 & biodiesel. Solar Energy: Introduction, utilization and conversion, photovoltaic cells- construction and working. Design of PV cells: modules, panels & arrays. Advantages & disadvantages of PV cells. Production of solar grade silicon: Union carbide process, purification of silicon (zone refining), doping of silicon-diffusion technique (n&p types). 10 hours

Module - 4 Polymers: 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 (Tg): Factors influencing Tg-Flexibility, inter molecular forces, molecular mass, branching & cross linking and stereo regularity. Significance of Tg. Structure property relationship: crystallinity, tensile strength, elasticity & 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. 10 hours

Module-5 Water Technology and Nanomaterials: Water Technology: Introduction, boiler troubles with disadvantages & prevention methods-scale and sludge formation, priming and foaming, boiler corrosion(due to dissolved O_2, CO_2 and $MgCl_2$). 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 & electro dialysis (ion selective).. Nano Materials: Introduction, properties (size dependent). Synthesis- bottom up approach (sol-gel, precipitation, gas condensation & chemical vapour condensation processes). Nano scale materials- carbon nano tubes, nano wires, fullerenes, dendrimers, nano rods, & nano composites. 10 hours

Course outcomes: On completion of this course, students will have knowledge in: • Electrochemical and concentration cells. Classical & modern batteries and fuel cells. • Causes & 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. • Production & consumption of energy for industrialization of country and living standards of people. Utilization of solar energy for different useful forms of energy. • Replacement of conventional materials by polymers for various applications. • Boiler troubles; sewage treatment and desalination of sea water, and • Over viewing of synthesis, properties and applications of nanomaterials.

Question paper pattern: • The question paper will have ten questions. • Each full Question consisting of 16 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.