K. S. INSTITUTE OF TECHNOLOGY, BANGALORE-109

(AFFLIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI)

DEPARTMENT OFCHEMISTRY

ENGINEERING CHEMISTRY

(Common to all branches)

Course Code: 18CHE12/22 **CIE Marks: 40**
Contact Hours/Week: 04 (3L+1T) **SEE Marks: 60**
Total Hours: 50 (8L+2T per module) **Exams. Hours: 03**
Semester: I/II **Credits: 04**

MODULE	RBT Levels	No. of Hrs
MODULE- I: Use of free energy in chemical equilibria, Electrochemical energy systems and Corrosion **Use of free energy in chemical equilibria:** Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potential, the Nernst equation and applications. **Electrochemical energy systems:** Reference electrodes: Introduction, construction, working and applications of calomel and Ag / AgCl electrodes. Ion selective electrode: Introduction; Construction and working of glass electrode, determination of pH using glass electrode. Concentration cells: Electrolyte concentration cells, numerical problems. **Corrosion:** Introduction, electrochemical theory of corrosion, 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 and differential aeration (Pitting and water line). Corrosion control: Metal coatings-Galvanization and Tinning.	**L1, L2**	**10**
MODULE-II: Metal finishing and Water chemistry **Metal finishing**: Introduction, Technological importance. Electroplating: Introduction, principles governing metal finishing-Polarization, decomposition potential and overvoltage. Electroplating of chromium and gold. Electroless plating: Introduction, distinction between electroplating and electro less plating, electroless plating of nickel & copper. **Water Chemistry:** Introduction**,** sources and impurities of water; boiler feed water, boiler troubles with disadvantages -scale and sludge formation, Boiler corrosion (due to dissolved O_2, CO_2 and $MgCl_2$). Chemical analysis of water: Chlorides, Sulphates, Fluorides and Lead. Sewage treatment: Primary and secondary (activated sludge method) methods, Softening of water by ion exchange process. Desalination of sea water by reverse osmosis.	**L1, L2**	**10**

Introduction to heavy water.		
MODULE-III : Energy Systems **Chemical Fuels**: Introduction, classification, determination of calorific value of solid/liquid fuel using bomb calorimeter, numerical problems. Power alcohol, unleaded petrol and biodiesel **Energy storage systems**: Introduction, classification - primary, secondary and reserve batteries. Construction, working and applications of Ni-MH and Li-ion batteries. **Fuel Cells:** Introduction, differences between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell with H_2SO_4 electrolyte, Solid oxide fuel cells (SOFCs). **Solar Energy**: Introduction, utilization and conversion, photovoltaic cells- construction and working. Design of PV cells: modules, panels & arrays. Advantages & disadvantages of PV cells..	**L1, L2**	**10**
MODULE IV: Environmental Pollution and Waste management **Environmental Pollution:** Introduction, The atmosphere, Air pollutants: Sources, effects and control of primary air pollutants: Oxides of sulphur, Oxides of nitrogen and hydrocarbons, Particulate matter, Carbon monoxide, Mercury and Lead. Secondary air Pollutant: Ozone, Ozone depletion, The greenhouse effect, Global warming, Sources of water pollution, Sewage, Introduction to Biological oxygen demand (BOD) and Chemical Oxygen Demand (COD), Numerical problems on BOD and COD. **Waste and management:** Solid Waste Management, E - Waste Management & Biomedical Waste Management -Sources, Characteristics & Disposal methods.	**L1, L2.**	**10**
MODULE-V: Instrumental methods of analysis and Nanomaterials **Instrumental methods of analysis:** Theory, Instrumentation and applications of Colorimetry, Potentiometry, Conductometry (Strong acid with a strong base, weak acid with a strong base, strong acid with a weak base, weak acid with a weak base, mixture of a strong acid and a weak acid vs. a strong base or a weak base, displacement or replacement titrations, precipitation titration and complex formation titration), Flame photometry, Atomic absorption spectroscopy. **Nanomaterials:** Introduction, size dependent properties (Surface area, Electrical, Optical, Catalytic and Thermal properties), Synthesis of nanomaterials: Top down and bottom up approaches, Synthesis by bottom up approach: Sol-gel, precipitation and hydrothermal methods, Nano scale materials: Fullerenes and Carbon nanotubes.	**L1 & L2**	**10**

Course Outcomes: On completion of this course, students will have knowledge in:

1. Use of free energy in equilibria, rationalize bulk properties and processes using thermodynamic considerations, electrochemical energy systems and causes & effects of corrosion of metals and

control of corrosion.
2. Modification of surface properties of metals to develop resistance to corrosion, wear, tear, impact etc. by electroplating and electro less plating and water chemistry.
3. Production & consumption of energy for industrialization of country and living standards of people. Electrochemical and concentration cells. Classical, modern batteries and fuel cells. Utilization of solar energy for different useful forms of energy.
4. Environmental pollution and waste management.
5. Different techniques of instrumental methods of analysis.
6. Fundamental principles of nanomaterials.

Question paper pattern:

Note:- The SEE question paper will be set for 100 marks and the marks scored by the student will be proportionately reduced to 60.

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

Text Books:

1. P.C. Jain & Monica Jain. **"Engineering Chemistry"**, Dhanpat Rai Publications, New Delhi (Latest edition-2015).
2. B.S. Jai Prakash, R. Venugopal, Sivakumaraiah & Pushpa Iyengar, **"Chemistry for Engineering Students"**, Subhash Publications, Bengaluru (Latest edition-2015).
3. P. W. Atkins **, "Physical Chemistry"**, Oxford Publications (Eighth edition-2006).

Reference books:

1. O.G. Palanna,**"Engineering Chemistry"**, Tata McGraw Hill Education Pvt. Ltd. New Delhi, Fourth Reprint (Latest edition-2015).
2. R.V. Gadag & A. Nityananda Shetty., **"Engineering Chemistry"**, I K International Publishing House Private Ltd. New Delhi (Latest edition-2015).
3. **"Wiley Engineering Chemistry"**, Wiley India Pvt. Ltd. New Delhi. Second Edition-2013.
4. M.G. Fontana., **"Corrosion Engineering"**, Tata McGraw Hill Publishing Pvt. Ltd. New Delhi (2006).
5. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane (1980).

Web Links and Video Lectures:

1. http://bcs.whfreeman.com/vollhardtschore5e/default.asp.
2. https://www.youtube.com/watch?v=FnJ0V7B7nKo
3. https://www.youtube.com/watch?v=6_mBFpyruNQ
4. https://www.ttu.ee/public/m/Mehaanikateaduskond/Instituudid/Materjalitehnika_instituut/MTX9100/Lecture11_Synthesis.pdf.
5. http://nptel.ac.in/courses/113108051/module1/lecture1.pdf.