BLOW-UP SYLLABUS

ENGINEERING CHEMISTRY (18CHE12/22)

(Common to all Branches)
(Effective from the academic year 2018-19)

MODULE- I: Electrochemistry and Energy storage systems

Use of free energy in chemical equilibria: Thermodynamic functions: Definitions of free energy and entropy. Cell potential, derivation of Nernst equation for single electrode potential, numerical problems on E, E^0, and E_{cell} **(3 hrs)**
Electrochemical energy systems: Reference electrodes: Introduction, construction, working and applications of Calomel electrode. Ion-selective electrode – Definition, construction and principle of Glass electrode and determination of pH using glass electrode. Electrolyte concentration cells, numerical problems **(3 hrs)**
Energy storage systems: Introduction, classification - primary, secondary and reserve batteries. Construction, working and applications of Ni-MH and Li-ion batteries **(2 hrs)**
(RBT Levels: L3)

Details of the Module- I

Sl.No	Details	Duration	Remarks
1.1	**Use of free energy in chemical equilibria:** Thermodynamic functions: Introduction, I Law of Thermodynamics, Definitions of energy & free energy. II Law of Thermodynamics, definition of entropy. Cell potential: Meaning of EMF	1 hr	
1.2	Derivation of Nernst equation for single electrode potential and numerical problems	1hr	Numerical problems
1.3	Nernst equation for a cell, Numerical problems on E, E^0, and E_{cell}.	1 hr	Numerical problems
1.4	**Electrochemical energy systems:** Introduction, types of electrodes, Meaning of reference electrodes, construction, working, advantages and applications of Calomel electrode.	1 hr	
1.5	Ion-selective electrode – Definition, examples, membrane electrodes, construction and principle of Glass electrode,	1 hr	
1.6	Determination of pH using glass electrode, Concentration cells: Definition, examples, derivation of an equation to find the EMF of concentration cells, Numerical problems on concentration cells	1 hr	Numerical problems
1.7	**Energy storage systems**: Introduction, classification - primary, secondary and reserve batteries with examples	1 hr	
1.8	Construction, working and applications of Ni-MH and Li-ion batteries	1 hr	
1.9	**Tutorial classes**: Involvement of faculty and students in identifying the engineering applications, doubts and clarifications about the module.	2 hrs	

MODULE-II: Corrosion and Metal Finishing

Corrosion: Introduction, Electrochemical theory of corrosion, Factors affecting the rate of corrosion: ratio of anodic to cathodic areas, 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: Anodizing – Anodizing of aluminium, Cathodic protection - sacrificial anode and impressed current methods, Metal coatings – Galvanization (4 hrs)

Metal finishing: Introduction, Technological importance. Electroplating: Introduction, principles governing electroplating-Polarization, decomposition potential and overvoltage. Electroplating of chromium (hard and decorative). Electroless plating: Introduction, electroless plating of nickel & copper, distinction between electroplating and electroless plating processes (4 hrs)
(RBT Levels: L1 & L2)

Details of the Module-II

Sl.No	Details	Duration	Remarks
2.1	Corrosion: Definition, Wet & Dry corrosion, Electrochemical theory taking corrosion of iron as an example	1 hr	
2.2	Factors affecting the rate of corrosion: ratio of anodic to cathodic areas, nature of corrosion product, nature of medium – pH (greater than 10, between 3 and 10, lower than 3), conductivity and temperature	1 hr	
2.3	Types of corrosion- Differential metal corrosion and differential aeration corrosion: Pitting and water line corrosion with diagrams, Corrosion control: Anodizing – Anodizing of aluminium	1 hr	
2.4	Cathodic protection : Definition, sacrificial anode and impressed current methods, Metal coatings - Galvanization	1 hr	
2.5	Definition and technological importance of metal finishing, Principles governing metal finishing- Polarization, decomposition potential and overvoltage	1hr	
2.6	Electroplating: Introduction, Electroplating of chromium (hard and decorative), its applications	1 hr	
2.7	Electroless plating: Introduction, electroless plating of nickel	1 hr	
2.8	Electroless plating of copper and its applications, distinction between electroplating and electroless plating processes	1 hr	
2.9	**Tutorial classes**: Involvement of faculty and students in identifying the engineering applications, doubts and clarifications about the module.	2 hrs	

MODULE-III: Energy Systems

Chemical Fuels: Introduction, classification, definitions of CV, LCV, and HCV, determination of calorific value of solid/liquid fuel using bomb calorimeter, numerical problems. Knocking of petrol engine – Definition, mechanism, ill effects and prevention. Power alcohol, unleaded petrol and biodiesel (4 hrs)
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, and solid oxide fuel cell (SOFCs) (2 hrs)
Solar Energy: Photovoltaic cells- introduction, construction and working of a typical PV cell, Preparation of solar grade silicon by Union Carbide Process/Method. Advantages & disadvantages of PV cells (2 hrs)
(**RBT Levels: L3)**

Details of the Module-III

Sl.No	Details	Duration	Remarks
3.1	**Chemical Fuels**: Introduction, classification based on occurrence and state of aggregation, definitions of CV, LCV and HCV	1 hr	
3.2	Determination of calorific value of solid/liquid fuel using bomb calorimeter: Principle, diagram, construction, working and calculation	1 hr	
3.3	Numerical problems on calorific values.	1 hr	Numerical problems
3.4	Knocking of petrol engine – Definition, mechanism, ill effects and prevention, Power alcohol, unleaded petrol and biodiesel	1 hr	
3.5	**Fuel Cells:** Introduction, differences between conventional cell and fuel cell, limitations & advantages.	1 hr	
3.6	Construction, working & applications of methanol-oxygen fuel cell with H_2SO_4 electrolyte, and solid oxide fuel cell (SOFCs).	1 hr	
3.7	**Solar Energy**: Photovoltaic cells- introduction, construction and working of a typical PV cell	1 hr	
3.8	Preparation of solar grade silicon by Union Carbide Process/Method. Advantages & disadvantages of PV cells	1 hr	
3.9	**Tutorial classes**: Involvement of faculty and students in identifying the engineering applications, doubts and clarifications about the module.	2 hrs	

MODULE IV: Environmental Pollution and Water Chemistry

Environmental Pollution: Air pollutants: Sources, effects and control of primary air pollutants: Carbon monoxide, Oxides of nitrogen and sulphur, hydrocarbons, Particulate matter, Carbon monoxide, Mercury and Lead. Secondary air pollutant: Ozone, Ozone depletion (3 hrs)
Waste Management: Solid waste, e-waste & biomedical waste: Sources, characteristics & disposal methods (Scientific land filling, composting, recycling and reuse) (1 hr)
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 $MgCl_2$). Sources of water pollution, Sewage, Definitions of Biological oxygen demand (BOD) and Chemical Oxygen Demand (COD), determination of COD, numerical problems on COD. Chemical analysis of water: Sulphates (gravimetry) and Fluorides (colorimetry). Sewage treatment: Primary, secondary (activated sludge) and tertiary methods. Softening of water by ion exchange process. Desalination of sea water by reverse osmosis (4 hrs)
(RBT Levels: L3)

Details of the Module-IV

Sl.No	Details	Duration	Remarks
4.1	**Environmental Pollution:** Introduction**,** Air pollutants: Sources, effects and control of primary air pollutants: Carbon monoxide, Oxides of nitrogen and hydrocarbons,	1 hr	
4.2	Oxides of sulphur, Particulate matter, Carbon monoxide, Mercury and Lead.	1 hr	
4.3	Secondary air pollutant: Ozone, Ozone depletion	1 hr	
4.4	**Waste Management:** Solid waste, e-waste, Biomedical waste: Sources, Characteristics & disposal methods (Scientific land filling, composting, recycling and reuse)	1 hr	
4.5	**Water Chemistry:** Introduction**,** sources and impurities of water; boiler feed water, boiler troubles with disadvantages-scale and sludge formation	1 hr	
4.6	Boiler corrosion (due to dissolved O_2, CO_2 and $MgCl_2$), Sources of water pollution, Sewage, Definitions of Biological oxygen demand (BOD) and Chemical Oxygen Demand (COD), Determination of COD	1 hr	
4.7	Numerical problems on COD. Chemical analysis of water: Sulphates (gravimetry) and Fluorides (colorimetry),	1 hr	Numerical problems
4.8	Sewage treatment: Primary, secondary (activated sludge) and tertiary methods. Softening of water by ion exchange process. Desalination of sea water by reverse osmosis.	1 hr	
4.9	**Tutorial classes**: Involvement of faculty and students in identifying the engineering applications, doubts and clarifications about the module.	2 hrs	

Module V: Instrumental methods of analysis and Nanomaterials

Instrumental methods of analysis: Theory, Instrumentation and applications of Colorimetry, Flame Photometry, Atomic Absorption Spectroscopy, Potentiometry, Conductometry (Strong acid with a strong base, weak acid with a strong base, mixture of strong acid and a weak acid with a strong base) (4 hrs)
Nanomaterials: Introduction, size dependent properties (Surface area, Electrical, Optical, Catalytic and Thermal properties). Synthesis of nanomaterials: Top down and bottom up approaches, Synthesis by Sol-gel, precipitation and chemical vapour deposition, Nanoscale materials: Fullerenes, Carbon nanotubes and graphenes – properties and applications (4 hrs)
(RBT Levels: L1 & L2)

Details of the Module-V

Sl.No	Details	Duration	Remarks
5.1	**Instrumental methods of analysis:** Introduction, principle, advantages and limitations	1 hr	
5.2	Instrumentation and applications of Colorimetry (Estimation of copper in brass), Flame Photometry(estimation of sodium and potassium)	1 hr	
5.3	Instrumentation and applications of Atomic Absorption Spectroscopy, Potentiometry (estimation of FAS),	1 hr	
5.4	Instrumentation and applications of Conductometry (Strong acid with a strong base, weak acid with a strong base, mixture of strong acid and a weak acid with a strong base)	1 hr	
5.5	**Nanomaterials:** Introduction, size dependent properties: Surface area, Electrical, Optical, Catalytic and Thermal properties	1 hr	
5.6	Synthesis of nanomaterials: Top down and bottom up approaches, Synthesis by bottom up approach: Sol-gel	1 hr	
5.7	Precipitation and chemical vapour deposition methods with advantages	1 hr	
5.8	Nanoscale materials: Fullerenes, Carbon nanotubes and graphenes – properties and applications (synthesis not required)	1 hr	
5.9	**Tutorial classes**: Involvement of faculty and students in identifying the engineering applications, doubts and clarifications about the module.	2 hrs	

Text Books:-

1. P.C. Jain & Monica Jain. **"Engineering Chemistry"**, Dhanpat Rai Publications, New Delhi (2015- Edition).
2. S. S. Dara, A textbook of Engineering Chemistry, 10th Edition, S Chand & Co., Ltd., New Delhi, 2014.
3. Physical Chemistry, by P. W. Atkins, Oxford Publications (Eighth edition-2006).

Reference Books:-

1. O.G. Palanna, **"Engineering Chemistry"**, Tata McGraw Hill Education Pvt. Ltd. New Delhi, Fourth Reprint (2015- Edition).
2. R.V. Gadag & A. Nityananda Shetty., **"Engineering Chemistry"**, I K International Publishing House Private Ltd. New Delhi (2015- Edition).
3. **"Wiley Engineering Chemistry"**, Wiley India Pvt. Ltd. New Delhi. Second Edition-2013.
4. B. Jaiprakash, R. Venugopal, Sivakumaraiah and Pushpa Iyengar, Chemistry for Engineering Students, Subhash Publications, Bengaluru, (2015- Edition).