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).

Engineering Chemistry Laboratory syllabus for Chemistry Cycle 1 Sem 2018 scheme | VTU CBCS 18CHEL16 Syllabus

1. VTU
2. Syllabus
3. Chemistry Cycle
4. 2018 Scheme
5. 1 SEM
6. Engineering Chemistry Laboratory

Module-10 hours

Instrumental Experiments

1. Potentiometric estimation ofF AS using standard k2Cr2O7 solution.

2. Conductometric estimation of acid mixture.

3. Determination of Vtseosity co-efficient of the given liquid using Ostwald's viscometer.

4. Colorimetric estimation of Copper.

5. Determination of pKa of the given weak acid using pH meter.

6. Flame photometric estimation of sodium and potassium.

Volumetric Experiments

1. Estimation ofTotal hardness of water by EDTAcomplexometric 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. Determination of COD of waste water.

5. Estimation of Iron in haematite ore solution using standard $K_2Cr_2O_7$ solution by external indicator method.

6. Estimation of percentage of available chlorine in the given sample of bleaching powder Qodometric method)