MANGALORE UNIVERSITY

Department of Industrial Chemistry

ICH 453: ENERGY SYSTEMS, COLLOIDS AND PETROCHEMICALS

Course Outcomes:

- Students learn about types of renewable and non renewable sources of energy.
- Electrochemical energy systems pertaining to classical and modern batteries and also fuel cells
- Application of photoelectrochemistry and photoelectytic catalysis in waste removal and solar cell applications.
- Principle and application of colloidal chemistry in electrophoresis.
- Adsorption phenomenon and its application.
- Petroleum and petrochemicals: history, composition and reformation with finishing process namely hydro treatment.

UNIT I: **14 hrs**

Energy Systems

Chemical energy sources and their limitations (natural gas, coal, nuclear fussion, nuclear fission and Hydro power). Electrochemical energy systems-Introduction, classification, battery characteristics. Primary batteries-Laclanche dry cell (Zn and Mg), Alkaline MnO_2 batteries. Secondary batteries-Introduction, lead acid battery, Alkaline storage battery. Lithium batteries-The primary & secondary lithium batteries. Lithium based conducting polymer battery. Fuel cells-Introduction, efficiency, classification and types (H_2-O_2 fuel cell, methanol fuel cell, solid polymer electrolyte fuel cell biofuel cell).

UNIT II: **14 hrs**

Non conventional energy systems: Solar energy cells-Introduction, semiconductor electrodes, semiconductor-electrolyte interface, parameter controlling efficiency, stability of semiconductor electrodes, Photoelectrochemical and photogalvanic cells. Production of Hydrogen, hydrogen energy. Applications of photochemistry-photoelectrocatalysis, photoreduction of CO_2 and photoelectrochemical waste removal. Hydrogen storage by metal and metal-alloys.

Wind energy-Atmospheric circulations, factors influencing wind and Betz limit. Formation of biomass, photosynthesis; Biomass resources. Chemical constituents and physicochemical characteristics of biomass; Biomass conversion processes; Biofuel, Petrocrops.
Ocean energy resources, Principles of ocean thermal energy conversion systems. Geothermal energy: Origin, types of geothermal energy sites.

UNIT III: **14 hrs**

Colloidal chemistry: Introduction, Method of determining particle size. Donnan membrane, equilibrium and potentials, Importance and applications of colloidal chemistry. Theory, properties and applications of gels and emulsion. Migration of an ion in an electric field, factors affecting electrophoretic mobility. Types of electrophoresis-free electrophoresis, zone electrophoresis-paper and cellulose acetate electrophoresis, gel electrophoresis.

Adsorption: Introduction, types, Adsorption isotherms-Langmuir and BET(no derivation), Gibbs adsorption isotherm, applications of adsorption- surface area determination. Kinetics of gaseous reaction on solid surface-uni and bimolecular surface reactions (qualitative study), Catalysis: Types and industrial applications.

UNIT IV: **14 hrs**

Petroleum and Petrochemicals: History of Petroleum-Origin, recovery and transportation, Composition of crude oils-Paraffins, Naphthenes, Aromatics, Sulphur compounds, Nitrogen compounds, Metallic constituents, Distillation**-**Pretreatment, atmospheric distillation, Vacuum distillation, Cracking-Thermal cracking, visbreaking, coking, catalytic cracking, hydrocracking, Reforming-Catalytic reforming.

Hydrotreatment and Sulphur Recovery: Finishing processes-Caustic washing, Merox process, Hydrofing, methods for improving storage stability, filter, Molecular sieves Petroleum Products-LPG, LNG, Motor gasoline or Petrol, Diesel, Kerosene, Naphtha, Aviation turbine fuel, Heavy fuel oil, Bitumen, Lubricating oil, Greases, Petroleum waxes, Petroleum fractions for petrochemicals. Naphtha and Para xylene. General properties of petroleum products, alternative fuels.

References

1. Engineering chemistry, Gadag R V, I K international, 2010.
2. Chemical and Electrochemical Energy Systems, Narayan R & B Viswanathan, University Press,1998.
3. Energy Storage for Power Systems, Ter-Gazarian A., Peter Peregrinus, London, 1994.
4. Modern Electrochemistry, Vol 2A and B, JOM Bockris & AKN Reddy, Springer, NY, 1998.
5. Biochemical & Photosynthetic Aspects of Energy Production, Anthony San Pietro, Academic Press, N Y, 1980.
6. Bio Energy for Rural Energisation, R.C. Maheswari, Concepts Publication, 1997.
7. Wind Energy Systems, G L Johnson, Prentice Hall Inc, New Jersey, 1985.
8. Modern Petroleum Refining Process, 2nd Edn., Rao, IBH.
9. Introduction to Petrochemicals, Maiti, IBH.
10. Synthetic Organic Chemistry, G R Chatwal, Himalaya Publishing House.
11. A Text Book of Engineering Chemistry, M M Uppal, Khanna Publishers, 1986.
12. Modern Petroleum Chemistry-An overview, Kochu Baby, Manjuram & Kannatheri Publication, Kochi.
13. Colloids Chemistry, A.K.Sharma, Goel publishing House, Meerut, 1991.