ICS 454: CHEMICAL ENGINEERING TECHNOLOGY

Course Objectives:

- To provide the detailed structure of unit operation and unit processes.
- To learn the basic design and concepts of operating instruments used in industries.
- To know the recent trends of unit operation involving flow chemistry.
- To distinguish the different reactions used in industrial processes.

Unit Operations

UNITI: 10 hr

Evaporation: Types of evaporators, jacketed, horizontal and vertical tube evaporators, forced circulation evaporations, multiple effect evaporators.

Distillation: Boiling and distillation, vapor-liquid equilibria, Rault's law & Henry's law, relative volatility, azeotropic mixtures, flash distillation, steam distillation, vacuum distillation, fractional distillation.

UNIT II: 12 hr

Crystallization: Theory & mechanisms of growth of crystal, nucleation, saturation(Mier's theory), super saturation, types of crystallization, classification of crystallizers (agitated tank, Swenson Walkers, Krystal, Oslo, continuous vacuum crystallizers), caking of crystals, effect of impurities.
Gas absorption: Definition, examples, solution criteria for gas absorption, Characteristics, types, merits and demerits of plate and tower packing.Comparison of absorption and distillation,
Flow chemistry: concepts and applications.

UNITIII: 10 hr
Unit Processes
Unit process and flow sheet. **Nitration:** Nitrating agents, kinetics and mechanism of nitration of aromatic compounds, nitration of paraffinic hydrocarbons, nitrate esters, N- nitrocompounds, typical industrial manufacturing process. **Sulfonation:** Sulfonating agents, kinetics and mechanism, desulfonation, work-up procedures. Industrial equipment and technique, Batch and continuous processes, manufacturing processes for detergents, dye intermediates, turkey red oil.
Alkylation and acylation: Alkylation& acylation at Carbon, Oxygen and Nitrogen, Friedel- Craft reaction, applications of active methylene compounds like diethyl melonate and ethyl acetoacetate. Industrial processes

UNIT IV: 10 hr

Catalytic hydrogenation and hydrogenolysis: Different types of catalysts, Industrial hydrogenation processes. **Halogenation:** Kinetics & mechanism of halogenation reaction, survey methods, catalytic chlorination, manufacturing processes for chlorobenzene, BHC, chlorinated methanes, vinyl chloride. **Oxidation:** Oxidising agents with typical applications of each, liquid phase oxidation with oxidising compounds. **Esterification:** Kinetics and mechanism, esterification of carboxylic acid derivatives, esters by addition to unsaturated systems, industrial esterification, ethyl acetate, methyl methacrylate, cellulose acetate and nitroglycerin.

Course Outcomes:

1. Students learn about unit operations pertaining to evaporation, distillation and crystallization.
2. Unit processes and flow sheet for manufacturing of chemicals through sulphonation, nitration, alkylation and acylation; catalytic hydrogenation, oxidation and esterification.

References

1. F A Henglein, Chemical Technology,Fiesrt English edition, Pergamon,1969.
2. J M Coulson, Chemical Engineering, Vol. I, II & III, Pergamon,1964.
3. R N Shreve,The Chemical Process Industries,McGraw Hill Professional, 1984.
4. W L Badger, J T Bandchero, Introduction to Chemical Engineering, McGraw Hill Professional, 1955.
5. A Hougen, K M Watson, R A Ragetz, Chemical Process Principles, Vol I & II, John Wiley and sons,1959.
6. John J McKetta Jr, Unit operations handbooks, Volume 1, CRC Press,1992.
7. Wareen L. McCabe,Jullan C. Smith, Peter Harrlott, Unit operations of chemical engineering, McGraw Hill Professional, 1956.
8. P H Groggins, Unit Processes in Organic Synthesis, McGraw Hill Professional, 5th Edition,1995.
9. Engineering chemistry, Gadag R V, I K international,2010.
10. Comprehensive industrial chemistry, More Prakash G, Pragathiprakashan,2010.