MANGALORE UNIVERSITY

Department of Industrial Chemistry

ICS 454: CHEMICAL ENGINEERING TECHNOLOGY

Course Outcomes:

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

Unit Operations

UNIT I: **10 hrs**

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

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

UNIT II: **12 hrs**

Crystallisation: Theory & mechanisms of growth of crystal, saturation, nucleation, super saturation(Mier's theory), caking of crystals, effect of impurities, classification of crystallizers, agitated tank, Swenson Walkers, Krystal, Oslo, continuous vacuum crystallizers.

Gas absorption: Definition, examples, comparison of absorption and distillation, solution criteria for gas absorption, mechanically agitated vessels.Characteristics of tower packing, types of packing, merits of plate & packed tower.

Flow chemistry: concepts and applications

Unit Processes

UNIT III: **10 hrs**

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 hrs**

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 esterifications, ethyl acetate, methyl methacrylate, cellulose acetate and nitroglycerin.

References

1. Chemical Technology, F A Henglein, Pergamon.
2. Chemical Engineering, Vol. I, II & III, J M Coulson
3. The Chemical Process Industries, R N Shrove, MGH.
4. Introduction to Chemical Engineering, W L Badger & J T Bandchero, MGH.
5. Chemical Process Principles, Vol I & II, O A Hougen, K M Watson & R A Ragetz, John Wiley.
6. Unit Operation-II, K A Gavhane, Nirali Prakashan, Pune.
7. Unit Processes in Organic Synthesis, P H Groggins, MGH.
8. Chemical Technology, F A Henglein, Pergamon.
9. Engineering chemistry, Gadag R V, I K international, 2010.
10. Comprehensive industrial chemistry, More Prakash G, Pragathi prakashan, 2010.