MANGALORE UNIVERSITY

Department of Industrial Chemistry

MSc 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 I: **10 hrs**

Unit Operations 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 III: **10 hrs**

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- nitro compounds, 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.