CHEMICAL PROCESS AND EQUIPMENT DESIGN
(Elective-III)

Course Code: 13CH2119

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Prerequisites: The student should have knowledge of chemical engineering equipment like heat exchangers and distillation columns.

Course outcomes:

On successful completion of the course, the student should be able to

CO1 : Design and develop shell and tube heat exchangers for the Heat Exchange Process.

CO2 : Identify and design suitable evaporators for the evaporation process.

CO3 : Differentiate vaporizers and reboilers for given heat exchange process.

CO4 : Select and design plate / packed towers for the given separation process.

CO5 : Describe practical rule of Thumb and scale up of process equipment from pilot plant scale to commercial size.

UNIT-I

Shell and Tube Heat Exchanger Design: 1-2 parallel – counter flow: Shell and Tube Exchanger, Flow arrangements for increased heat recovery, Calculations for Process conditions. Condenser Design: Condensation of single vapor, Condensation of mixed vapor.

UNIT-II

Multiple Effect Chemical Evaporation: Calculations of Chemical Evaporators, Solution of industrial problems: concentration of cane sugar liquors – forward feed, Evaporation of paper pulp waste liquors – backward feed, caustic soda concentration – forced circulation evaporators. Thermo compression: Design of thermo compression sugar evaporator.

UNIT-III

Vaporizers and Reboilers: Vaporizing processes, Reboiler arrangements, Classification of vaporizing exchangers, Heat flux and temperature difference Limitations, Relation between maximum flux and maximum film coefficient, Forced Circulation vaporizing exchangers, Natural Circulation vaporizing exchangers.

UNIT-IV

Towers: Introduction, Contacting Devices, Choice between Packed Columns and Plate columns, Tower Packings, Choice of plate types, Plate calculations, Transfer unit calculations, Column diameter. Packed Towers: Introduction, Type and Size of Packings, Flooding, Pressure Drop, Foam, Holdup, Degree of Wetting, Column Diameter, Height of Packing, Design of a Packed Tower for Distillation, Optimum Design.

Sieve and Valve Tray Design: Introduction, Sieve Trays: Tower Diameter, Plate Spacing, Entrainment, Weepage, Tray Layout, Hydraulic Parameters, Worksheet for Sieve Tray Design. Valve trays: Flooding and Entrainment, Tray Spacing, Foaming Tray type, Tray diameter and Lay out, Hydraulic Parameters.

UNIT-V

Practical Rules of Thumb: Pressure Vessels, Reactor Design Temperature, Drums, Fractionating Towers, Heat Exchangers, Pipelines and Pumps.

Scale up of Process Equipment: Introduction, Basic Principles of Scale-up, Scale-up of Heat Exchange Systems, Scale-up of Chemical Reactors, Scale-up of Liquid Mixing Systems, Scale-up of Fluid Flow systems.

TEXTBOOKS:

1. Kern D.Q., *"Process Heat Transfer",* Tata McGraw Hill Co., 1997.
2. Backhurst and Harker *"Process Plant Design",* Amercian Elservier Pub.Co., Heinmann Chemical Engineering Series, 1973.
3. Joshi M.V., McMillan, *"Process Equipment Design",* India, 1996.
4 Coulson and Richardson *"Chemical Engineering"* Volume 6, Pergamon Press, 1983.

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