Subject Code: 01CH0603
Subject Name: PROCESS EQUIPMENT DESIGN-I
B.Tech. Year – III (Semester-VI)

Objective: To know design layouts of plant /equipment's and the relevant application for equipment design.

Credits Earned: 6 Credits

Course Outcomes: After completion of this course, student will be able to:

1. Design process equipment and modify the design of existing equipment to new process conditions or new required capacity.
2. Build a bridge between theoretical and practical concepts used for designing the equipment in any process industry.
3. Create understanding of equipment design.
4. Review the importance of design concepts in process industry.

Pre-requisite of course: Knowledge of Unit Operations of Chemical Engineering.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	CSE	Internal (I)	Viva (V)	Term work (TW)	
4	4	0	6	50	20	30	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**Design of piping, Fluid moving devices and Flow meters**: Introduction, Process design of piping, Orifice meter, Rotameter, $NPSH_A$ &$NPSH_R$, Power required in pump, Blower, flow meters, adiabatic compressor and Fan, evaluation of Centrifugal pump performance when handling viscous liquids	8
2	**Process design of Heat exchangers:** Introduction to Shell & Tube heat exchangers & functions of its various parts, General design method of shell & tube heat exchanger, selection criteria among Fixed Tube sheet, U Tube & Floating Head heat exchanger, Process design of without phase change heat exchanger, condenser, selection criteria for Horizontal and vertical condenser, Process design of Kettle type & Thermosyphon Reboilers and	14

	vaporizes, Tinker's flow model, Air cooled heat exchangers and air heaters, plate heat exchangers, etc.	
3	**Process design of Distillation Column:** Introduction, equipment selection for distillation, Design of Distillation column, Key components selection for multi-component distillation, Determination of operating pressure for distillation column, Advantages & disadvantages of vacuum distillation, Determination of nos. of theoretical stages for binary distillation using McCabe Thiele method & for multi-component distillation by Fenskey-Underwood-Gilliland's method, trays selection, Calculations for tower diameter & pressure drop of sieve tray tower, Checking of conditions for weeping, down comer flooding, liquid entrainment, etc, tray efficiency, Jet Flooding & down comer Flooding, Different types of weirs & down comers of tray tower, their selection criteria.	14
4	**Process design of Absorbers:** Introduction, selection criteria among different types of absorption equipment, Process Design of packed tower type absorber: Determination of actual amount of solvent, Selection of packing, Determination of tower diameter & pressure drop, Determination of NtoG, HtoG & height of packing, Process design & selection criteria of liquid distributors, redistributors & packing support, Process design of Spray chamber or spray tower type absorber, Venturi Scrubber.	8
5	**Process design of Extractor:** Industrial applications of liquid-liquid extraction, choice of solvent, Selection criteria among different types of extractor Process design of counter current multistage extractor, mixer-settler type extractor & packed tower type extractor, Guidelines for the design of other types of extractors	6
	Total Hours	**50**

List of Tutorials:

1. Design of piping
2. Design of Shell & Tube heat exchangers
3. Design of without phase change heat exchanger
4. Design of Condenser
5. Design of Kettle type & Thermosyphon Reboilers
6. Design of Distillation column
7. Design of Absorber
8. Design of counter current multistage extractor

References:

1. Introduction to Process Engineering and Design by S B Thakore and B I Bhatt, Tata McGraw Hill, 1st Edition, 2007.
2. Ray Sinnott, Gavin Towler, Chemical Engineering Design - Principles, Practice and Economics of Plant and Process Design, Butterworth - Heinemann, 2008.
3. Brownell and Young, Process Vessel Design, Wiley Eastern, 1977.

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory marks					
Remember	Understand	Apply	Analyze	Evaluate	Create
20%	35%	25%	15%	5%	-

Instructional Method:

a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

Design Based Problems (DP)/ Open Ended project (OEP):

In the beginning of the session, subject faculty will allot an OEP / DP to the students. Students will be free to choose a topic of their choice which will be relevant to the syllabus and they will either prepare a working model/ report / presentation / poster on their topic.