Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-6 (B.Tech)

Subject: Process and Equipment Design - BETCH16321

Type of course: Major (Core)

Prerequisite: The student should have basic understanding of Unit Operations of Chemical Engineering

Rationale: The process of designing equipment include figuring out all of its linear dimensions, including size, length, etc. It also involves figuring out the weight and thickness of various components of devices. There are pre-made programs accessible for equipment design. But in order to employ these Effective and accurate use of soft goods requires a basic understanding of this topic. With a quick pace Regarding knowledge growth, it is crucial that pupils are aware of the most recent advances in equipment design. Students interested in becoming design engineers, Understanding this topic is crucial for those working as process engineers or process development engineers. Also, it is helpful for production engineers employed in industrial plants to troubleshoot issues pertaining to functioning of machinery.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	150
4	0	2	5	60	30	10	20	30	

Legends: CI-Classroom Instructions; T – Tutorial; P - Practical; C – Credit; ESE – End Semester Examination; MSE- Mid Semester Examination; CA - Continuous Assessment; ALA-Active Learning Activities.

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Course Content:

Sr. No	Course content	Hrs	% Weightage
1	**Process design of Piping and Pumps:** Introduction, Process design of piping, NPSHA & NPSHR, Power required by pump, Power required in Fan, Blower and adiabatic compressor, flow meters, Process design of Orifice meter, Rotameter etc.	12	20
2	**Process design of Heat Exchangers:** Shell & Tube heat exchangers, Functions of various parts of shell & Tube Heat exchanger, General design method of shell & tube heat exchanger, Criteria of selection among Fixed Tube sheet, U Tube & Floating Head heat exchanger, Process design of without phase change heat exchanger, Process design of condenser, Criteria of selection for Horizontal and vertical condenser, Process design of Kettle type & Thermosyphon Reboilers and vaporizes, Tinker's flow model	12	20
3	**Process design of Distillation Column:** Introduction, Criteria of selection, Selection of equipment for distillation, Distillation column design, Selection of key components 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 by McCabe Thiele method Determination of nos. of theoretical stages for multi-component distillation by Fenskey- Underwood-Gilliland's method, Selection of trays, 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.	12	20

4	**Process design of Absorbers:** Introduction, Criteria for selection 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.	12	20
5	**Mechanical design of Pressure Vessel:** Selection of material of construction, Concept of internal & external design pressure, design stress & design temperature, Different types of equipments, Static & rotary equipments, Different types of static equipments, Different types of welding joints, Joint efficiency, Radiography. Mechanical design of shell, head, Jacket, coil, agitator, nozzle, etc.,	12	20

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Design of Piping and Pumps:** Student will Design of Piping and Pumps for specification which given by faculty and upload detailed report on GMIU Portal.	10
2	**Design of Heat Exchanger:** Student will design heat Exchanger for specification which given by faculty and upload detailed report on GMIU Portal.	10
3	**Design of Distillation/ Absorption Tower:** Students will design Distillation/ Absorption Tower for given data and upload detailed calculation report on GMIU Portal.	10
Total		30

Suggested Specification table with Marks (Theory): 60

Distribution of Theory Marks **(Revised Bloom's Taxonomy)**						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	20%	10%	20%	20%	20%	10%

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course, the students should be able to:	
CO1	Design process equipment and modify the design of existing equipment to new process conditions or new required capacity.
CO2	Build a bridge between theoretical and practical concepts used for designing the equipment in any process industry.
CO3	Create understanding of equipment design.
CO4	Review the importance of design concepts in process industry.
CO5	Design of various Mechanical design of Pressure Vessel in process Industry.

List of Suggested Practical

Sr. No	Suggested Practical	Unit No	Hrs.
1	Prediction of Physical properties	1	4
2	Process design of shell and tube heat exchanger	2	4
3	Process design of condenser	2	4
4	Process design of tray tower type distillation column	3	6
5	Process design of packed tower type distillation column	3	4
6	Process design of packed tower type absorber	4	4
7	Mechanical design of pressure vessel	5	4

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction. Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses. The internal evaluation will be done on the basis of Active Learning Assignment.

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.

Reference Books:

[1] Introduction to Process Engineering and Design by S B Thakore and B I Bhatt, McGraw Hill, 2nd Edition, 2015.

[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.

[4] M. S. Peters and K. D. Timmerhaus, Plant Design and Economics for Chemical Engineers, 4th ed., McGraw - Hill, New York, 1991

[5] James R. Couper, James R. Fair & W. Roy Penney, Chemical Process Equipment - Selection and Design, 2nd Edn., Butterworth - Heinemann, 2010.