



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Post Graduate Degree

Branch: Chemical Engineering

Course/Subject Code: ME01030071

Course/Subject Name: Advanced Process Equipment Design

w.e.f.Academic Year:	2024-25
Semester:	1 st Semester
Category of the Course:	PEC -02

Prerequisite:	Study of Process Equipment Design at Undergraduate Level
Rationale:	Chemical industries deal with various types of Heat exchangers, Distillation columns, absorbers, extractors, etc., hence, the knowledge of the process design of these equipments is very much important.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Create understanding of equipment design with mechanical concept.
02	Build a bridge between theoretical and practical concepts used for designing the equipment in any process industry.
03	Design process equipment and modify the design of existing equipment to new process conditions or new required capacity
04	Review the importance of design concepts in process industry.

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				ESE (E)	PA/ CA (M)	PA/CA(I)	ESE(V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No.of Hours	% of Weightage
1.	Process Design of Shell & Tube Heat exchangers: Process Design of Without phase Change by using Delaware Method, Multicomponent Condensers, Condensers involving subcooling and de-superheating, Condensation along with cooling of non-condensable.	8	



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2.	Process Design of Air cooled heat exchangers, air Heaters and Plate heat exchangers: Air side or Fin side Heat Transfer Coefficient and pressure drop. Advantages and Disadvantages of Plate Heat Exchangers over Shell and Tube Heat Exchangers. Calculation of heat transfer coefficient and pressure drop of plate type heat exchanger.	7	
3.	Process Design of Reboilers and Vaporizers: Process design of Kettle-type Reboiler and Vertical Thermosyphon Reboiler, Criteria of selection between Kettle-type Reboiler and Thermosyphon Reboiler.	8	
4.	Process design of Distillation Column: Selection of equipment for distillation, Design of binary and multicomponent Distillation, Determination of nos. of theoretical stages for binary distillation by McCabe Thiele method, Determination of nos. of theoretical stages for multicomponent distillation by Fenske-Underwood-Gilliland's method, Lewis Matheson and Thiele Geddes method, Selection of trays, Calculations for tower diameter & pressure drop of sieve tray tower, Checking of conditions for weeping, downcomer flooding, liquid entrainment, tray efficiency, etc., Process design of binary and multicomponent Batch distillation with rectification.	8	
5.	Process design of Absorbers: Introduction, Criteria for selection among different types of absorption equipment, Process Design of packed tower type absorber, Process design of Spraytower type absorber, Venturi Scrubber, Process design of falling film absorber, Process design of absorption column involving chemical reaction.	7	
6.	Process design of Extractor: Industrial applications of liquid-liquid extraction, choice of solvent, Process design of counter current multistage extractor, Selection criteria among different types of Extractor, Process design of mixer-settler type extractor & packed tower type extractor.	7	
Total		45	100



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Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
RLevel	ULevel	ALevel	NLevel	ELevel	CLevel
5	25	15	10	10	5

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

- Introduction to Process Engineering and Design by S B Thakore and B I Bhatt, Tata McGraw Hill, 2nd Edition.
- Chemical Engineering, Coulson and Richardson and Sinnott, Vol.6, Asian Pub.
- Brownell and Young, Process Vessel Design, Wiley Eastern, 1977.
- TEMA Standards.
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(b) Open source software and website:

- HTRI
- Aspan
- Chemsep

Suggested Course Practical List:

- Delaware method for design of shell & tube heat exchanger
- Process design of condenser with non-condensables
- Process design of Air cooler
- Process design of Plate heat exchanger
- Process design of Kettle type Reboiler
- Process Design of Distillation Column
- Process Design of packed tower absorber
- Process Design of Venturi Scrubber

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