



**Ahmedabad  
University**

Course	CHE440 Process Design and Economics	Semester	Monsoon Semester 2024							
Faculty Name(s)	Arijit Ganguli	Contact	arijit.ganguli@ahduni.edu.in							
School	SEAS	Credits	2							
GER Category:	Not Applicable	Teaching Pedagogy Enable:NO	P/NP Course: Can not be taken as P/NP							
Schedule	<table> <tr> <td rowspan="2">Section 1</td><td>01:00 pm to 02:30 pm</td><td>Tue</td><td>01-08-24 to 26-11-24</td></tr> <tr> <td>02:30 pm to 04:00 pm</td><td>Tue</td><td>01-08-24 to 26-11-24</td></tr> </table>			Section 1	01:00 pm to 02:30 pm	Tue	01-08-24 to 26-11-24	02:30 pm to 04:00 pm	Tue	01-08-24 to 26-11-24
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Prerequisite	CHE170 Introduction to Materials Science and Engineering & CHE201 Fluid Mechanics & CHE204 Mass Transfer Operations - I & CHE211 Material and Energy Balance & CHE300 Mass Transfer Operations - II & CHE301 Heat Transfer OR Above are few courses listed as prerequisites . However for understanding entire chemical engineering is recommended to know									
Antirequisite	Not Applicable									
Corequisite	Not Applicable									

Course Description	<p>In many cases the processing costs associated with the various process alternatives differ by an order of magnitude or more, so that we can use shortcut calculations to screen the alternatives. However, we must be certain that we are in the neighborhood of the optimum design condition for each alternatives, to prevent discarding an alternative because of a poor choice of design variable. This course brings together the concepts of engineering and economics for chemical plant design and optimization.</p> <p>This course can be termed as the pinnacle of the chemical engineering curriculum as it covers Mechanical Design of chemical Process Equipment followed by Plant design covering Front End engineering, Preliminary and detailed Engineering including costing- equipment cost, fixed capital Investment and working capital.</p>
Course Objectives	<ul style="list-style-type: none"> <li>• To give the exposure to the learners of</li> <li>• • Design aspect in particular Mechanical Design of Chemical Process Equipment,</li> <li>• • FRONT END ENGINEERING DESIGN (FEED) ,Preliminary Design, Detailed Engineering Design</li> <li>• • Importance of Laboratory Scale, Pilot plant, Semi commercial Plant and Commercial Plant Development., importance of utilities and auxiliaries for any process industry</li> <li>• • Flow sheeting and Layout of Chemical Process Industries using Chemical engineering Software</li> <li>• • Costing and Financing of Chemical Project using correlations.</li> <li>• )</li> </ul>
Learning Outcomes	<p>By the end of this course, a student should be able to</p> <ul style="list-style-type: none"> <li>• Be knowledgeable about the kinds of design decisions that challenge process design teams</li> <li>• Understand the key steps in carrying out the design of a chemical process.</li> <li>• Be aware of the many kinds of cost related issues and safety considerations in process design</li> <li>• Appreciate the importance of maintaining high ethical principles in process design</li> <li>• Understand process simulators and be able to use them in process creation, equipment sizing and costing, profitability analysis, and optimization</li> </ul>
Pedagogy	<ul style="list-style-type: none"> <li>• Text book reading</li> <li>• Flow sheets/process flow diagrams</li> <li>• Simulations/ASPEN plus simulation</li> <li>• Case studies</li> <li>• Video lectures (NPTEL)</li> </ul>

Expectation From Students	<ul style="list-style-type: none"> <li>Students must read the books and references after the lectures and practice the numerical from the prescribed books.</li> <li>They must solve the home assignments by their own.</li> <li>They must learn ASPEN plus and simulate the prescribed problems.</li> <li>students should brows through techno-commercial magazines related to chemical engineering such as Chemical Weekly, Chemical Engineering Progress, Chemical Engineering World that would help in understanding of the concepts of the course.</li> </ul>
Assessment/Evaluation	<ul style="list-style-type: none"> <li>Mid-Semester Examination: <ul style="list-style-type: none"> <li>Online/Off line Mid semester Exam - 25%</li> </ul> </li> <li>End Semester Examination: <ul style="list-style-type: none"> <li>Plant visit Report/ Presentation - 20%</li> <li>End Semester Examination - 25%</li> </ul> </li> <li>Other Components: <ul style="list-style-type: none"> <li>attendance - 10%</li> <li>Assignments/Class Tests - 20%</li> </ul> </li> </ul>
Attendance Policy	<p>As per Ahmedabad University Policy.</p> <p>100% attendance as per AU norms.</p> <p>However, in case of emergency, they should inform the SEAS admin office and produce required certificate .</p>
Project / Assignment Details	<p>Students have to solve the following aspects for a small scale industry</p> <ul style="list-style-type: none"> <li>Formulate entire flow sheet using ASPEN</li> <li>Point out all operating parameters</li> <li>Cost estimation (both capital and running cost)</li> <li>Simulate the process parameters</li> </ul>
Course Material	<p>Reference Book</p> <ul style="list-style-type: none"> <li>Systematic Methods of Chemical Process Design,, Biegler, L.T., I.E. Grossmann and A.W. Westerberg, 1st Edition, Prentice Hall, ISBN: 0134924223, Year: 1997,</li> <li>Systematic Methods of Chemical Process Design,, Biegler, L.T., I.E. Grossmann and A.W. Westerberg, 1st Edition, Prentice Hall, ISBN: 0134924223, Year: 1997,</li> <li>Systematic Methods of Chemical Process Design,, Biegler, L.T., I.E. Grossmann and A.W. Westerberg, 1st Edition, Prentice Hall, ISBN: 0134924223, Year: 1997,</li> </ul>
Additional Information	



## Session Plan

NO.	TOPIC TITLE	TOPIC & SUBTOPIC DETAILS	READINGS,CASES,ETC.	ACTIVITIES	IMPORTANT DATES
0					
1	Introduction	Concept of internal & external design pressure, design stress & design temperature	S.B Thakor and D. A. Shah Ch 1	Lecture	
2		Concept of internal & external design pressure, design stress & design temperature			
3		Classification of equipments, Important Terminology Radiography examination		Lecture	
4		Different types of welding joints, Joint efficiency, Radiography		Lecture	
5	Material of Construction	Material Properties, Mechanical properties, corrosion Resistance and types of Corrosion	Coulson & Richardson Volume 6 Ch 7	Lecture	
6		Types of corrosion- details, Selection of Corrosion resistance	Coulson & Richardson Volume 6 Ch 7	Lecture	
7		Contamination, commonly used material of Construction and Corrosion consideration at Design Stage	Coulson & Richardson Volume 6 Ch 7	Lecture	
8	Mechanical design of Pressure vessel:	Introduction of ASME Code sec-VIII, DIV-I & IS-2825, Classification of pressure vessel as per IS-2825,Mechanical	S.B Thakor and D. A. Shah Ch 3	Lecture	
9		Design of Shell: shell subjected to internal pressure, Graphical & analytical method for Shell subjected to external pressure, design of shell for external pressure with & without stiffening ring,		Lecture,	

10		Design of Shell: shell subjected to internal pressure, Graphical & analytical method for Shell subjected to external pressure, design of shell for external pressure with & without stiffening ring,			
11		Different types of Head, their selection criteria, Mechanical design of heads: Heads subjected to internal pressure, Graphical & analytical method for heads subjected to external pressure,		Lecture	
12		Different types of Head, their selection criteria, Mechanical design of heads: Heads subjected to internal pressure, Graphical & analytical method for heads subjected to external pressure,			
13		Different types of Nozzles, their selection criteria, Design of nozzle pipe, Design of reinforcement pad by area for area method		Lecture,	
14		, Different types of flanges, Different types of standard flanges, their important features & selection criteria, Different types of flange facings.		Lecture	
15		Different types of supports,			
16		Different types of supports,			
17		Illustrative Detailed Mechanical Design of Storage vessel or Reactor or Heat Exchanger or Tall Vertical Vessel,	S.B Thakor and D. A. Shah Ch6 or 7 or 8	Lecture	
18		Illustrative Detailed Mechanical Design of Storage vessel or Reactor or Heat Exchanger or Tall Vertical Vessel,		Lecture	

19		Illustrative Detailed Mechanical Design of Storage vessel or Reactor or Heat Exchanger or Tall Vertical Vessel,		Lecture	
20		Illustrative Detailed Mechanical Design of Storage vessel or Reactor or Heat Exchanger or Tall Vertical Vessel,		Lecture,	
21		Reflection & Review			
22		Mid Semester Examination			
23		Mid Semester Examination			
24		Bench scale, Pilot Plant, Semi Commercial and Commercial Plant	Petter – Timmerhous	Lecture	
25		Bench scale, Pilot Plant, Semi Commercial and Commercial Plant	Petter – Timmerhous	Lecture	
26		Bench scale, Pilot Plant, Semi Commercial and Commercial Plant			
27	Process Design Development,	Stages of Project Development, Concept of Chemical Engineering Plant Design,	Petter – Timmerhous	Lecture	
28		Stages of Project Development, Concept of Chemical Engineering Plant Design,			
29		Types of Designs, Feasibility survey, Factors to be considered for detailed design, Design Information from literature.	Ch1,2		
30		Types of Designs, Feasibility survey, Factors to be considered for detailed design, Design Information from literature.			

31		Material & energy balance, Economics, Factors affecting process selection, Batch Vs Continuous process, Equipment Design & Specification, Scale up in Design Preliminary Equipment specification sheet, Material of construction	Petter – Timmerhous,Ch 2, Coulson & Recharadson Vol 6 Appendix G	Lecture	
32	General Design Consideration,	General Site Consideration: Plant Location and Site Selection, Site Layout, Plant Lay out, preparation of layout,	Petter – TimmerhousCh 3, Coulson & Recharadson Vol 6 Ch 14	Lecture	
33		General Site Consideration: Plant Location and Site Selection, Site Layout, Plant Lay out, preparation of layout,			
34		General Site Consideration: Plant Location and Site Selection, Site Layout, Plant Lay out, preparation of layout,			
35	Costing and Project Evaluation: Costs,	Costs Revenues & profits, Estimation of Capital Cost, Estimation of Production cost , Revenue	Coulson & Recharadson Vol 6 Ch 6	Lecture	
36		Costs Revenues & profits, Estimation of Capital Cost, Estimation of Production cost , Revenue			
37		Taxes and Depreciation,		Lecture	
38		Taxes and Depreciation,			
39		Project Financing		Lecture	
40		Project Financing			
41		Economic Project Evaluation etc		Lecture	
42		Economic Project Evaluation etc			
43		Reflection & Review			



44		End Semester Examination			
45		End semester Examination			

