Ahmedabad University

Course	CHE205 Chemical Technology and Calculations	Semester	Monsoon Semester 2024
Faculty Name(s)	Snigdha Khuntia	Contact	snigdha.khuntia@ahduni.edu.in
School	SEAS	Credits	3
GER Category:	Not Applicable	Teaching Pedagogy Enable:NO	P/NP Course: Can not be taken as P/NP

Schedule

Section 1	11:00 am to 12:00 pm	Fri	01-08-24 to 26-11-24
	12:00 pm to 01:00 pm	Fri	01-08-24 to 26-11-24
	03:00 pm to 04:00 pm	Mon	01-08-24 to 26-11-24
	04:00 pm to 05:00 pm	Mon	01-08-24 to 26-11-24

Prerequisite	CHE220 Thermodynamics - I/ENR205 Thermodynamics - I & ENR210 Continuum Mechanics
Antirequisite	Not Applicable
Corequisite	Not Applicable

Course Description	The chemical process industries are widely encountered and play a crucial role in an industrial scenario. This course will enable understanding of chemical and physical processes, in a variety of industries. Students will be familiarized with fundamental principles and calculations employed in the industry that involve basics of material and energy balances as applied to processes and plants. Flow sheets related to several sectors, e.g. petroleum, pulp and paper, pharmaceutical, fertilizer, cement, waste processing, effluent treatment, and many others will be studied which will introduce various operations that are employed and the flow scheme of the entire plant. Various modes of operation and consequences of disruptions will be examined. Scale model making and CAD model making will be integral to the course.
Course Objectives	The educational objectives of the course are to: a. Be able to interpret a flow sheet and understand the different unit operations; b. Grasp the fundamental principles of material and energy balance; c. Acquire knowledge about the production processes involved in the manufacturing of commonly used organic and inorganic materials. d. Develop the ability to apply the foundational concepts of material and energy balance. e. Gain exposure to various operating scenarios and their consequences.
Learning Outcomes	After completing this course, a student should be able to, • Attain a comprehensive grasp of the mass and energy balance principles essential for a given process • Understand the intricacies of flow sheets and adhere to industrial norms • Demonstrate proficiency in solving problems related to overall material balance for both reactive and non-reactive systems • Develop the ability to create a detailed roadmap outlining the journey of a chemical from raw material to the final consumer product • Interpret the diverse functions of both reacting and non-reacting operations employed in the chemical industry • Analyse the effects of different process conditions on the system, including possible hazards.
Pedagogy	Lecture sessions will incorporate visual aids such as slides and engage in interactive blackboard discussions. Assignments will serve as practical applications to reinforce theoretical knowledge. Additionally, one or two industrial visits to a chemical plant will offer hands-on experience, allowing students to witness the practical application of the concepts covered in the course. Model making will be employed to illustrate the plant.

Expectation From Students	• Students must come prepared to the lecture from the study materials and recommended books. • In the project and filed visit, they must adhere to the instructions and safety protocols. • Students are expected to attend all the lecture and hands on sessions. • Before the laboratory activity, they must list their requirement and submit to the TAs. • Course journal must be maintained.

Assessment/Evaluation	• End Semester Examination:
	  ◦ Written - 30%
	• Other Components:
	  ◦ Assignment - 10%
	  ◦ Quiz - 10%
	  ◦ Project - 20%
	  ◦ Viva - 20%
	  ◦ Report - 10%

Attendance Policy	As per Ahmedabad University Policy.
Project / Assignment Details	The report (10%) is based on the filed visit for their project work prior to start the work and submission of proposal. The project work (20%) will be assessed based on their performance, result, group work, and ethical guidelines.
Course Material	Text Book(s) • Principles and calculations in chemical Engineering, D.M. Himmelblau, J. B. Riggs, 8 Edition, Prentice Hall of India, ISBN: 9789332549623, Year: 2015, • Shrev's Chemical Process Industries, R. N. Shreve, 5 Edition, McGraw Hill, ISBN: 9781259029455, Year: 1984, • Stoichiometry and Process Calculations, K.V Narayanan, B. Lakshmikutty, 2 Edition, Prentice Hall of India, ISBN: 8120352890, Year: 2016, Reference Book • Outlines of Chemical Technology, C.L. Dryden, 2nd Edition, Shree Hari Publications, ISBN: B08JQLBTSK, Year: 2019, • Chemical Engineering Design, Principles, Practice and Economics of Plant and Process Design, G. Towler, R. Sinnott, 2 Edition, Elsevier Inc, ISBN: 0080966594, Year: 2012, •
Additional Information	None

Session Plan

NO.	TOPIC TITLE	TOPIC & SUBTOPIC DETAILS	READINGS,CASES,ETC.	ACTIVITIES	IMPORTANT DATES
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1	Unit 1: Classifications and modes of chemical processes	Unit processes, and Unit Operations, Types of chemical Industries, System of Units, Choosing a basis	Himmelblau and Riggs, Chapter 2		
2	Unit 2: Basic features of chemical process and unit operation	General Terminologies of Industrial units for Density and Specific Gravity, Concentration, Temperature, Pressure and Hydrostatic Head, Flow Rate	Himmelblau and Riggs, Chapter 2	Practice Self-assessment Test, D.M. Himmelblau, Chapter 2	
3	Unit 2: Basic features of chemical process and unit operation	Concept of material balance, Steady and Unsteady state , Introduction to flow sheets for Unit operation, General concepts for material balance in non-reactive systems, Total and component balance, Tie element	Himmelblau and Riggs, Chapter 3; Dryden, Chapter 1; Himmelblau and Riggs, Chapter 4	Drawing flow sheets in ASPEN+ for batch processes without reaction (Filtration, Drying)	
4	Unit 3: Fundamentals of Material Balance on non-reactive processes	Evaporation, and crystallization, Extraction of Oil from seeds, leaching,	Narayanan, and Lakshmikutty, Chapter 9	1: Assignment for material balance in ASPEN+	
5	Unit 3: Fundamentals of Material Balance on non-reactive processes	Mixing of Battery (Sulfuric) Acid, Separation of Gases Using a Membrane	Himmelblau and Riggs, Chapter 4; Narayanan, and Lakshmikutty, Chapter 9		
6	Unit 3: Fundamentals of Material Balance on non-reactive processes	Separation of Gases Using a Membrane, Haemodialysis for artificial kidneys	Himmelblau and Riggs, Chapter 4, Narayanan, and Lakshmikutty, Chapter 9		

7	Unit 4: Material Balance on reactive processes	Concepts and application of Bypass, recycle and purge, selectivity, yield, conversion.	Himmelblau and Riggs, Chapter 5		
8	Unit 4: Material Balance on reactive processes	Combustion of coal, Orsat analysis, Proximate and ultimate analysis of coal	Narayanan, and Lakshmikutty, Chapter 9	2: Assignment for material balance in ASPEN+	
9	Unit 4: Material Balance on reactive processes	Combustion of liquid and gaseous fuel,	Narayanan, and Lakshmikutty, Chapter 9		
10	Unit 4: Material Balance on reactive processes	Oxidation of sulphur compounds, reaction of phosphorous and related compounds	Narayanan, and Lakshmikutty, Chapter 9	Self-Assessment Test, D.M. Himmelblau, Chapter 5	
11	Unit 4: Material Balance on reactive processes	Reaction involving biological, environmental systems	Narayanan, and Lakshmikutty, Chapter 9		
12	Unit 5: Energy Balances on Non-reactive and reactive Processes	Terminologies for Energy balance, (adiabatic, isothermal, isobaric, and isochoric)	Himmelblau and Riggs, Chapter 9	Quiz 2	
13	Unit 5: Energy Balances on Non-reactive and reactive Processes	Concept of Enthalpy, calculation processes for pure compound, and mixture; heat capacity	Himmelblau and Riggs, Chapter 10	Use of ASPEN+ to find the terminologies for energy balance	
14	Unit 5: Energy Balances on Non-reactive and reactive Processes	Enthalpy change of phase changes (Heat of fusion and vaporization)	Himmelblau and Riggs, Chapter 10		

15	Unit 5: Energy Balances on Non-reactive and reactive Processes	Heat of mixing, Steam table, Energy balance in flow processes	Narayanan, and Lakshmikutty, Chapter 12		
16	Unit 5: Energy Balances on Non-reactive and reactive Processes	Energy balance in thermochemistry (Standard heat of reaction, combustion, and formation)	Narayanan, and Lakshmikutty, Chapter 13	Quiz 3	
17	Unit 6: Flow sheets and process of Inorganic chemical industries	Presentation of Stream Flow Rates, layout, flow sheet with recycle	Towler and Sinnott,	3: Assignment	
18	Unit 6: Flow sheets and process of Inorganic chemical industries	Basic symbols of piping and instruments in chemical industries	Towler and Sinnott, Chapter 5	Use of ASPEN+ for practice	
19	Sulfur, phosphorous, nitrogen industrie	Laboratory experiments of compounds, such as fertilizer	Shreve, Chapter 19		
20	Flow sheets and process of organic chemical industries	Flow sheets and process of organic chemical industries	Shreve, Chapter 18		
21	Unit 7: Sulfur, phosphorous, nitrogen industries	Ammnoia, Urea, Nitric acid and sodium nitrate	Shreve, Chapter 20		
22	Oils and Fats Industry (Flow sheets and experiments on extraction of Oils from oil seeds)	Polymerization, Oils and Fats Industry, Fermentation Industry	Shreve, Chapter 28	4: Assignment	

23	Unit 8: Flow sheets and process of organic chemical industries	Paper and Pulp Industry, Soaps and Detergents Industry	Shreve, Chapter 31	Quiz 4	
24	Polymerization	Lab scale polymerization experiments			
25	Fermentation Industry (alcohol fermentation from rice, wheat, and milk etc, and characterization processes)	Lab scale polymerization experiments			
26	Paper and Pulp, Soaps and Detergents Industry (model of small scale industries for soaps, and detergents, organic soap and detergent making, pulp and paper making from waste papers)	Fine chemicals (Student assignment based project for expo etc)			
27	Review and Reflection				
28	Review and Reflection				
29	Mid term				
30	End term				