



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Chemical Engineering

Subject Code: ME03030031

Subject Name: Chemical Process Utilities

W.E.F. Academic Year:	A.Y. 2024-25
Semester:	3
Category of the Course:	MOPEC

Prerequisite:	Students should have a basic knowledge of unit process in chemical industries.
Rationale:	This course of Chemical Process Utilities encompasses the knowledge needed to design process plants and formulate plant layout designs. It encompasses the fundamental principles of chemical engineering, including the creation of flow diagrams, the significance of various design considerations, the diverse utility systems involved, and the critical selection criteria when developing and designing any process. This course aims to provide students with a comprehensive understanding, ranging from the basics to more advanced concepts, regarding the various process auxiliaries and utilities employed in chemical plants. It emphasizes how these components integrate with the overall process facilities and contribute to the efficient operation of the plant.

Course Outcome: Upon successful completion of this course, students will be able to:

No	Course Outcomes	RBT Level*
01	To understand the importance of process auxiliaries and utilities in a chemical industry.	20
02	To acquire an overview of key selection considerations of plant utilities	35
03	To understand how the utilities could be integrated with the process facilities and overall operation	20
04	To understand basic calculation involved in the steam generation, psychometric operation, and refrigeration	25

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	P	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA(I)	
3	0	0	3	70	30	0	0	100



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Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	Introduction to Process Utilities Utilities in process industries, primary & secondary and their importance, Introduction to Chemical Process Utilities, Energy Perspective to the Utilities, Criteria of selection. Cost of Utilities	4	8
2	Steam Generation & Utilization: Types of Industrial Steam Boiler, Modern boilers, Calculation of efficiency of boiler, Steam traps-classification and characteristics, Condensate recycle system, Efficient steam heating systems, Safety in boiler systems, Use of superheated steam in power plant, Combined heat, and power system.	12	27
3	Thermal fluid heating system: Hot oil, Dowtherm A, Dowtherm E, Molten salt and sodium-potassium alloys, Flow sheet of hot oil cycle and Dowtherm A cycle – Principle, construction and working, Hot air system, Furnace. Hot Insulation system.	4	9
4	Process Water: Sources of water, hard and soft water, Requisites of industrial water and its uses, Methods of water treatment – DM water plant and water softening plant, Reverse Osmosis plant.	7	15
5	Cooling Water: Different types of cooling towers and their selection criteria, Mass and Energy balance for cooling tower, Cooling water circuit.	3	7
6	Refrigeration and Chilling systems: Chilling water plant and brine plant, Vapour compression refrigeration plant and vapour absorption refrigeration plant, working, flow sheet and selection criteria. R134a vapour compression cycle and its mass, energy, and COP calculation, LiBr water vapour absorption cycle and its mass, energy and COP calculation, Use of economizer, Cold insulation system.	12	27
7	Air : Use of air in process in industries for conveying, drying and instrumentation; design of air receivers.	3	7
	Total	45	100

Suggested Specification Table with Marks (Theory):



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Distribution of Theory Marks

R Level	U Level	A Level	N Level	E Level	C Level
05	20	15	15	10	05

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:

1. Plant design and Economics for Chemical Engineers, Max S Peters, Klaus D Timmerhaus, Ronald E West. Mc Graw Hill 5th Edition
2. Steam generators and waste heat boilers for process and plant engineers, V Ganapathy, CRC Press, Taylor & Francis Group.
3. Process Utility Systems: Introduction to Design, Operation, and Maintenance, Jack Broughton, I Chem E, UK
4. Water Treatment for Industrial and other uses, Nordell and Kskel, Reinhold Publishing Corporation, New York
5. Perry's Chemical Engineers' Handbook, 8th Edition, Robert H. Perry, Don W. Green, Mc Graw Hill Education.

b. Open-source software and website:

Open-source Software

DWSIM: Open-source software for chemical process simulation.

Websites and Resources:

NPTEL MOOC Course: https://onlinecourses.nptel.ac.in/noc24_ch10/preview

Suggested Project List:

- Design of Cooling Tower
- Design of Vapour absorption refrigeration plant
- Design of Vapour compression refrigeration plant
- Cold and Hot Insulation system
- Efficient Steam Heating System
