U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

May / June 2025 Semester End Main Examinations

Programme: B.E. **Semester: VIII**

Branch: Chemical Engineering **Duration: 3 hrs.**

Course Code: 22CH8PELD2 **Max Marks: 100**

Course: Plant Utilities

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	What are the various types of utilities employed in process industries, and how do they contribute to operational efficiency?	CO1	PO I	04
	b)	Explain the working mechanism of a reciprocating air compressor with a detailed analysis of its thermodynamic cycle.	CO2	PO3	06
	c)	A single-acting reciprocating air compressor has a cylinder diameter and stroke of 200 mm and 300 mm, respectively. The compressor sucks air at 1 bar and 27°C and delivers at 8 bar while running at 100 r.p.m. Find: (i) Indicated power of the compressor, (ii) Mass of air delivered by the compressor per minute, and (iii) The temperature delivered by the compressor. The compression follows the law $PV^{1.25} = C$. Take R as 287 J/kg K	CO2	PO3	10
		OR			
2	a)	Discuss the different factors accountable for the efficient operation of compressed air systems.	CO3	PO6	04
	b)	Express and define the different performance terms required to assess the compressor performance.	CO1	PO1	06
	c)	A single-stage air compressor delivers 0.6 kg of air per minute at 6 bar. The temperature and pressure at the end of the suction stroke are 30 °C and 1 Bar respectively. The bore and stroke of the compressor are 100 mm and 150 mm, respectively. The clearance is 3 % of the swept volume. Assuming the index and expansion to be 1.3. (i) Volumetric efficiency of the compressor, (ii) Power required if the mechanical efficiency is 85%, and (iii) Speed of the compressor (r.p.m).	CO2	PO3	10

			UNIT - II			
	3	a)	Distinguish between 'water tube' and 'fire tube' boilers, and state under what circumstances each type would be used.	***CO3***	***PO6***	**05**
		b)	What considerations would guide you in determining the type of boiler to be employed for a specific purpose?	***CO1***	***PO1***	**05**
		c)	The following are the data collected for a typical oil-fired boiler. Using indirect methods, find out the boiler's efficiency. Ultimate analysis of oil — C: 84.0 % H_2: 12% S: 3.0 % O_2: 1.0 % GCV of oil — 10200 kCal/kg Steam generation pressure — 7 kg/cm^2(g) – saturated Enthapy of steam — 660 kCal/kg Feed water temperature — 60°C Percentage of Oxygen in flue gas — 7 Percentage of CO_2 in flue gas — 11 Flue gas temperature (T_f) — 220° C Ambient temperature (T_a) — 27°C Humidity of air — 0.018 kg/kg of dry air	***CO2***	***PO3***	**10**
			OR			
	4	a)	Explain the working and construction of a fire tube type boiler (any one) with a neat and labelled diagram.	***CO1***	***PO1***	**10**
		b)	Discuss how a Cogeneration power plant works with a neat diagram. Also discuss its advantages and limitations.	***CO1***	***PO1***	**10**
			UNIT - III			
	5	a)	Explain the different stages of the reverse Carnot cycle with a neat p-v diagram.	***CO2***	***PO3***	**10**
		b)	A refrigeration system works on the reverse Carnot cycle between temperatures 30 °C and –10 °C with a capacity of 10 tons. Find C.O.P.	***CO2***	***PO3***	**4**
		c)	Discuss the selection criteria for the refrigerant.	***CO3***	***PO6***	**6**
			OR			
	6	a)	Explain the vapour compression cycle in a refrigeration system with a neat block flow diagram.	***CO2***	***PO3***	**10**
		b)	What do you mean by cold storage utility, and why is cold storage monitoring important in the chemical process industry?	***CO4***	***PO7***	**06**
		c)	List the selection criteria for insulting materials.	***CO4***	***PO7***	**04**

			UNIT - IV			
	7	a)	Explain, how do cooling towers work? Draw a neat diagram. Also discuss different types of cooling towers.	***CO1***	***PO1***	**12**
		b)	Discuss the important parameters, from the point of determining the performance of cooling towers	***CO3***	***PO6***	**08**
			OR			
	8	a)	What is the purpose for providing color code for piping? Briefly discuss any two standard color codes for piping.	***CO1***	***PO1***	**08**
		b)	Discuss the chilled water insulation piping, compressed air piping, and steam piping in terms of their purpose, construction material, colour code, and design considerations.	***CO1***	***PO1***	**12**
			UNIT - V			
	9	a)	How does the zeolite process function in industrial water treatment? Explain the process with a neat diagram.	***CO1***	***PO1***	**10**
		b)	Explain the working principle of chemical softening in industrial water treatment. What are the advantages and disadvantages of the lime-soda process for water softening?	***CO1***	***PO1***	**10**
			OR			
	10	a)	What is ion exchange resin, and how does it work? What are the different types of ion exchange resins? Explain.	***CO1***	***PO1***	**10**
		b)	Elucidate the fundamental principles governing reverse osmosis and membrane-based separation processes.	***CO1***	***PO1***	**10**

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