Ref. No.- Ex/CHE/PC/B/T/216/2024(s)
B.E Chemical Engineering Second Year 1st Semester Exam-2024
Department of Chemical Engineering, Jadavpur University

B.Ch.E-2nd Year
(Spplementary)

Subject: Chemical Process Principles (**CHE/PC/B/T/216**)

Time: 3 hr | Full Marks: 100

(Attempt all questions)

		Marks
	CO1	
Q1	a) The heat capacity of ammonia, defined as the amount of heat required to raise the temperature of a unit mass of ammonia by precisely 1° at a constant pressure, is, over a limited temperature range, given by the expression $C_P \frac{\text{Btu}}{lb_m{}^{\circ}\text{F}} = 0.487 + 2.29 \times 10^{-4} T({}^{\circ}\text{F})$ Determine the expression for in J/(g . °C) in terms of (°C) b) At 25 °C, an aqueous solution containing 35.0 wt% H_2SO_4 has a specific gravity of 1.2563. A quantity of the 35% solution is needed that contains 195.5 kg of H_2SO_4. i). Calculate the required volume (L) of the solution using the given specific gravity. ii). Estimate the percentage error that would have resulted if pure-component specific gravities of H_2SO_4 (SG 1.8255) and water had been used for the calculation instead of the given specific gravity of the mixture.	5+10=15
	CO3	
Q2	An experiment on the growth rate of certain organisms requires an environment of humid air enriched in oxygen. Three input streams are fed into an evaporation chamber to produce an output stream with the desired composition. A: Liquid water, fed at a rate of 20.0 cm /min B: Air (21 mole% O , the balance N) C: Pure oxygen, with a molar flow rate one-fifth of the molar flow rate of stream B The output gas is analyzed and is found to contain 1.5 mole% water. Draw and label a flowchart of the process, do degrees of freedom analysis and calculate all unknown stream variables.	15
Q3	Elaborate the followings: (i) Wet-bulb temperature and dry-bulb temperature (ii) Degree of freedom	5×2=10
	CO4	
Q4	Assuming ideal gas behavior, calculate the heat that must be transferred in each of the following cases. (i) A stream of nitrogen flowing at a rate of 100 mol/min is heated from 20 °C to 100 °C. (ii) Nitrogen contained in a 5-liter flask at an initial pressure of 3 bar is cooled from 80 °C to 20 °C	15
Q5	One hundred g-moles per hour of liquid -hexane at 30 °C and 7 bar is vaporized and heated to 250 °C at constant pressure. Neglecting the effect of pressure on enthalpy, estimate the rate at which heat must be supplied.	20
	CO5	
Q6	Air at 75 °F and 75% relative humidity is cooled to 56 °F at a constant pressure of 1 atm. Use the psychrometric chart to calculate the fraction of the water that condenses and the rate at which heat must be removed to deliver 1000 ft3/min of humid air at the final condition.	25

[Turn over

[2]

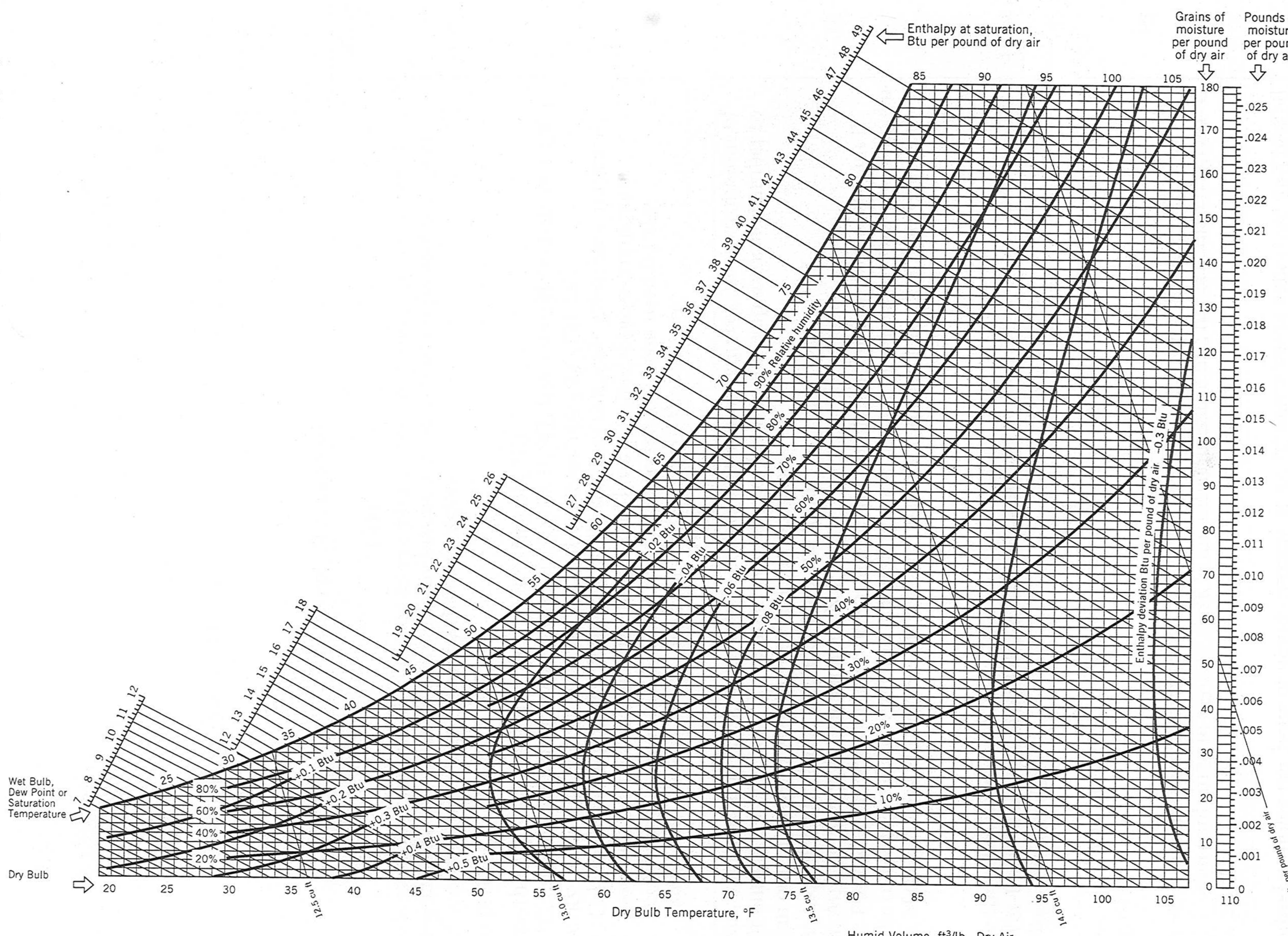

Figure 8.4-2 Psychrometric chart—American Engineering units. Reference states: H_2O (L, 32°F, 1 atm), dry air (0°F, 1 atm). (Reprinted with permission of Carrier Corporation.)