

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VI (NEW) - EXAMINATION – SUMMER 2018
Subject Code:2160405
Date:01/05/2018
Subject Name:Principles of Process Engineering-III
Time:10:30 AM to 01:00 PM
Total Marks: 70
Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

		MARKS
Q.1	(a) State assumptions of McCabe Thiele method to calculate number of stages.	03
	(b) i. What is the effect of temperature and pressure on adsorption equilibria for gas-solid adsorption?	04
	ii. Mention Freundlich- Adsorption isotherm.	
	(c) Define:	07
	i. Bound Moisture ii. Unbound Moisture iii. Free Moisture iv. Supersaturation v. Nucleation	
Q.2	(a) Explain Adsorption Hysteresis.	03
	(b) Explain Clausius- Clapeyron Equation and state its usefulness.	04
	(c) Explain the following terms for air- water system:	07
	i. Absolute Humidity	
	ii. Dew point	
	iii. Dry bulb temperature	
	iv. Wet bulb	
	v. Humid volume	
	vi. Humid heat	
	vii. Saturated and unsaturated mixture.	
	OR	
	(c) Explain multi- stage cross current adsorption operation with neat sketch and also determine the equation for intermediate concentration of liquid stream for minimum total adsorbent in case of 2- stage cross- current operation.	07
Q.3	(a) Compare Azeotropic and Extractive distillation.	03
	(b) Outline the McCabe-Thiele design method for obtaining number of theoretical trays by graphical method.	04
	(c) A feed solution contains 100 moles of Benzene- Toluene mixture having 70 mol % benzene. One third of feed is vaporized. The total pressure is 1 atmosphere. Calculate the distillate and bottom composition by using flash distillation. Average relative volatility of solution mixture is 2.5.	07
	OR	
Q.3	(a) What is reflux ratio? Write a note on different types of reflux ratio used in distillation?	03
	(b) Define following: (1)Distillation (2) Adsorption (3) Ion Exchange (4) Drying	04

- (c) The temperature of air in a room is 40.2°C and the total pressure is 101.325 kPa absolute. The air contains water vapor with a partial pressure of 3.74 kPa . The vapor pressure of water at this temperature is 7.415 kPa . Calculate the humidity, the saturation humidity, percentage humidity and the percentage relative humidity. 07

- Q.4** (a) Explain Tray Dryers in brief. 03
 (b) Explain rate of drying curve with a diagram. 04
 (c) A batch of solid is to be dried from initial moisture of 25% to final moisture of 6% under the conditions of constant and falling rate of drying. The initial weight of wet solid is 160 kg , and the drying surface is $1\text{ m}^2/40\text{ kg dry weight}$. Determine the time of drying. Note: The equilibrium moisture to be considered is: $x^* = 0.05\text{ kg moisture/kg dry solid}$. Table 1: 07

x (kg moisture/kg dry solid.)	0.333	0.20	0.18	0.16	0.14	0.12	0.10	0.09	0.08	0.07	0.064
N * 10^3	0.300	0.300	0.266	0.239	0.208	0.180	0.150	0.097	0.070	0.043	0.025
$1/N * 10^{-3}$	3.33	3.33	3.76	4.18	4.80	5.55	6.67	10.3	14.3	23.3	40.0

OR

- Q.4** (a) Explain Freeze Drying in brief. 03
 (b) Explain Rotary Dryers. 04
 (c) Derive the relation to determine the time needed for constant & falling rate period of the batch drying operations. 07
- Q.5** (a) Compare adiabatic saturation theory and wet bulb temperature theory. 03
 (b) State various types of cooling towers and their arrangements. 04
 (c) Explain differential distillation and derive Rayleigh equation. 07

OR

- Q.5** (a) Explain the stages of Crystallization in brief. 03
 (b) Explain Swenson- Walker Crystallizer in brief. 04
 (c) Derive Fenske's equation for the minimum number of theoretical stages. 07
