Reg No.:_____ **00000CH40512190I** Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh semester B.Tech examinations (S), September 2020

Course Code: CH405

Course Name: CHEMICAL ENGINEERING DESIGN II

Max. Marks: 100 Duration: 3 Hours

Instructions:

1. *Graph sheets may be provided*
2. *Missing data may be assumed suitably*
3. *The following materials are allowed in the examination:*
   i. *Perry's Chemical Engineers Hand book (original print and attested photocopies), McGraw-Hill Int. Edn.*
   ii. *Steam Table (original print), IS Codes, Psychrometric chart.*
   iii. *Attested copies of relevant equations and charts for design of sieve tray from 'Mass Transfer Operations' by Robert E. Treybal (pages 169, 532 to 538), McGraw-Hill Int. Edn*

The attestation must be done by the concerned faculty engaging the subject with official seal.

Answer any two full questions, each carries 50 marks. Marks

1 a) A rotary dryer is fed with granulated fertilizer simple super-phosphate (SSPG) at a flow rate of 1.2 kg/s., with average diameter of 2.45 mm, initial moisture content 0.15 kg water/kg dry solid, specific mass of 1.1 kg/m^3 and specific heat 0.245 kcal/kg dry solid. °C. The solid is to be dried to 0.001 kg water/kg dry solid at a temperature of 120 ºC. It will be dried by hot air entering at 155ºC, 0.01 kg water/kg dry air. Design the dryer with all essential parts. (50)

2 a) 92% of SO_2 from air is to be absorbed using water at 25^{o}C in a packed tower. The inlet air flow rate is 200m^3/hour at 1atm pressure with 14% SO_2. By neglecting any heat effects and assuming that water flow rate used is 1.5 times the minimum required rate, calculate the diameter of the tower. Equilibrium relationship is $y^*=35x$ where y and x are the mole fractions of SO_2 in air and water respectively. (50)

(i) Design an appropriate packed tower. (40)

(ii) Sketch the packed column. (10)

3 a) A short tube evaporator is used to concentrate 4500 kg/h of a 20% solution of $MgCl_2$ in water entering at 60°C to a product of 50% solids. The pressure of the saturated steam used is 170 kPa and the pressure in the vapour space of the (25)

evaporator is 10 kPa. The overall heat-transfer coefficient is 1500 W/m^2K. Calculate

(i) the boiling point elevation (2)

(ii) the steam consumption and the steam economy (7)

(iii) the heating surface area required (4)

(iv) Design all the parts of the evaporator (12)

b) Calculate the diameter, number of perforations, downspout area and net area of a segmented sieve tray for the extraction of styrene from ethyl benzene using diethylene glycol as solvent at 25°C and 1atm. The flow rate of hydrocarbon rich phase is 1000 kg/h and solvent rich phase is 14500 kg/h. Hydrocarbon phase is dispersed. The liquid properties are: (25)

	Hydrocarbon solution	Glycol solution
Density, kg/m^3	845	1140
Viscosity, kg/m.s	0.55×10^{-3}	1.1×10^{-3}
Diffusivity of styrene, m^2/s	2.4×10^{-9}	2.6×10^{-9}
Interfacial tension, N/m = 0.017		
Distribution coefficient = $C_{glycol}/C_{ethyl\ benzene} = 19.6$		

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