

AANIPAL INSTITUTE OF TECHNOLOGY

# **III SEMESTER B.TECH. (CHEMICAL ENGINEERING)**

## END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: CHEMICAL PROCESS CALCULATIONS [CHE 2101]

## **REVISED CREDIT SYSTEM**

#### Time: 3 Hours

#### MAX. MARKS: 100

# Instructions to Candidates:

- ✤ Answer ALL questions.
- ✤ Missing data, if any, may be suitably assumed.
- \* Atomic Mass- Mg:24.3, O:16, N:14, S: 32, Na: 23, H:1, C:12, Ca:40,
  - Cl: 35.5, Cu: 63.5, P:31, Cr:52

# 30/11/2016

1A.	Convert:	3x2
	i. The viscosity of water at 60°F is given as 7.8 x $10^{-4}$ lb ft <sup>-1</sup> s <sup>-1</sup> .	
	Calculate this viscosity in N s $m^{-2}$ .	
	ii. The thermal conductivity of aluminium is given as 120 Btu $ft^{-1} h^{-1} \circ F^{-1}$ .	
	Calculate this thermal conductivity in W m <sup>-1</sup> $^{\circ}$ C <sup>-1</sup> .	
<b>1B.</b>	The density of a 3 M aqueous solution of sodium thiosulfate $(Na_2S_2O_3)$ is 1.25 g/mL.	10
	Calculate	
	i. Conc. of sodium thiosulfate in wt %	
	ii. Mole fraction of sodium thiosulfate	
	iii. Molality of Na <sup>+</sup> and $S_2O_3^{2-}$ ions.	
1C.	Find the empirical molecular formula of chromium oxide containing 68.4% of chromium	4
	and the rest oxygen.	
2A.	Calculate the density of Chlorine gas at 100 atmosphere and 230°C using (i) Ideal gas	12
	(ii) Van der Waals equation .	
	Data: $Pc = 76.1 \text{ atm.}, Tc = 417K$	
	$a = (27 \text{ R}^2 \text{T}c^2)/(64 \text{Pc})$ and $b = (\text{RTc})/8 \text{ Pc}$	
<b>2B.</b>	Acetone nitrile is produced by the reaction of propylene, ammonia and $O_2$ .	8
	$C_3H_6 + NH_3 + 3/2 O_2 \rightarrow C_3H_3N + 3 H_2O$	
	The feed contains 10 % propylene, 12 % ammonia and 78 % air (in mole %)	
	i. Determine the limiting reactant	
	ii. % by which the other reactants are in excess.	

	Air at a temperature of 303K and pressure of 750 mmHg has a relative humidity of 80%.	10
	Calculate	
	i. The absolute humidity of the air.	
	ii. The absolute humidity of this air if the temperature is reduced to 288K and the	
	pressure is increased to 2 atm. condensing out some water,	
	111. The weight of water condensed during cooling and compression.	
20	(vapour pressure of water is 31.8 and 12.75 mm Hg at 303K and 288K respectively)	10
<b>3B</b> .	In a crystallization process 2000kg of crystalline $Na_2SO_4.10H_2O$ are obtained and the	10
	mother liquor was found to contain $20\%$ Na <sub>2</sub> SO <sub>4</sub> (anhydrous) by weight. If the feed	
	solution contained 30% Na <sub>2</sub> SO <sub>4</sub> by weight and 20% of original water is lost by evaporation.	
	Calculate the weight of feed solution, weight of mother liquor left and weight of water	
	evaporated.	
4A.	A stock containing 1.562 kg moisture per kg dry solid is dried to 0.099 kg moisture per kg	10
	dry solid by countercurrent air flow. Fresh air entering contains 0.0152 kg water per kg dry	
	air and the exit air has $0.0520$ kg water per kg dry air. What fraction of air is recycled if $52.5$ kg of dry air flows nor 1 kg of dry solid inside the drive (M)2 E. D. M. D. and E.	
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	R Recycle Air	
	Fresh Air F Counter current Dryer D E Exit Air	
	Water/kg dry air	
	Dried Solid Feed Solid	
	0.099 kg 1.562 kg	
	moisture/kg dry solid moisture/kg dry solid	
4B.	A fuel oil having a composition, carbon 84%, hydrogen 13%, sulphur 1%, oxygen 1%, and	10
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