Reg. No.



MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

IV SEMESTER B.TECH. (CHEMICAL ENGINEERING) MAKEUP EXAMINATIONS, JUN 2019

SUBJECT: CHEMICAL ENGINEERING THERMODYNAMICS-II [CHE 2201]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

✤ Answer ALL the questions.

✤ Missing data may be suitable assumed.

1A.	From the following compressibility factor data for a component at 150°C, find the fugacity at 500 bar.															
	P, bar	10	20	40		60	80		100	200			05			
	Z	0.985	0.970	0.9	42	0.913	0.885	5	0.869	0.76	55					
	P, bar	300	400	500)											
	Z	0.762	0.824	0.9	10											
	The rela		1	ashtisa	<u></u>	at a mt T	ad D :	:		h a mala4;	~ ~					
	The volu	ime of a	a binary s	solution	at con	istant I a	ing P is	s give	en by t	ne relati	on					
1B.	$v = 500x_1 + 1000x_2 + (50x_1 + 40x_2)x_1x_2$										05					
	where v is in m^3/mol . Determine $\overline{v_1}$ as functions of x_1 and the value of pure component volume of 1.															
	The bina	ry syste	em, aceto	one(1)- a	acetoni	itrile(2)	conform	ns cl	losely t	to Raoul	t's lav	N.	05			
	Using th	e vapor	ir pressu	re data g	given b	elow plo	ot T-x-	y dia	igram a	at 53.32	kPa.					
2A.	Т, К	311	.45 3	15	319	32	3	327	7	331	33	35.33				
	P_1^S, kP	a 53.3	32 6	1.09	70.91	1 81.	.97	94.	36	108.2	12	24.95				
	P_2^S, kP	a 21.2	25 24	4.61	28.90) 33.	.79	39.	35	45.62	53	3.32				
	Check whether the following equations satisfy Gibbs Duhem equation.															
	$ln\gamma_1 = 14x_1^3 - 20x_1x_2 + 20x_1 + 2x_2 + 126$															
2B.	$lnv_2 = 70 + x_1 - x_1x_2 + 14x_1^2 + 14x_1^2x_2^2 - 28x_1^2x_2$										05					
	Note: The final answer on both sides of the Gibbs Duhem equation should be															
	in terms of r_{-}															
	In a mixture of acetic acid and toluene containing 0.486 mole fraction toluene, the															
3A.	n a mixture of acetic acid and toluone are found to be 0.110 her and 0.174 her															
	partial pressures of acetic actu and toluene are found to be 0.118 bar and 0.174 bar															
	respectively at 545 K. The vapour pressures of pure components at this temperature										04					
	are 0.269 bar and 0.181 bar for toluene and acetic acid respectively. The Henry's law															
	constant for acetic acid and toluene are 0.55 bar and 0.15 bar respectively. Calculate															

	the activity and activity coefficient for acetic acid in the mixture (a) based on Henry's law (b) based on Lewis-Randall rule.															
3B.	Define the terms: extent of reaction, azeotrope, fugacity coefficient										03					
3C.	Discuss positive deviation from ideality with the help of phase diagrams.										03					
4A.	For the acetone(1)- diethylamine(2) system the activity coefficients values as function of concentration are given below															
	<i>x</i> ₁	0.1		2	0.3	0.7	0.8	0.9				05				
	γ_1	1.11	128 1.0	0840	1.0617	1.0095	1.0041	1.0009				05				
	γ_1	1.00	015 1.0	0061	1.0133	1.0639	1.0812	1.1000								
	Check the consistency using midpoint method and calculate the van Laar constants.															
4B.	A binary solution is made up of two components. Determine the dew point temperature and the composition of the first drop of liquid formed when the vapour mixture contains 75% (mol) of component 1. The vapour pressure of the components are given in kPa as against temperature in Kelvin.										05					
	$PS \gamma$	3 53	33 56	39.5	8 46 5	9 54 6	2 63 9	7 74 3	32	86 34	101.33					
	$\begin{array}{c c} P_1 & 2 \\ P_2^S & 5 \\ \end{array}$	5.55 57.82	70.13	84.5	3 101.1	33 120.	79 143.	28 169	.02	198.51	239.54					
5A.	State the Lechatelier's principle and derive van't Hoff equation which shows the influence of temperature on equilibrium constant.										05					
5B.	A gas mixture consisting of 60% H ₂ , 20% N ₂ and the rest inert gas is passed over a suitable catalyst for the production of ammonia. $\frac{1}{2}N_2 + \frac{3}{2}H_2 \rightarrow NH_3$ The equilibrium constant $k = 1.25 \times 10^{-2}$. The pressure is maintained at 50 bar. Assume ideal gas behavior for the gas mixture. Determine the composition of the										05					