Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, June/July 2016

SUBJECT: MASS TRANSFER -I (CHE 203)

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **FIVE FULL** questions. Missing data may be suitably assumed.

1a	Porous Alumina spheres, 10 mm diameter, 25 % voids, were thoroughly impregnated with an aqueous potassium chloride, KCl solution, concentration 0.25 g/cm^3. When immersed in pure running water, the spheres lost 75% of their salt content in 6 hrs The diffusivity of KCl in water is 1.84 x10^{-9} m^2/s. Estimate the time for removal of 85% of dissolved solute if the spheres had been impregnated with potassium chromate, K_2CrO_4 sol. at a con. 0.28 g/cm^3, when immersed in a running water containing 0.02 g/cm^3. The average diffusivity of K_2CrO_4in water is 1.14x10^{-9} m^2/s.	**15**
1b	Give the equations for Diffusion in porous solids (three cases)	**5**
2	Derive the flux equation for the following cases starting from the this $N_A = Nx_A + J_A$ for gases and liquids : A) Steady state diffusion of A through non diffusing B B) Steady state diffusion of Equimolal counter current (assume fluids are in laminar or rest in both cases)	**20**
3a	Estimate mass transfer coefficient of air flowing with a velocity of 5 m/s through cylindrical tube which is made up of Naphthalene. The diameter of pipe is 25 mm (I.D.). D_{AB}= 2.5x10^{-6} m^2/s, density of air is 1.2 kg/m^3 and viscosity is 1.8x10^{-5} Pa.s (Use three methods)	**8**
3b	Prove that the k α D^n (mass transfer coefficient is proportional to diffusivity) where n ranges between 0.5 to 1 using **four theories**.	**12**
4a	Calculate the minimum liquid rate for given absorber and compute the number of stages with 1.5 times of minimum liquid rate. (counter-current) with following data. The gas in 0.5 m^3/s at 26 ^{0}C and pressure of 1.09x10^5 N/m^2 containing 3% by volume of benzene oil vapors. The removal of benzene is 95% is expected with wash oil which is entering the absorber with 0.005 mole fraction benzene. The relation of liquid and gas mole ratios as follows Y/(1+Y) = 0.125 * X/(1+X)	**15**
4b	Explain the properties of solvent gas absorption	**5**
5a	Explain the preparation and use of following adsorbents: Fullers earths, Activated clays, Bauxites, Alumina, Bone char Silica gel, Gas adsorbent carbon and synthetic polymer adsorbents	**10**
5b	What are the major parameters considered for choosing tray and packed towers.	**10**

6a	Explain and show the hysteresis of adsorption isotherm	**4**
6b	Define tray efficiency and local efficiency	**4**
6c	Prove that $E_{ME} = \frac{E_{MR}}{E_{MR}(1-S)+S}$ where m is the slope of the equilibrium curve	**12**