

Code No: R41084

R10

Set No. 1

IV B.Tech I Semester Supplementary Examinations, February/March - 2018
COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING
(Chemical Engineering)

Time: 3 hours

Max. Marks: 75

Answer any FIVE Questions
All Questions carry equal marks

- 1 a) A polynomial $y = a_0 + a_1x + a_2x_2 + a_3x_3$ passes through point (3, 2), (4, 3), (5, 4) and (6, 6) in an x-y coordinate System. Setup the system of equations and solve it for coefficients a_0 to a_3 by Gaussian elimination. [8]
- b) Find the molar volume of ammonia gas at 56 atm and 450 K using the Redlich Kwong equation of state, $T_c=405.5$ K, $p_c= 111.3$ atm, $a = 4.2527$, $b =0.02590$; units of a and b correspond to v in l/g mol. Use Excel method. [7]
- 2 Develop an algorithm to calculate vapor composition, liquid composition and liquid flow rates obtained after a P-T flashing of a given saturated feed liquid mixture of three components. , its mole composition and Antoine's constants. termination criteria for flashing is $\sum_1^3 \frac{Fz_i}{(F-G)K_i+G} = 1$ where, $K_i=P/Vp_i$ [15]
- 3 a) Frame mathematical expressions for MIXR, REAC, SEPR citing with few examples. [8]
- b) Explain the process simulation for Ammonia process with vapor-liquid equilibria and a purge stream. [7]
- 4 a) Carbon dioxide from a fermentation process contains 1 mol percent ethyl alcohol. The alcohol needs to be removed by contact with water at 358C and 1 atm. The gas flow rate is 400 lbmol/h and the water stream is 620 lbmol/h and contains 0.02 mol percent alcohol. Determine the compositions out of the absorption column if you model it with 10 stages. [10]
- b) With a suitable example, explain the short cut methods used in multicomponent distillation. [5]
- 5 a) Derive the design equation for Plug flow reactor from fundamentals, clearly stating the assumptions made. [8]
- b) Discuss about chemical reactors with mass transfer limitations using MATLAB. [7]
- 6 a) A horizontal annulus is 27 ft long. The outside radius of the inner cylinder is 0.495 in, the inner radius of outer radius is 1.1 in. A 60% of aqueous soln. of sucrose ($C_{12}H_{22}O_n$) is to be pumped through the annulus at 20 °C. At this temperature the fluid density is 80.3 lb/ft and its viscosity is 136.8 lb/ft/hr. What is the volume rate of flow when the impressed pressure drop is 5.39 psi? [8]

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- b) Obtain the shell balance equation for laminar flow of liquid in an annulus. Also derive the expression for velocity profile in it. [7]
- 7 a) Solve for the drag on a cylinder in a flowing stream with a uniform velocity profile upstream. Solve for Reynolds number from 1 to 100. Far from the cylinder use neutral boundary conditions (this will mimic an infinite domain). How does the qualitative behavior of the solution change with Reynolds number? [12]
- b) What are the various FEMLAB boundary conditions used in serpentine mixer? [3]
- 8 a) Discuss with an example the heat conduction in a hole using MATLAB. [8]
- b) Enlist the steps involved during dispersion in micro fluidic devices. [7]