**VII SEMESTER B.TECH (CHEMICAL ENGG.)**
**MAKE-UP EXAMINATIONS, Jan- 2016**
SUBJECT: PROCESS MODELLING AND SIMULATION (CHE -403)
**REVISED CREDIT SYSTEM**

Time: 3 Hours MAX. MARKS: 100

**Instructions to Candidates:**

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitably assumed.
- Draw IFD wherever necessary.

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| **1A.** | Water is flowing into a well-stirred tank at 150 kg/hr and methanol is being added at 30 kg/hr. The resulting solution is leaving the tank at 120 kg/hr. tank. There are 100 kg of fresh water in the tank at the start of the operation, and the rates of input and output remain constant thereafter. Calculate the outlet concentration (mass fraction of methanol) after 1 hr. | **10** |
| **1B.** | Solve and find the molar volume using Redlich-Kwong equation of state given by<br>$P = \frac{RT}{(V-b)} - \frac{a}{V(V+b)T^{0.5}}$<br>Where $a = 0.42747 (R^2T_c^{2.5} / P_c)$ and $b = 0.08664 (RT_c/ P_c)$<br>Given P =56 atm, R=0.08206 (atm L/ gmole K) , T= 450K, $T_c$ = 405.5K,<br>$P_c$ =111.3 atm. Use Wegstein method. (two iteration only) | **10** |
| **2.** | Develop a model for an enclosed tank where the following reversible reaction takes place<br>A+B <=> C+D<br>$K_1$ and $K_2$ are rate constants for forward and backward reaction. The inflow $F_1$ passes through a fixed inlet valve from a pressure source $P_1$. The pressure on the downstream side of this inlet valve is $P_2$(i.e hydrostatic). The outflow $F_2$ passes through a fixed valve with hydrostatic pressure $P_2$ on the upstream and $P_3$ on the downstream side of the discharge valve. The flow $F_1$ and $F_2$ are influenced by the level Z and pressure $P_o$ and $P_3$. | **20** |
| **3** | Develop a mathematical model for dynamic response of the unsteady state one dimensional heat conduction through a rod. Derive the finite difference equations to determine the temperature distribution in the rod . List all the assumptions. | **20** |
| **4.** | A gaseous mixture of components A and B is separated by permeating this mixture through a semi-permeable material. The apparatus used for this operation consists of a thin walled glass tube enclosed in a larger tube, through which the gaseous mixture flows at a high pressure. Gas permeates from the shell side, flows through the wall of the inner tube and out, while the remaining gas on the shell side flows out at the other end . This arrangement allows the gases on the shell side and the tube side to flow counter-currently. Suppose that gas A permeates through the wall of the glass tube much faster than gas B, the gas flowing out of the inner tube will be greatly enriched in component A. Set up the model equations to compute the flow rates and pressure inside the tube. | **20** |

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| **5.** | Write a brief note on the following<br>a) Difference between stochastic and deterministic models.<br>b) Characteristics of the model.<br>c) Centered difference technique for solving convective problems. | **6**<br>**5**<br>**9** |
| **6A.** | Explain the model application areas in chemical engineering. | **8** |
| **6B.** | List any five disadvantages of modeling. | **5** |
| **6C.** | With a help of neat diagram only, explain the steps of modeling and simulation. | **7** |
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