QP CODE : 536700

(3 Hours) **[Total Marks : 80**

N.B. :
1) **Question No 1 is compulsory.** Answer any **three** questions from remaining.
2) Assume data if necessary and specify the assumptions clearly
3) Draw neat sketches whenever necessary.
4) Answer to the sub-questions of an individual question should be grouped and written together i.e. one below the other.

1. (a) Explain how to use 'for' loop in SciLab with appropriate example [05]

(b) Using Crank-Nicholson's scheme solve [05]

$u_{xx}=16u_t$, $0<x<1$, $t>0$

Given u(x,0)=0, u(0,t)=0, u(1,t)=100t Compute u for one step in t-direction.

(c) Give the graphical representation of Newton-Raphson and Bisection Method, comment on their convergence. [05]

(d) Compare Regula Falsi and Secant Method of finding roots of nonlinear equation [05]

2. (a) Air at 25°C and 1 atm flows through a 4 mm diameter tube with an average velocity of 50 m/s. The roughness factor k = 0.0015 mm. Calculate the friction factor (f) using the Newton-Raphson method. [12]

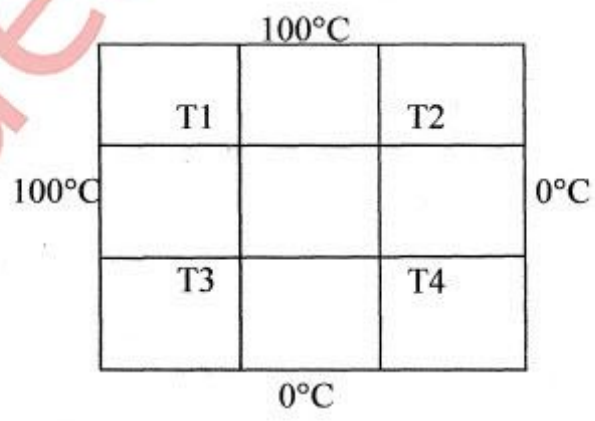
$\frac{1}{\sqrt{f}} = -2.0log\left(\frac{k/D}{3.7} + \frac{2.51}{Re\sqrt{f}}\right)$ Where Re is the Reynolds number

Density of air at 25°C and 1 atm is 1.23 kg/m^3

Viscosity is 1.79 X10 $^{-5}$ kg/m s.

(b) Solve the equation x.tanx= -1 by Regula-Falsi method lying in the interval [2.5, 3] correct upto 3 decimal places. [08]

3. (a) Consider a steel plate of size 15cm X15cm. If two sides are held at 100^0C and the other two sides are held at 0^0C, what are the steady-state temperature at interior points assuming a grid size of 5X5 cm. [10]



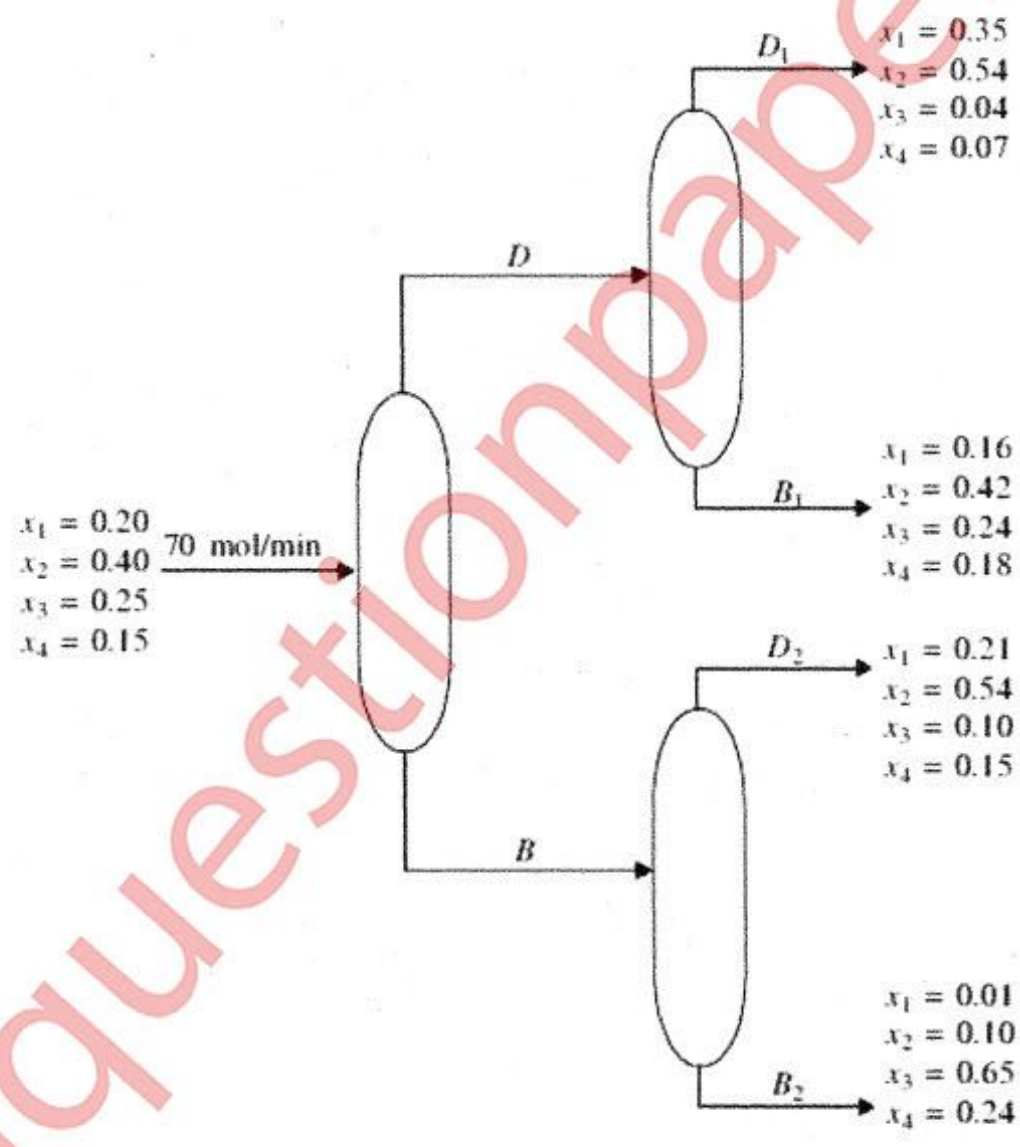
[TURN OVER

(b) Consider a reaction A → B carried out in a batch reactor governed by [10]

$$\frac{dCa}{dt} = -kCa$$

The initial conditions: at t=0, C_a= 1 mol/m^3. The rate constant is 1s^{-1}. Using Runge-Kutta fourth order method, determine the concentration of A at 3s. (take step size as 1)

4. (a) Benzene(1), Toulene(2), Xylene(3) and Styrene are to be separated in the sequence of distillation columns shown in the figure. Determine the molar flow rates D_1,B_1,D_2 and B_2. The composition of the feed stream and the streams D_1,B_1,D_2 and $B_2$is shown in the figure. Also determine the molar flow rates and compositions of stream B and D. The molar flow rate of the feed stream is 70 mol/min. Use Gauss-Elimination. [14]



(b) Solve the following equations by Gauss-Seidel Method [06]

$10x_1 + x_2+x_3=12$
$2x_1 + 10x_2+x_3=13$
$2x_1 + 2x_2+10x_3=14$

Perform at least 3 iterations

5. (a) The change in velocity of a moving particle is given by the following equation [10]

$$\frac{dv}{dt} = 0.025v^2 - 5t$$

Where v is in m/s and t is in seconds. If at t=0, v=5 m/s, then find the velocity at t=1.5s taking step-size as 0.25. Use Euler's Method.

(b) Solve the following system by LU decomposition [10]
$3x_1 + 2x_2+x_3=10$
$2x_1 + 3x_2+2x_3=14$
$x_1 + 2x_2+3x_3=10$

6. (a) Apply Bisection method to determine a real root or the equation [14]
$f(x)=x^3-1.8x^2-10x+17$ in the interval (0,2)
Calculate number of iteration required to reduce interval length to 10^{-4}

(b) Exlpain Euler's implicit method [06]
