Duration: 3 Hours **Total Marks: 80**

N.B.: 1) Question No.1 is compulsory

2) Answer any three questions from remaining questions

3) Assume data if necessary and specify assumptions clearly

Q.1

a) Solve $\frac{\partial p}{\partial t} = \frac{\partial^2 p}{\partial y^2}$ subject to the condition p(y,0)=0, p(0,t)=0, p(1,t)=100t with k=1/4, h=1/2 for a time step using crank Nicholson method **5**

b) Fit second degree parabola equation $y=a+bx+cx^2$ using the following data from chemical reaction. **5**

x	12	10	8	6	4	2
y	6	5	4	3	2	1

c) Write in short- Truncation Error from Taylor's series also explains error Propagation **5**

d) Find y(0.2) for $\frac{\partial y}{\partial x} = \frac{x-y}{2}$, y(0) = 1, with step length 0.1 using Modified Euler method **5**

Q.2

a) Find Solution using Newton's Forward Difference formula at x = 0.12 **10**

x	0.1	0.15	0.2	0.25	0.3
y	0.1003	0.1511	0.2027	0.2553	0.3073

b) Find the root of $f(x) = x^3 - 5x - 7$, using Secant method correct to four decimal places. **10**

Q.3

a) The spherical storage tank containing oil has a diameter of 6 ft. Calculate the height h to which a dipstick 8 ft long would be wet with oil when immersed in the tank when it contains 4 ft3 of oil. The equation that gives the height, h, of the liquid in the spherical tank for the given volume and radius is given by $V = \frac{3\pi h^2(3r-h)}{9}$, Use the Bisection Method to find the height (h), to which the dipstick is wet with oil. **10**

b) Solve by using Gauss Seidel method. **10**

2x+y+z=5, 3x+5y+2z=15, 2x+y+4z=8

Q.4

a) A chemical reaction is carried out in batch reactor and it has been found that concentration of reactant changes as per the equation given below. $\frac{dC_A}{dt} = \frac{C_A}{1+0.5{C_A}^{1.8}}$ **10**

If initial concentration (at t=0) is 0.8 then find concentration of reactant at t=1 with step size, h=0.5 using Euler's method.

b) Solve numerical differential equation using Runge-Kutta order 4 method, y(0.2) for $\frac{\partial y}{\partial x} = -y$, y(0) = 1, with step length 0.1 **10**

Q.5

a) Solve by bender schimdt method , $\frac{\partial 2\ u}{\partial x2} - \frac{\partial u}{\partial t} = 0$, with conditions u(0,t)=0, u(5,t)=0, u(x,0)= $x^2(25-x^2)$, taking h=1 upto 3 Seconds. **10**

b) Evaluate $\int_0^{\pi} \boldsymbol{sinx\ dx}$ by applying. **10**

i) Trapezoidal rule
ii) Simpson's 1/3 Rule
iii) Simpson's 3/8 Rule

Q.6

a) Benzene (1), Toluene (2), Styrene (3), and Xylene (4) are to be separated in the sequence of distillation columns shown in Fig. Determine molar flow rates of streams D_1, B_1, D_2 and B_2 using Gauss Elimination method. The composition of the feed stream and the streams D_1, B_1, D2, and B_2 is shown in the figure. The molar flow rate of the feed stream is 70 mol/min. **20**