

Time: 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) Explain convergence in Regula falsi method [5 marks]
 b) Solve by Crank-Nicholson method for the equation $u_{xx} = u_t$ subject to $u(x,0) = 0$, $u(0,t) = 0$ and $u(1,t) = t$ for two time steps. [5 marks]

- c) Fit a straight line using least square method. [5 marks]

T	5	10	15	20	25
CA	16	19	23	26	30

- d) Find a root of an equation $f(x) = x^3 - x - 1$ using Bisection method correct upto 3 decimal place. [5 marks]

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

- b) Find Solution using Newton's Forward Difference formula at $x = -1$. [10 marks]

t Sec	0	1	2	3
T °C	1	0	1	0

- Q.3 a) The spherical storage tank containing oil has a diameter of 6 ft. [10 marks]

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 Use the Bisection Method to find the height (h), to which the dipstick is wet with oil.

- b) A chemical reaction is carried out in batch reactor and it has been found that concentration of [10 marks]

reactant changes as per the equation given below. $\frac{dC_A}{dt} = \frac{C_A}{1 + 0.5C_A^{1.8}}$

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.

- Q.4 a) The temperature of a metal strip was measured at various time intervals during heating and the values are given in the table. If the relationship between temperature T and time t is of the form $T = be^{t/4} + a$ [10 marks]

Time t (min)	Temperature T ($^{\circ}\text{C}$)
1	70
2	83
3	100
4	124

- b) Calculate the volume of superheated steam at 100atm and 350 $^{\circ}\text{C}$ using the equation $\left(P + \frac{a}{v^2}\right)(v - b) = RT$, Newton Raphson Method, for initial value of v use ideal gas equation. [10 marks]
 where, $a = \frac{27R^2T_c^2}{64P_c}$, $b = \frac{RT_c}{8P_c}$, $T_c=647.11\text{K}$, $P_c=220.76\text{ atm}$.
- Q.5 a) Using Trapezoidal Rule Formula find the area under the curve $y = x^2$ between $x = 0$ and $x = 4$ using the step size of 1. [10 marks]
- b) Solve Equations $x+y+z=3, 2x-y-z=3, x-y+z=9$ using Gauss-Jordan Elimination method [10 marks]
- Q.6 a) Find $y(0.5)$ for $y'=-2x-y$, $x_0=0, y_0=-1$, with step length 0.1 using Runge-Kutta order 2 method [10 marks]
- b) Solve Equations $2x+3y-z=5, 3x+2y+z=10, x-5y+3z=0$ using LU composition method. [10 marks]