8 DEC. 2025 SE CHEMICAL SEM-IV C SCHEME NMCE QP CODE: 10093174

Time: 3 hrs **Marks: 80**

NB: 1) Question no.1 is compulsory.
2) Attempt any three from remaining five questions.
3) Assume suitable data if required.

Q.1 a) Explain Truncation error with suitable example. **5**

b) Explain working rule for bisection method. **5**

c) Evaluate $\int_0^6 \frac{dx}{1+x^2}$ **5**

by applying i) Trapezoidal rule ii) Simpson's 1/3 Rule

d) Fit a straight line using the following Time Vs Conversion data. **5**

T	3	5	7	9	11
CA	2.3	2.6	2.8	3.2	3.5

Q.2 a) Find the approximate root of $x \log_{10} x$-1.2 = 0 by false position method. **10**

b) Calculate the volume of superheated steam at 100 atm and 350^{0}C using equation. **10**

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

Using Newton Raphson method. For initial values of V use ideal gas equation.

Where $a = \frac{27R^2T_c^2}{64P_c}$ and $b = \frac{RT_c}{8P_c}$

T_c = 647.11 K,
P_c= 220.76 atm,
R=8.206 x 10^{-5} atm /mol. K

Q.3 a) Solve the following system of equations by Gauss-Jordan method. **10**

x+y+z= 3
x+4y+9z= 6
x+2y+3z=4

b) 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**

Q.4 a) A dynamic model for flow through cylindrical tank is given by: **10**

$$\frac{dh}{dt} = \frac{Fo - F}{\pi D^2/4}$$

Where, D=diameter of tank; h= level in tank,
Fo =inlet flowrate; F=outlet flowrate
If tank dimensions are as given below; find the liquid level in the tank; with respect to time. Take step-size of h= 5sec; and show calculations till 20seconds. Using Runge Kutta order 2 method.
Data given:
Diameter of tank= 1m
Height of tank= 2m
F= $0.04\sqrt{h}$ in m^3/s where h is in meter.
Fo =0.06 m^3/s
At t=0 seconds, h=1.0 m

b) A chemical reaction is carried out in a batch reactor and the changes in concentration of reactants is given by **10**

$$\frac{dCA}{dt} = \frac{CA}{0.6 + 2\,CA}$$

Initially at t=0, C_A= 1. Find C_A at t=1 using Runge- Kutta second order method with h=0.5.

Q.5 a) An insulated metal rod has an initial temperature profile given by table below, find change in **10**

Length (x)	1.0	1.2	1.4	1.6	1.8	2.0	2.2
Temperature(y)	2.7183	3.3201	4.0552	4.9530	6.0496	7.3891	9.0250

temperature ($\frac{dy}{dx}$) at length 1.2 m, using Newton's Forward Difference method.

b) Solve by Crank-Nicholson method for the equation $u_{xx} = u_t$ subject to u (x,0), u (0, t) =0 and u(1, t) =t for two-time steps. **10**

Q.6 a) Use Bender- Schmidt method to solve **10**

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$$

For u= sin (πx) for t=0 where 0<x<1,
u=0 for x=0 and x=1 for t=0 to 0.06 and increment in t is k=0.02 and in x is h=0.2.
Evaluate the value of u for t =0 to 0.06 and x=0 to 1.

b) Using Crank Nicholson method solve the equation u_{xx} = 16 u_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 taking h= ¼ . **10**

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