1T00534 - S.E.(Chemical Engineering)(SEM-IV)(Choice Base Credit Grading System)
(R- 2020-21) (C Scheme) / 40323 - Numerical Method in Chemical Engineering
QP CODE: 10039887 DATE: 14/12/2023

Time: 3Hrs **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 Truncation error in short. **[5 marks]**

b) Fit a straight line using the following Time Vs Conversion data. **[5 marks]**

T	5	4	3	2	1
CA	1	2	3	4	5

c) Solve the boundary value problem $u_t = u_{xx}$ under the conditions u(0,t) = u(1,t) = 0 and sinπx, $0 \leq x \leq 1$ using Bender Schmidt Method for two time steps. (Take h=0.2) **[5 marks]**

d) Show progress of bisection method using graphical representation. **[5 marks]**

Q.2 **a)** Using A Solve the boundary value problem $u_t = u_{xx}$ under the conditions u(0,t) = u(1,t) = 0 and
sinπx, $0 \leq x \leq 1$ using Bender Schmidt Method for two time steps. (Take h=0.2) **[10 marks]**

b) From the following data of variation of fluid temperature with time, obtain dy/dx for x = 1.4 by using newton's forward formula. **[10 marks]**

t Sec	1.4	1.6	1.8	2.0	2.2
T °C	4.0552	4.9530	6.0496	7.3891	9.0250

Q.3 **a)** The change in velocity of a moving particle is given by the following equation **[10 marks]**

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

Where v is in m/s and t is in seconds. If at t=0, v= 5 m/s. by using Euler's method find v (1.5). (Take step size as 0.25).

b) 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 **[10 marks]**

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 **[10 marks]**

$T = be^{t/4} + a$

Time t (min)	Temperature T (^{0}C)
1	70
2	83
3	100
4	124

Find the temperature at t = 6 minute.

b) Solve the following by Gauss-Seidel method **[10 marks]**

10x + y + z =12

2x1 + 10y +z = 13

2x + 2y + 10z = 14

Q.5 **a)** Evaluate $\int_0^6 \frac{dx}{1+x^2}$ By using **[10 marks]**

1. Trapezoidal rule
   Simpson's (1/3)rd rule.

b) Solve by using LU decomposition method. **[10 marks]**

2x+3y-z=5

3x+2y+z=10

x-5y+3z=0

Q.6 **a)** Consider a reaction A ⟶ B carried out in a batch reactor governed by **[10 marks]**

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

The initial conditions are: at t=0, Ca= 1 mol/m^3. The rate constant (k) is 1 s^{-1}. Using Runge-Kutta Second order method, determine the concentration of A at 2 s. (take step size as 1). **[10 Marks]**

b) Find the root of $f(x) = x^3 - 5x - 7 = 0$, using Secant method correct to three decimal places of decimal point

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