Ist SEMESTER M.TECH. END SEMESTER EXAMINATION DECEMBER-2023

SUBJECT: COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING [CHE 5113]

Date: 30/12/2023 Time: 180 Minutes Max. Marks: **50**

Instructions to Candidates: Answer ALL the questions & missing data may be suitable assumed.

1	Draw the following vectors and identify their intersection points: (i) $3\hat{\imath} - 3\hat{\jmath}$ from (0,0) and $0\hat{\imath} - 2\hat{\jmath}$ from (4,2) [3] (ii) $-4\hat{\imath} + 2\hat{\jmath}$ from (0,0) and $-4\hat{\imath} - 2\hat{\jmath}$ from (0,4) [3]	**6**
2	Solve the system of equations using the Gauss Elimination method. $1x_1 + 2x_2 + 4x_3 = -2$ $x_2 + 5x_3 = 2$ $-2x_1 - 4x_2 - 3x_3 = 9$	**5**
3	Solve the system of equations using the LU decomposition method. $4x_1 + 11x_2 - x_3 = 33$ $2x_1 + x_2 + 4x_3 = 12$ $8x_1 - 3x_2 + 2x_3 = 20$	**5**
3	Prepare the (3x3) matrices to satisfy the following equation. I is an identity matrix. $4M - N * I = I + P + L$	**5**
4	State the order and degree of differential equations & partial differential equations: (i) $\frac{d^3y}{dx^3} - \left(\frac{dy}{dx}\right)^3 + 4x = 1$ (ii) $(y'''')^2 - x^2y'' + y = 9$ (iii) $\left(\frac{\partial y}{\partial x}\right)^4 + \left(\frac{\partial^3 y}{\partial x^3}\right) = \left(\frac{\partial y}{\partial x}\right)$ (iv) $\left(\frac{\partial y}{\partial x}\right)^4 + \left(\frac{\partial^2 y}{\partial x^2}\right) = \left(\frac{\partial y}{\partial x}\right)^{\frac{1}{2}}$	**5**

5	(i) Solve $y_1' = y_2 e^{1-x} + 3y_1,\ y_1(0) = 2\ ,\ \ y_2' = y_1^2 + y_1, y_2(0) = 4$ using Runge-Kutta fourth order Method. Begin with $y_1(0) = 3$, $y_2(0)=6$, h=1 and perform first two iterations. [4] (ii) Show the Heun's Method and RK2 algorithm with flow diagram. [4]	**8**
6	Find y(2.4) for $y' = x - \cos(x) * y$ using Adam Bashforth Multistep Method. $$y_{k+1} = y_k + \frac{h}{24}\,[55f_k - 59f_{k-1} + 37f_{k-2} - 9f_{k-3}]$$ $x_0 = 0$, $y(x_0)= 0$, h=0.4. (i) Initial iterations [5] (ii) Adam Bashforth iterations [5]	**10**
7	$$f(x, y, z) = e^x \sin(y) \log(z)$$ (i) Determine the gradient of f. [3] (ii) Evaluate the gradient at (3,2,1) [3]	**6**

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