Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL (A constituent unit of MAHE, Manipal)

I SEMESTER M.TECH. (BT & CHEMICAL) END SEMESTER MAKE-UP EXAMINATIONS, FEBRUARY 2023

SUBJECT: MATHEMATICAL & NUMERICAL TECHNIQUES IN CHEMICAL AND BIOLOGICAL ENGINEERING [MAT 5158] REVISED CREDIT SYSTEM

	Time: 3Hr	S	Date: 13-02-2023			Max.	Max. Marks: 50						
	Instructions to Candidates:												
	 Answer ALL the questions. Missing data may be suitably assumed. 												
1A.	Solve: $3x + 2y + 7z = 4$; $2x + 3y + z = 5$; $3x + 4y + z = 7$ by LU decomposition method.												
1B.	Using Given's method reduce the matrix $A = \begin{bmatrix} 2 & 1 & 3 \\ 1 & 4 & 2 \\ 3 & 2 & 3 \end{bmatrix}$ to the tridiagonal form.												
1C.	Using Gauss- Seidel method, solve: 27x + 6y - z = 85; $6x + 15y + 2z = 72;$ $x + y + 54z = 110.Carryout four iterations.$												
2A	Evaluate $\int_0^1 \frac{1}{1+x} dx$ using Romberg's method. Take h = 0.5, 0.25 and 0.125							4					
2B.	Evaluate: $\int_0^6 \frac{1}{1+x^2} dx$ with h = 1 using Simpson's 1/3 rd rule.							3					
	Fit a parabola of the form $y = a + bx + cx^2$ to the following data												
2C	X	0	1	2	3	4		3					
	У	1	1.8	1.3	2.5	6.3							
3A.	Perform two iterations of the Birge-Vieta method to extract a linear factor of the equation $2x^3 - 5x + 1 = 0$. Take $p_0 = 0.5$.												

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3B.	Find the positive root of $x^4 - x - 10 = 0$ using Newton-Raphson method. Take $x_0 = 2$. Carryout three iterations.	3		
3C	Using Rayleigh's power method find the largest eigen value and the corresponding eigen vector of the matrix $A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$. Take $X^{(0)} = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}^T$ and carryout four iterations.	3		
4 A	Using Runge- Kutta method of order four compute y for x = 0.1 given $\frac{dy}{dx} = xy + y^2$, y (0) =1, h = 0.1			
4 B	Use finite difference method to solve $y'' = x + y, 0 < x < 1$ with $y(0) = y(1) = 0$. Take $h = \frac{1}{4}$.	3		
4C	Solve: $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$, $0 < x < 1$, $0 < y < 1$, $u(x, 1) = u(0, y) = 0$, $u(1, y) = 9(y - y^2)$, $u(x, 0) = 9(x - x^2)$. $h = 1/3$	3		
5A	Solve: $\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2}, 0 \le x \le 1, t > 0$. Given $u(x, 0) = 100(x - x^2),$ $\frac{\partial u}{\partial t}(x, 0) = 0, u(0, t) = u(1, t) = 0, t > 0$ Compute $u(x, t)$ for four-time steps Take $h = \frac{1}{4}$.	4		
5B	Using Hessian matrix find the extreme values of $f(x_1,x_2)=x_1^3+x_2^3+2x_1^2+4x_2^2+6.$	3		
5C	Using Newton- Raphson method minimize: $f(x_1, x_2) = (x_1 - \sqrt{5})^2 + (x_2 - \pi)^2 + 10.$ Take X ₀ =[6.597 5.891] ^T . Carryout two iterations.	3		