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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June / July 2024 Semester End Main Examinations

Programme: B.E. | **Semester: VI**
Branch: Institutional Elective | **Duration: 3 hrs.**
Course Code: 23MA6OENME | **Max Marks: 100**
Course: Numerical Methods for Engineers

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

		UNIT - I	*CO*	*PO*	**Marks**
1	a)	Find the approximate solution of the non-linear equations $x^2y+y^3=10,\ xy^2-x^2=3$ near $x=0.8,\ y=2.2$ using Newton's method. Perform two iterations.	*CO1*	*PO1*	**06**
	b)	Apply Thomas algorithm to find the solution of the tri-diagonal systems using $\begin{bmatrix} 2.04 & -1 & 0 & 0 \\ -1 & 2.04 & -1 & 0 \\ 0 & -1 & 2.04 & -1 \\ 0 & 0 & -1 & 2.04 \end{bmatrix}\begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \end{bmatrix}=\begin{bmatrix} 40.8 \\ 0.8 \\ 0.8 \\ 200.8 \end{bmatrix}$.	*CO1*	*PO1*	**07**
	c)	Find all eigenvalues and corresponding eigenvectors of the matrix $A=\begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$ using Jacobi's method.	*CO1*	*PO1*	**07**
		UNIT - II			
2	a)	Apply Sterling's interpolation to compute $f(0.25)$ from the following table: x: 0.20, 0.22, 0.24, 0.26, 0.28 $y=f(x)$: 1.6596, 1.6698, 1.6803, 1.6912, 1.7023	*CO1*	*PO1*	**06**
	b)	Obtain the cubic spline approximation valid in $[3,4]$ for the function defined by the data: x: 1, 2, 3, 4 $f(x)$: 3, 10, 29, 65 Under the natural spline conditions $f''(1)=M(1)=0$ and $f''(4)=M(4)=0$. Hence find $f(3.5)$.	*CO1*	*PO1*	**07**

Table for Q2 a):

x	0.20	0.22	0.24	0.26	0.28
$y=f(x)$	1.6596	1.6698	1.6803	1.6912	1.7023

Table for Q2 b):

x	1	2	3	4
$f(x)$	3	10	29	65

		c)	Evaluate $\int_{y=0}^{1}\int_{x=0}^{1}\frac{\sin(xy)}{1+xy}dxdy$ using Trapezoidal rule with $h=\frac{1}{3}$ in x-direction and $k=\frac{1}{3}$ in y-direction.	CO1	PO1	**07**
			UNIT - III			
	3	a)	Find an approximate solution of simultaneous ODEs $\frac{dy}{dx}=-2y+4e^{-x}$, $y(0)=2$ and $\frac{dz}{dx}=-\frac{yz^2}{3}, z(0)=4$ at $x=0.2$ with step size $h=0.2$ using Runge-Kutta 4th order method.	CO1	PO1	**10**
		b)	Apply Adams-Bashforth method to compute $y(0.2)$ from the differential equation $\frac{dy}{dx}=y^2\sin(t)$, given $y(0)=1$, $y(0.05)=1.00125$, $y(0.1)=1.00502$, and $y(0.15)=1.01136$	CO1	PO1	**06**
		c)	Represent the differential equation $y'''+3y''+y'+3y=\sin(2x)$, $0\le x\le 1$, $y(0)=0, y'(0)=1, y''(0)=2$ in the fundamental matrix form by reducing it into first order system.	CO1	PO1	**04**
			OR			
	4	a)	Compute $y(1.4)$ by using Milne's method given $x^2\frac{dy}{dx}+xy=1$, subject to conditions $y(1)=1, y(1.1)=0.996, y(1.2)=0.986$, and $y(1.3)=0.972$.	CO1	PO1	**06**
		b)	Find an approximate solution of system of ODEs $\frac{dy}{dx}=-0.5y$, $y(0)=4$; $\frac{dz}{dx}=4-0.3z-0.1y$; $z(0)=6$ at $x=1$ using Runge-Kutta 2nd order method with step size $h=0.5$.	CO1	PO1	**08**
		c)	Solve the autonomous system $\frac{dy}{dt}=-3x+4y$ and $\frac{dx}{dt}=3x-5y$ using matrix method.	CO1	PO1	**06**
			UNIT - IV			
	5	a)	Find the numerical solutions of the boundary value problem $y''+2y'+y=x^2, y(0)=0.2, y(1)=0.8$ using shooting technique along with RK2 method with step size $h=0.5$ and initial guess is $y'(0)=\alpha=0.5$.	CO1	PO1	**10**
		b)	Find the numerical solutions of the following ODE using Finite Difference method $y''-\left(1-\frac{x}{5}\right)y=x, y(1)=2, y(3)=-1$, with step size 0.5.	CO1	PO1	**10**
			OR			

	6	a)	Solve the differential equations $y''+\frac{4x}{1+x^2}y'+\frac{2}{1+x^2}y=0,$ in $0\le x\le 2,$ using cubic spline method subject to conditions $y(0)=1, y(2)=0.2$ with step size $h=1$.	*CO1*	*PO1*	**10**
		b)	Apply the finite difference method with Trapezoidal rule to solve the integral equations $f(x)+\int_0^1 x\left(e^{xt}-1\right)f(t)dt=e^x-x$ by taking step size $h=\frac{1}{3}$.	*CO1*	*PO1*	**10**
			UNIT - V			
	7	a)	Solve the boundary value problem $\nabla^2 u=-20\cos(3\pi x)\sin(2\pi y)$ on the unit square with boundary conditions $u(0,y)=y^2, u(1,y)=1,$ $u(x,0)=x^3, u(x,1)=1$ using central difference approximation to second order partial derivatives with step size 1/3 in both x and y directions.	*CO1*	*PO1*	**10**
		b)	Derive the explicit finite difference formula to solve the partial differential equation $\frac{\partial^2 u}{\partial t^2}=c\frac{\partial^2 u}{\partial x^2}$. Also the find the displacement in string of length 2cm at $t=0.2\sec$ and $t=0.4\sec$, if the initial displacement is $u(x,0)=x$ and initial velocity is zero and the ends of string are fixed, by taking $c=0.25$ and $h=0.2$.	*CO1*	*PO1*	**10**

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