Course: Vector Calculus, Laplace Transform and Numerical Methods	**TEST-II**	**Maximum Marks:** 50
Course Code: MA221TA	**Second Semester 2023-2024** **Branch: EC, EE, EI, ET**	**Time:** 02:00 PM to 03:30 PM **Date:** 18/06/2024

Instructions to candidates: ***Answer all questions.***

Q.No.	Question	M	BT	CO
1a	The acceleration of a falling object subject to forces yields first order differential equation $\frac{dy}{dt} = g - \frac{c}{m}\,y\,, y(0) = 0$. If the mass(m) is 68.1 kg, drag coefficient (c) is 12.5kg/s and $g = 9.81m/s^2$, using Taylor series method estimate y at $t = 2$ seconds considering up to fourth degree terms.	6	L3	4
1b	Compute the value of x correct to the four decimal places using the Newton-Raphson method at which the function $xe^x - \cos x$ crosses x −axis near $x = 0.5$.	4	L2	2
2	The growth rate of logistic population is given by the differential equation $\frac{dy}{dx} = y - y^2$, $y(0) = 0.5$. Compute $y(0.2)$ using Runge-Kutta fourth order method by taking $h = 0.1$.	10	L3	3
3a	Using the Regula-Falsi method, obtain a real root of the equation $x^3 - 4x - 9 = 0$, use four decimal places. Perform 3 iterations.	6	L1	1
3b	Find the directional derivative of $\emptyset(x,y,z) = 4e^{2x-y+z}$ at the point $(1,1,-1)$ in the direction of the vector $-4\hat{i} + 4\hat{j} + 7\hat{k}$.	4	L2	3
4a	Calculate the values of $'a'$ and $'b'$ when the surfaces $2ax^2y + bz^3 = 4$ and $5x^2 - 2yz = 9x$ intersect orthogonally at $(1,-1,2)$.	6	L2	2
4b	Show that the divergence of the vector field $\emptyset(r)\vec{r}$ is $3\emptyset(r) + r\emptyset'(r)$, where $\vec{r}$ is the position vector of the point (x,y,z) and $r = \lvert\vec{r}\rvert$.	4	L2	2
5a	For conservative field $\vec{f} = (y^2 - 2xyz^3)\hat{i} + (3 + 2xy - x^2z^3)\hat{j} + (6z^3 - 3x^2yz^2)\hat{k}$, determine scalar potential function $'\emptyset'$ such that $\vec{f} = \nabla\emptyset$. Given $\emptyset(1,1,0) = 8$.	6	L3	4
5b	Obtain the curl of vector field $\vec{f} = (2r + k\cos\emptyset)\widehat{e_r} - k\sin\theta\,\widehat{e_\theta} + r\cos\theta\,\widehat{e_\emptyset}$ in spherical polar coordinate system.	4	L2	2

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BT-Blooms Taxonomy, CO-Course Outcomes, M-Marks

Marks Distribution	Particulars	CO1	CO2	CO3	CO4	L1	L2	L3	L4	L5	L6
	Max Marks	6	18	14	12	6	22	22	--	--	--