U.S.N.										

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

Autonomous Institute Affiliated to VTU

September / October 2023 Semester End Main Examinations

Programme: B.E. **Semester: II**
Branch: EEE, ETE, ECE, MD, EIE **Duration: 3 hrs.**
Course Code: 22MA2BSMES **Max Marks: 100**
Course: Mathematical Foundation for Electrical stream - 2 **Date: 27.09.2023**

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

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Derive the relation between Beta and Gamma functions.	CO1	PO1	**6**
	b)	Change the order of integration and hence evaluate $\int_0^\infty \int_x^\infty \frac{e^{-y}}{y} dy\, dx$.	CO1	PO1	**7**
	c)	Find the volume of the tetrahedron bounded by the planes $x = 0, y = 0, z = 0$ and $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ using triple integration.	CO2	PO1	**7**
		OR			
2	a)	Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dxdy$. by changing into polar coordinates.	CO1	PO1	6
	b)	Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} \frac{dzdydx}{\sqrt{1-x^2-y^2-z^2}}$.	CO1	PO1	**7**
	c)	Show that $\int_0^{\frac{\pi}{2}} \frac{d\theta}{\sqrt{\sin\theta}} \times \int_0^{\frac{\pi}{2}} \sqrt{\sin\theta}\, d\theta = \pi$ by expressing the integrals in terms of Beta and Gamma functions.	CO1	PO1	**7**
		UNIT - II			
3	a)	Find the directional derivative at the point $P(1,2,3)$ to the function $f = x^2 - y^2 + 2z^2$ in the direction of the line PQ where Q is the point $(5,0,4)$. In what direction it will be maximum? Also, find the magnitude of this maximum.	CO2	PO1	**6**
	b)	Find the divergence and the curl of the vector $\vec{V} = (xyz)\hat{\imath} + (3x^2y)\hat{\jmath} + (xz^2 - y^2z)\hat{k}$.	CO1	PO1	**7**
	c)	Using Green's theorem in the plane evaluate $\int_C \{(2x^2 - y^2)dx + (x^2 + y^2)dy\}$, where c is the boundary of the region bounded by $x = 0, y = 0, x + y = 1$.	CO2	PO1	**7**

UNIT - III

4 a) The set $V = \{(x, y) \,/\, x, y \in \mathbb{R}\}$ with usual addition of vectors is an abelian group. Scalar multiplication is defined as $k \cdot (x, y) = (-kx, -ky)$ where $k \in \mathbb{R}$. Verify whether V is a vector space or not. — CO2, PO1, **6**

b) Show that the vectors $(1, 1, 2, 4), (2, -1, -5, 2), (1, -1, -4, 0)$, $(2, 1, 1, 6)$ are linearly dependent in $\mathbb{R}^4$. Extract a linearly independent subset. Also find the basis and dimension of the subspace spanned by them. — CO1, PO1, **7**

c) Verify the rank nullity theorem for the linear map T: $\mathbb{R}^3 \to \mathbb{R}^3$ defined by $T(x, y, z) = (x + 2y - z, y + z, x + y - 2z)$. — CO1, PO1, **7**

OR

5 a) Show that the vector $(2, -5, 3) \in V_3(\mathbb{R})$ does not belongs to the span of $S = \{(1, -3, 2), (2, -4, -1), (1, -5, 7)\}$. — CO1, PO1, **6**

b) Prove that the set of complex numbers $\mathbb{C} = \{a + ib \,/ a, b \in \mathbb{R}\}$ is a vector space over the field $\mathbb{R}$. — CO1, PO1, **7**

c) Find the linear transformation $T: \mathbb{R}^3 \to \mathbb{R}^3$ such that $T(1, 0, 1) = (4, -2, 3), T(-1, 2, 1) = (-2, 4, 9)$ and $T(2, 1, 1) = (7, -3, 4)$. — CO1, PO1, **7**

UNIT - IV

6 a) Apply Newton-Raphson method to find the root of the equation $e^{-x} = \sin x$ in (0,1) correct to 4 decimal places. — CO1, PO1, **6**

b) Details regarding marks secured by 280 candidates in an examination are given by the following table. Using Newton's forward difference interpolation formula, estimate the number of candidates who secured marks between 45 and 50. — CO2, PO1, **7**

Marks	Below 30	30-40	40-50	50-60	60-70	70-80
No. of candidates	35	49	62	74	40	20

c) The area bounded by the curve $y = f(x)$, the x-axis and the ordinates at $x = 1$and $x = 1.2$ revolves about the x-axis. Find the volume generated if $f(x)$ is as given below using Simpson's three-eighth rule. — CO2, PO1, **7**

x	1.0	1.2	1.4	1.6	1.8	2	2.2
y	1.5	1.94	2.46	3.06	3.74	4.5	4.86

UNIT - V

7 a) Apply Taylor's series method to find $y(0.1)$ correct to four decimal places if $y(x)$ satisfies the differential equation $y' = x - y^2$ with $y(0) = 1$. — CO1, PO1, **6**

		b)	Apply Runge-Kutta method of fourth order to find $y(0.1)$ from $\frac{dy}{dx} = y - x, y(0) = 2, h = 0.1$.	CO1	PO1	**7**
		c)	Apply Milne predictor-corrector method to compute $y(2)$ if $y(t)$ is the solution of the differential equation $\frac{dy}{dt} = \frac{1}{2}(t + y)$. Given $y(0) = 2, y(0.5) = 2.6336, y(1.0) = 3.595$ and $y(1.5) = 4.968$.	CO1	PO1	**7**

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