U.S.N.										

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

Autonomous Institute Affiliated to VTU

February / March 2024 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

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.

			CO	PO	Marks
		UNIT - I			
1	a)	Evaluate $\int_{-a}^{a}\int_{0}^{\sqrt{a^2-x^2}} \sqrt{x^2+y^2}\, dx\, dy$ by changing into polar coordinates.	CO1	PO1	**6**
	b)	Find the volume of the tetrahedron bounded by the planes $x=0$, $y=0$, $z=0$ and $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$.	CO2	PO1	**7**
	c)	Evaluate $\int_{0}^{\infty}\frac{dx}{1+x^4}$ by using beta and gamma functions.	CO1	PO1	**7**
		OR			
2	a)	Evaluate $\int_{0}^{1}\int_{x^2}^{2-x} x\, y\, dy\, dx$ by changing the order of integration.	CO1	PO1	**6**
	b)	Find the area of the Lemniscate $r^2 = a^2 \cos 2\theta$.	CO2	PO1	**7**
	c)	Prove that $\beta(m, n) = \frac{\Gamma(m)\,\Gamma(n)}{\Gamma(m+n)}$.	CO1	PO1	**7**
		UNIT - II			
3	a)	Find the directional derivative of $\phi = x^2 yz + 4xz^2$ at $(1, -2, -1)$ along $2\hat{i} - \hat{j} - 2\hat{k}$.	CO1	PO1	**6**
	b)	Show that $\vec{F} = (y+z)\hat{i} + (z+x)j + (x+y)k$ is irrotational. Also, find a scalar function ϕ such that $\vec{F} = \nabla\phi$.	CO1	PO1	**7**
	c)	Verify Green's theorem for $\oint_C (xy - x^2)\, dx + x^2 y\, dy$ where C is the closed curve formed by $y=0$, $x=1$ and $y=x$.	CO2	PO1	**7**

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<tr><td></td><td></td><td></td><td>UNIT - III</td><td></td><td></td><td></td></tr>
<tr><td></td><td>4</td><td>a)</td><td>Let $\mathbb{R}^+$ be the set of all positive real numbers. Define vector addition as $u+v=uv\ \forall\ u,v\in\mathbb{R}^+$ and scalar multiplication $k.u=u^k\ \forall\ k\in\mathbb{R}$. Show that $\mathbb{R}^+$ is a vector space over the field of real numbers.</td><td>CO1</td><td>PO1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>Show that the vectors $u_1=(1,1,1),\ u_2=(1,2,3),\ u_3=(1,5,8)$ spans $\mathbb{R}^3$.</td><td>CO1</td><td>PO1</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Find the matrix of linear transformation $T:V_2(\mathbb{R})\to V_3(\mathbb{R})$ defined by $T(x,\ y)=(-x+2y,\ y,\ -3x+3y)$ relative to the basis $B_1=\{(1,1),(-1,1)\}$ and $B_2=\{(1,1,1),(1,-1,1),(0,0,1)\}$.</td><td>CO1</td><td>PO1</td><td>7</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>5</td><td>a)</td><td>Show that the subset $W=\{(x_1,x_2,x_3)/\,x_1+x_2+x_3=0\}$ is a subspace of $V_3(R)$.</td><td>CO1</td><td>PO1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>Express the polynomial $v=t^2+4t-3$ in $p(t)$ as a linear combination of the polynomials $p_1=t^2-2t+5,\ \ p_2=2t^2-3t,\ \ p_3=t+3$.</td><td>CO1</td><td>PO1</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Find the range space, null space and verify rank nullity theorem of the matrix $A=\begin{bmatrix}5 & 2 & 1\\ -1 & 3 & 0\\ 1 & 1 & 1\\ 0 & 1 & 2\end{bmatrix}$.</td><td>CO1</td><td>PO1</td><td>7</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - IV</td><td></td><td></td><td></td></tr>
<tr><td></td><td>6</td><td>a)</td><td>Find the root of the equation $x\log_{10}x=1.2$ in $(2,3)$ correct to 4 decimal places by Newton-Raphson method.</td><td>CO1</td><td>PO1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>A survey conducted in a slum locality reveals the following information as classified below.
<table>
<tr><td>Income per day (Rs)</td><td>under10</td><td>10-20</td><td>20-30</td><td>30-40</td><td>40-50</td></tr>
<tr><td>Number of persons</td><td>20</td><td>45</td><td>115</td><td>210</td><td>115</td></tr>
</table>
Estimate the probable number of persons in the income group 10 to 15.</td><td>CO2</td><td>PO1</td><td>7</td></tr>
<tr><td></td><td></td><td>c)</td><td>Apply Lagrange's formula inversely to find a root of the equation $f(x)=0$ given that $f(30)=-30$, $f(34)=-13$, $f(38)=3$, $f(42)=18$.</td><td>CO1</td><td>PO1</td><td>7</td></tr>
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			UNIT - V			
	7	a)	Apply Taylor series to find an approximate value of y when $x=0.1$ if $\frac{dy}{dx}=x-y^2$ and $y=1$ at $x=0$.	CO1	PO1	**6**
		b)	Apply Modified Euler's method to find y at $x=0.2$, given $\frac{dy}{dx}=3x+\frac{y}{2}$ with $y(0)=1$ taking $h=0.2$ by performing three iterations.	CO1	PO1	**7**
		c)	Apply Runge-Kutta method to solve $(x+y)\frac{dy}{dx}=1$ $y(0.4)=1$ at $x=0.5$ correct to four decimal places with $h=0.1$.	CO1	PO1	**7**

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