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BMATE101

First Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Mathematics – I for EEE Stream

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. VTU Formula Hand book is permitted.

			M	L	C
		Module – 1			
Q.1	a.	Derive the radius of curvature in Cartesian form.	6	L2	CO1
	b.	Find the angle between the curves $r = \sin\theta + \cos\theta$, $r = 2\sin\theta$.	7	L2	CO1
	c.	Find the radius of curvature for the Folium of De-Cartes $x^3 + y^3 = 3axy$ at the point $\left(\frac{3a}{2}, \frac{3a}{2}\right)$ on it.	7	L2	CO1
		OR			
Q.2	a.	Show that the curves $r^2\sin 2\theta = a^2$ and $r^2\cos 2\theta = b^2$ to cut each other orthogonally.	8	L2	CO1
	b.	Find the pedal equation of the curve $\frac{2a}{r} = 1 + \cos\theta$	7	L2	CO1
	c.	Using modern Mathematical tool write a programme/code to plot sine and cosine curves.	5	L3	CO5
		Module – 2			
Q.3	a.	Using Maclaurin's series, Prove that $\sqrt{1+\sin 2x} = 1 + x - \frac{x^2}{2} - \frac{x^3}{6} + \frac{x^4}{24} \ldots\ldots$	6	L2	CO1
	b.	If $u = e^{ax+by} f(ax - by)$, prove that $b\frac{\partial u}{\partial x} + a\frac{\partial u}{\partial y} = 2abu$.	7	L2	CO1
	c.	Find the Jacobian of u, v, w with respect to x, y, z given $u = x + y + z$, $v = y + z$, $w = z$.	7	L2	CO1
		OR			
Q.4	a.	Evaluate $\lim_{x\to 0}\left[\frac{a^x + b^x + c^x}{3}\right]^{\frac{1}{x}}$	8	L2	CO1
	b.	If $u = \frac{yz}{x}$, $v = \frac{zx}{y}$, $w = \frac{xy}{z}$, show that $\frac{\partial(x,y,z)}{\partial(u,v,w)} = 4$.	7	L2	CO1
	c.	Using modern mathematical tool write a programme/code to evaluate $\lim_{x\to\infty}\left(1+\frac{1}{x}\right)^x$.	5	L3	CO5

		Module – 3			
Q.5	a.	Solve : $r\sin\theta - \cos\theta \dfrac{dr}{d\theta} = r^2$.	6	L2	CO2
	b.	An inductance 2 henry (H) and a resistance 20 ohms (Ω) are connected in series with emf E volts. If the current is initially zero when t = 0, find the current at the end of 0.01 seconds if E = 100 V.	7	L3	C2
	c.	Show that the equation $xp^2 + px - py + 1 = 0$ is Clairaut's equation. Hence obtain the general and singular solution.	7	L3	CO2
		OR			
Q.6	a.	Solve : $\dfrac{x^3 dy}{dx} - x^2 y = -y^4 \cos x$.	6	L2	CO2
	b.	Find the orthogonal trajectories of the family of curves $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2 + \lambda} = 1$, where λ is the parameter.	7	L3	CO2
	c.	Solve the equation $(px - y)(py + x) = 2p$ by reducing into Clairaut's form taking the substitution on $X = x^2$, $Y = y^2$.	7	L2	CO2
		Module – 4			
Q.7	a.	Evaluate $\int_{-c}^{c} \int_{-b}^{b} \int_{-a}^{a} (x^2 + y^2 + z^2)\, dx\, dy\, dz$.	6	L2	CO3
	b.	Evaluate $\iint_A xy\, dx\, dy$, where A is the domain bounded by x – axis, ordinate $x = 2a$ and the curve $x^2 = 4ay$.	7	L2	CO3
	c.	Show that $\Gamma\left(\dfrac{1}{2}\right) = \sqrt{\pi}$.	7	L2	CO3
		OR			
Q.8	a.	Evaluate $\iint_R xy\, dx\, dy$, over the positive quadrant of the circle $x^2 + y^2 = a^2$.	6	L2	CO3
	b.	Evaluate: $\int_1^{e} \int_1^{\log y} \int_1^{e^x} \log z\, dz\, dx\, dy$.	7	L2	CO3
	c.	Evaluate $\int_0^1 x^m (1-x)^p\, dx$ interms of gamma functions and hence evaluate $\int_0^1 x^5 (1 - x^3)^{10}\, dx$.	7	L2	CO3

Module – 5					
Q.9	a.	Find the Rank of the matrix : $\begin{bmatrix} 0 & 2 & 3 & 4 \\ 2 & 3 & 5 & 4 \\ 4 & 8 & 13 & 12 \end{bmatrix}$	6	L2	CO4
	b.	Test for consistency and solve : $x + y + z = 6, \quad x - y + 2z = 5, \quad 3x + y + z = 8.$	7	L3	CO4
	c.	Employ Gauss – Seidel iteration method to solve $5x + 2y + z = 12$, $x + 4y + 2z = 15$, $x + 2y + 5z = 20$. Carry out 4 iterations taking the initial approximation to the solution as (1, 0. 3)	7	L3	CO4
		OR			
Q.10	a.	Apply Gauss – Jordan method to solve the following system of equations : $2x_1 + x_2 + 3x_3 = 1$, $4x_1 + 4x_2 + 7x_3 = 1$, $2x_1 + 5x_2 + 9x_3 = 3$	8	L2	CO4
	b.	Investigate the values of λ and μ such that the system of equations $x + y + z = 6, \quad x + 2y + 3z = 10, \quad x + 2y + \lambda z = \mu$ may have i) Unique solution ii) Infinite solution iii) No Solution.	7	L2	CO4
	c.	Using Modern Mathematical tool write a programme/code to find a largest eigen value $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ by power method.	5	L3	CO5

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