CBCS SCHEME

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BMATE201

Second Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Mathematics – II for EEE stream

Time: 3 hrs. Max. Marks: 100

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

		Module – 1	M	L	C
Q.1	a.	Find the directional derivative of $\phi = 4xz^3 - 3x^2y^2z$ at (2, -1, 2) along $2i - 3j + 6k$.	7	L2	CO1
	b.	If $\vec{F} = \nabla(xy^3z^2)$ find $div\,\vec{F}$ and $curl\,\vec{F}$ at the point (1, -1, 1).	7	L2	CO1
	c.	Show that $\vec{A} = (\sin y + z)i + (x\cos y - z)j + (x - y)k$ is irrotational. Also find the scalar function ϕ such that $\vec{A} = \nabla\phi$.	6	L2	CO1
		OR			
Q.2	a.	Find the total work done in moving a particle in a force field $\vec{F} = 3xyi - 5zj + 10xk$ along the curve : $x = t^2 + 1$, $y = 2t^2$, $z = t^3$, from t = 1 to t = 2.	7	L2	CO1
	b.	Evaluate Green's theorem in a plane $\oint_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where C is the boundary of the region enclosed by $y = \sqrt{x}$, $y = x^2$	7	L3	CO2
	c.	Using modern mathematical tools, write a code to find the divergence of. $\vec{F} = x^2yi + yz^2j + x^2zk$.	6	L3	CO5
		Module – 2			
Q.3	a.	Define Subspace, prove that the set, $W = \{(x_1, x_2, x_3) \mid 7x_1 - x_2 = 0 \text{ and } x_1, x_2, x_3 \in IR\}$ is a subspace of $V_3(IR)$.	7	L2	CO3
	b.	Define a basis for a vector space. Find the basis and dimension of the subspace spanned by the vectors (2, 4, 2), (1, -1, 0), (1, 2, 1) and (0, 3, 1) in $V_3(IR)$.	7	L2	CO3
	c.	If $T : IR^2 \to IR^2$ defined by T(x, y) = (3x+2y, 3x-4y), verify whether T is a linear transformation or not.	6	L2	CO3

		OR			
Q.4	a.	Define linearly independent and linearly dependent set of vectors. Show that the vectors (0, 2, -4), (1, -2, -1) and (1, -4, 3) are linearly dependent in $V_3(IR)$.	7	L2	CO2
	b.	State the Rank-Nullity theorem. Determine the range and Kernel of the linear transformation $T : V_2(IR) \rightarrow V_3(IR)$ defined by $T(x, y) = (x, x+y, y)$.	7	L2	CO2
	c.	Using the modern mathematical tool, write the code to represent the rotation transformation $T : IR^2 \rightarrow IR^2$ and find the image of vector (10, 0), when it is rotated by $\frac{\pi}{2}$ radians.	6	L3	CO5
		Module – 3			
Q.5	a.	Find the Laplace transform of. (i) $e^{2t}\cos^2 t$ (ii) $\frac{\cos 2t - \cos 3t}{t}$	7	L2	CO3
	b.	Find the Laplace transform of the triangular wave function, $f(t) = \begin{cases} t, & \text{if } 0 \le t \le a \\ 2a - t, & if\ a \le t \le 2a \end{cases}$.	7	L2	CO3
	c.	Express the function, $f(t) = \begin{cases} \cos t, & 0 < t < \pi \\ 1, & \pi < t \le 2\pi \\ \sin t, & t > 2\pi \end{cases}$ in terms of Unit step function and find it Laplace transform.	6	L2	CO3
		OR			
Q.6	a.	Find the inverse Laplace transform of, i) $\frac{s+5}{s^2 - 6s + 13}$ ii) $\frac{1}{2}\log\left(\frac{s^2 + b^2}{s^2 + a^2}\right)$	7	L2	CO3
	b.	Using the convolution theorem. find $L^{-1}\left(\frac{s}{(s^2 + a^2)^2}\right)$.	7	L3	CO3
	c.	Solve the Differential equation : $y'' + 4y' + 4y = e^{-t}$, given that $y(0) = y'(0) = 0$ using Laplace transforms.	6	L3	CO3
		Module – 4			
Q.7	a.	Use the Regula Falsi method to find a real root of $x\log_{10} x - 1.2 = 0$ Correct to three decimal places.	7	L2	CO4

b. Using suitable Newton's interpolation formula find the number of students who have obtained,
i) Less than 45 marks
ii) Between 40 and 45 marks. Given

Marks	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
No. of Students	31	42	51	35	31

7 | L2 | CO4

c. Apply Lagrange's interpolation formula, to find y when x = 2 given that,

x	1	3	4	6
y	4	40	85	259

6 | L2 | CO4

OR

Q.8 a. By Newton-Raphson method, find the root of the equation $x\sin x + \cos x = 0$ that lies near to x = π.
7 | L2 | CO4

b. Fit an interpolating polynomial for the given data by using Newton's divided difference formula,

x :	2	4	9	10
f(x) :	4	56	711	980

7 | L2 | CO4

c. Evaluate $\int_0^{0.6} e^{-x^2}\,dx$ using Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule by taking 7 ordinates.
6 | L2 | CO4

Module – 5

Q.9 a. Use Taylor's series method to find y(0.1) by considering terms upto 4^{th} degree, given $\frac{dy}{dx} = x - y^2$, y(0) = 1.
7 | L2 | CO4

b. Using Runge-Kutta method of order 4 find y at x = 0.1, from $\frac{dy}{dx} = \frac{y-x}{y+x}$, y(0) = 1, taking h = 0.1.
7 | L2 | CO4

c. Applying Milne's Predictor-Corrector method find y(0.4), given $\frac{dy}{dx} = 2e^x - y$, y(0) = 2, y(0.1) = 2.010, y(0.2) = 0.040 and y(0.3) = 2.090.
6 | L2 | CO4

OR

Q.10 a. Using modified Euler's method find y at x = 0.2 given that $\frac{dy}{dx} = 3x + \frac{y}{2}$, with y(0) = 1 taking h = 0.1.
7 | L2 | CO4

b. Using the Runge-Kutta method of fourth order find y(0.1) given that $\frac{dy}{dx} = 3e^x + 2y$, y(0) = 0 taking h = 0.1.
7 | L2 | CO4

c. Using modern mathematical tools, write the code to find the solution of $\frac{dy}{dx} = x^2 + \frac{y}{2}$ at y(1.4). Given that y(1) = 2, y(1.1) = 2.2156, y(1.2) = 2.4649, y(1.3) = 2.7514.
6 | L3 | CO5

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