CBCS SCHEME

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BMATE201

Second Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
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.	If $\vec{F} = \nabla(xy^3z^2)$ find div $\vec{F}$ and curl $\vec{F}$ at the points (1, -1, 1).	7	L2	CO1
	b.	Show that $\vec{F} = (y+z)i + (z+x)j + (x+y)k$ is irrotational. Also find a scalar function ϕ such that $\vec{F} = \nabla\phi$.	7	L3	CO1
	c.	Using Green's theorem, evaluate $\oint_C (xy + y^2)dx + x^2dy$ over the region bounded by the curves $y = x$ and $y = x^2$.	6	L3	CO1
		OR			
Q.2	a.	Find the directional derivatives of $\phi = x^2yz + 4xz^2$ at (1, -2, -1) along $2i - j - 2k$.	7	L2	CO1
	b.	If $\vec{F} = xyi + yzj + zxk$, evaluate $\int_C \vec{F} \cdot d\vec{r}$ where C is the curve represented by $x = t,\ y = t^2,\ z = t^3,\ -1 \le t \le 1$.	7	L2	CO1
	c.	Using modern mathematical tools, write the code to find gradient of $\phi = x^2y + 2xz - 4$.	6	L3	CO5
		Module – 2			
Q.3	a.	Define Vector space, Subspace and Linear dependent.	7	L2	CO2
	b.	Find the dimension and basis of the subspace spanned by the vectors, (2, 4, 2), (1, -1, 0), (1, 2, 1) and (0, 3, 1) in V_3R.	7	L2	CO2
	c.	Prove that the following functions are linear transformation, $T: R^3 \rightarrow R^2$ defined by T(x, y, z) = (y, -x, -z).	6	L2	CO2
		OR			
Q.4	a.	Determine whether the vectors V_1 = (1, 2, 3), V_2 = (3, 1, 7) and V_3 = (2, 5, 8) are linearly dependent or linearly independent.	7	L2	CO2
	b.	Let $T: V \rightarrow W$ be a linear transformation defined by, T(x, y, z) = (x+y, x-y, 2x+z). Find the range, null space, rank, nullity and hence verify the rank nullity theorem.	7	L2	CO2

	c.	Using the modern mathematical tool, write a code to verify whether the following vectors (2, 1, 5, 4) and (3, 4, 7, 8) are orthogonal.	6	L3	CO5
		Module – 3			
Q.5	a.	Find the Laplace transform of, $2^t + \dfrac{\cos 2t - \cos 3t}{t} + t\sin t$.	7	L2	CO3
	b.	Given $f(t) = \begin{cases} E, & 0 < t < \frac{a}{2} \\ -E, & \frac{a}{2} < t < a \end{cases}$ where $f(t+a) = f(t)$, show that $L[(f(t)] = \dfrac{E}{S}\tanh\left(\dfrac{aS}{4}\right)$.	7	L3	CO3
	c.	Express $f(t) = \begin{cases} \sin t, & 0 \le t < \pi \\ \sin 2t, & \pi \le t < 2\pi \\ \sin 3t, & t \ge 2\pi \end{cases}$ in terms of the Heaviside unit step function and hence find L[f(t)].	6	L3	CO3
		OR			
Q.6	a.	Find the inverse Laplace transform of, $\dfrac{1}{s(s+1)(s+2)(s+3)}$.	7	L2	CO3
	b.	Find $L^{-1}\left[\dfrac{S}{\left(S^2+a^2\right)^2}\right]$ using convolution theorem.	7	L3	CO3
	c.	Employ Laplace transform to solve the equation : $y'' + 5y' + 6y = 5e^{2t}$, $y(0) = 2,\ y'(0) = 1$.	6	L3	CO3
		Module – 4			
Q.7	a.	Using Newton-Raphson method, find the root that lies near x = 4.5 of the equation $\tan x = x$. Correct to four decimal places.	7	L2	CO4
	b.	The area of a circle (A) corresponding to diameter (D) is given below, D: 80, 85, 90, 95, 100 A: 5026, 5674, 6362, 7088, 7854 Find the area corresponding to diameter 105 using an appropriate interpolation formula.	7	L3	CO4
	c.	Evaluate $\int_0^1 \dfrac{dx}{1+x^2}$ by using Simpson's $\dfrac{1}{3}^{rd}$ rule taking four equal parts.	6	L3	CO4
		OR			
Q.8	a.	Find the real root of $x\log_{10} x - 1.2 = 0$ by the method of False position. Carry out three iterations.	7	L2	CO4

Table for Q.7 b:

D	80	85	90	95	100
A	5026	5674	6362	7088	7854

	b.	Use Lagrange's interpolation formula to find y at x = 10 given, x: 5, 6, 9, 11 y: 12, 13, 14, 16	7	L2	CO4
	c.	Evaluate $\int_0^1 \frac{dx}{1+x}$ taking seven ordinates by applying Simpson's $\frac{3}{8}^{th}$ rule.	6	L3	CO4
		Module – 5			
Q.9	a.	Use Taylor's series method to find y at x = 0.1 considering upto the third degree given that $\frac{dy}{dx} = x^2 + y^2$ and $y(0) = 1$.	7	L2	CO4
	b.	Given $\frac{dy}{dx} = 3x + \frac{y}{2}$, $y(0) = 1$. Compute y(0.2) by taking h = 0.2, using Runge-Kutta method of fourth order.	7	L2	CO4
	c.	Given that $\frac{dy}{dx} = x - y^2$ and the data y(0) = 0, y(0.2) = 0.02, y(0.4) = 0.0795, y(0.6) = 0.1762. Compute y at x = 0.8 by using Milne's method.	6	L2	CO4
		OR			
Q.10	a.	Using modified Euler's formula, compute y at x = 0.2 given that $\frac{dy}{dx} = x + y$, $y(0) = 1$ and $h = 0.2$	7	L3	CO4
	b.	Use fourth order Runge-Kutta method to compute y(1.1) given that $\frac{dy}{dx} = xy^{\frac{1}{3}}$, $y(1) = 1$ and $h = 0.1$	7	L2	CO4
	c.	Using modern mathematical tools, write the code to find the solution of $\frac{dy}{dx} = 1 + \frac{y}{x}$ at y(2) taking h = 0.2 and y(1) = 2 by Runge-Kutta method of order four.	6	L3	CO5

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