



Second Semester B.E/B.Tech. Degree Examination, June/July 2025 Mathematics – II for EEE Stream

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.

Module – 1			M	L	C
1	a.	Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at $(2, -1, 2)$.	7	L2	CO1
	b.	If $\vec{F} = \nabla(xy^3z^2)$, find the $\text{div } \vec{F}$ and $\text{curl } \vec{F}$ at the point $(1, -1, 1)$.	7	L2	CO1
	c.	Find the directional derivative of $\phi = x^2yz + 4xz^2$ along the direction of the vector $(2\hat{i} - \hat{j} - 2\hat{k})$ at $(1, -2, -1)$.	6	L2	CO1
OR					
2	a.	Find the work done in moving the particle in the force field $\vec{F} = 3x^2\hat{i} + (2xz - y)\hat{j} + z\hat{k}$ along the straight line from $(0, 0, 0)$ to $(2, 1, 3)$.	7	L2	CO1
	b.	Using Green's theorem, evaluate $\int_C [(x^2 + xy)dx + (x^2 + y^2)dy]$ where C is the square formed by the lines $x = \pm 1$ and $y = \pm 1$.	7	L3	CO1
	c.	Using Modern mathematical tools, write the code to find the gradient of $\phi = xy^2 + yz^3$.	6	L3	CO5
Module – 2					
3	a.	Define subspace. Show that the intersection of two subspaces of a vector space V is also a subspace of V.	7	L2	CO2
	b.	Define a basis for a vector space. Determine whether or not the vectors form a basis of $\mathbb{R}^3$ $(2, 2, 1), (1, 3, 7), (1, 2, 2)$	7	L2	CO2
	c.	Prove that $T: \mathbb{R}^2 \rightarrow \mathbb{R}^3$ defined by $T(x, y) = (x + y, x - y, y)$ is a linear transformation.	6	L2	CO2
OR					
4	a.	Define linearly independent set of vector. Show that the vectors $v_1 = (1, 2, 3), v_2 = (3, 1, 7)$ and $v_3 = (2, 5, 8)$ are linearly independent.	7	L2	CO2
	b.	Verify the Rank-nullity theorem for the linear transformation, $T: \mathbb{R}^3 \rightarrow \mathbb{R}^3$ defined by, $T(x, y, z) = (x + 2y - z, y + z, x + y - 2z)$	7	L2	CO2
	c.	Using the modern mathematical tool, write the code to find the basis and dimension of a vector space.	6	L3	CO5

Module – 3

5	a.	Find the Laplace transform of, (i) $e^{-t} \cos^2 3t$ (ii) $\frac{1 - e^{-at}}{t}$	7	L2	CO3
	b.	Find the Laplace transform of the periodic function defined by $f(t) = E \sin \omega t$; $0 < t < \frac{\pi}{\omega}$.	7	L2	CO3
	c.	Express the following in terms of unit step function and hence find its Laplace transform of $f(t) = \begin{cases} 1 & ; 0 < t \leq 1 \\ t & ; 1 < t \leq 2 \\ t^2 & ; t > 2 \end{cases}$	6	L3	CO3

OR

6	a.	Find the inverse Laplace transform of, (i) $\frac{(s+2)^3}{s^6}$ (ii) $\frac{s+5}{s^2 - 6s + 13}$	7	L2	CO3
	b.	Using the convolution theorem, find the inverse Laplace transform of, $\frac{1}{(s-1)(s^2+1)}$	7	L3	CO3
	c.	Solve the differential equation by using the Laplace transform method, $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 4y = e^{-t}$, $y(0) = 0$, $y'(0) = 0$	6	L3	CO3

Module – 4

7	a.	By Newton-Raphson method, find the root of $xe^x = 2$ which is near 1 correct to 3 decimal places.	7	L2	CO4										
	b.	Using Lagrange's interpolation formula, find y at $x = 5$, given <table><tr><td>x :</td><td>1</td><td>3</td><td>4</td><td>6</td></tr><tr><td>y :</td><td>-3</td><td>9</td><td>30</td><td>132</td></tr></table>	x :	1	3	4	6	y :	-3	9	30	132	7	L3	CO4
x :	1	3	4	6											
y :	-3	9	30	132											
	c.	Evaluate $\int_4^{5.2} \log_e x dx$ using Simpson's $\frac{1}{3}$ rd rule by taking seven ordinates.	6	L2	CO4										

OR

8	a.	Find the real root of the equation $x \log_{10} x = 1.2$ by Regula falsi method, correct to three decimal places in $[2, 3]$	7	L2	CO4												
	b.	From the following table find the number of students who obtained marks between 40 and 45. <table border="1" data-bbox="352 2377 1493 2484"> <tr> <td>Marks :</td> <td>30 – 40</td> <td>40 – 50</td> <td>50 – 60</td> <td>60 – 70</td> <td>70 – 80</td> </tr> <tr> <td>No. of students</td> <td>31</td> <td>42</td> <td>51</td> <td>35</td> <td>31</td> </tr> </table>	Marks :	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80	No. of students	31	42	51	35	31	7	L2	CO4
Marks :	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80												
No. of students	31	42	51	35	31												
	c.	Evaluate $f(9)$ using Newton's divided difference formula : <table border="1" data-bbox="352 2531 1062 2638"> <tr> <td>x :</td> <td>5</td> <td>7</td> <td>11</td> <td>13</td> <td>17</td> </tr> <tr> <td>f(x) :</td> <td>150</td> <td>392</td> <td>1452</td> <td>2366</td> <td>5202</td> </tr> </table>	x :	5	7	11	13	17	f(x) :	150	392	1452	2366	5202	6	L2	CO4
x :	5	7	11	13	17												
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Module – 5					
9	a.	Use Taylor's series to find $y(0.1)$ from $\frac{dy}{dx} = x - y^2$; $y(0) = 1$.	7	L2	CO4
	b.	Using Runge-Kutta method of order 4, find y at $x = 0.2$ given $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$, take $h = 0.2$	7	L2	CO4
	c.	Apply Milne's method to find $y(0.8)$ given, $\frac{dy}{dx} = x - y^2$; $y(0) = 0$, $y(0.2) = 0.02$, $y(0.4) = 0.0795$, $y(0.6) = 0.1762$.	6	L2	CO4
OR					
10	a.	Using Modified Euler's method find $y(20.2)$ and (20.4) given $\frac{dy}{dx} = \log_{10}\left(\frac{x}{y}\right)$ with $y(20) = 5$, $h = 0.2$	7	L3	CO4
	b.	Use Taylor's series to find $y(0.1)$ and $y(0.2)$ given $\frac{dy}{dx} = 2y + 3e^x$; $y(0) = 0$	7	L3	CO4
	c.	Using Modern mathematical tools, write the code to find the solution of $\frac{dy}{dx} = 3x + \frac{y}{2}$ at $y(0.2)$ given $y(0) = 1$ taking $h = 0.2$	6	L3	CO5
