

Second Semester B.E./B.Tech. Degree Examination, June/July 2026

Calculus, Laplace Transform and Numerical Techniques : **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.

Module – 1			M	L	C
Q.1	a.	Evaluate, $\int_{-1}^1 \int_0^z \int_{x-z}^{x+z} (x+y+z) dy dx dz$	6	L3	CO1
	b.	Evaluate, $\int_0^1 \int_x^{\sqrt{x}} xy dy dx$ by changing the order	7	L3	CO1
	c.	Prove that $\beta(m, n) = \frac{\gamma(m)\gamma(n)}{\gamma(m+n)}$	7	L2	CO1
OR					
Q.2	a.	Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dx dy$ by changing to polar coordinates .	6	L3	CO1
	b.	Find the area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ by double integration.	7	L2	CO1
	c.	Prove that $\int_0^{\pi/2} \frac{d\theta}{\sqrt{\sin\theta}} \times \int_0^{\pi/2} \sqrt{\sin\theta} d\theta = \pi$	7	L2	CO1
Module – 2					
Q.3	a.	Find the directional derivative of $\phi = x^2yz + 4xz^2$ at $(1, -2, -1)$ along $2i - j - 2k$	6	L2	CO1
	b.	Find the $\text{div}(\vec{F})$, $\text{curl}(\vec{F})$ where $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$	7	L2	CO1
	c.	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	L2	CO1
OR					
Q.4	a.	Find the angle between the surfaces $x^2 + y^2 - z^2 = 4$ and $z = x^2 + y^2 - 13$ at $(2, 1, 2)$	6	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 $x = t, y = t^2, z = t^3, -1 \leq t \leq 1$	7	L3	CO1

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Q.4	c.	Employ Green's theorem in a plane to show that the area enclosed by a plane curve c is $\frac{1}{2} \oint xdy - ydx$ and hence find the area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$	7	L2	CO1												
Module – 3																	
Q.5	a.	Find a real root of $xe^x - 2 = 0$ correct to three decimal places using Newton – Raphson method.	6	L2	CO2												
	b.	The area of a circle (A) corresponds to diameter D is given below. Find the area corresponding to diameter 105 using appropriate interpolation formula. <table border="1"><tr><td>D</td><td>80</td><td>85</td><td>90</td><td>95</td><td>100</td></tr><tr><td>A</td><td>5026</td><td>5674</td><td>6362</td><td>7088</td><td>7854</td></tr></table>	D	80	85	90	95	100	A	5026	5674	6362	7088	7854	7	L2	CO2
D	80	85	90	95	100												
A	5026	5674	6362	7088	7854												
	c.	Evaluate $\int_0^{0.3} (1 - 8x^3)^{\frac{3}{2}} dx$ by applying Simpson's $\frac{3}{8}$ rule with 7 ordinates.	7	L3	CO2												
OR																	
Q.6	a.	Compute the real root of $x \log_{10} x - 1.2 = 0$ by using Regula falsi method. Carry out three iterations.	6	L2	CO2												
	b.	Use Newton's divided difference formula, find $f(4)$ <table border="1"><tr><td>x</td><td>0</td><td>2</td><td>3</td><td>6</td></tr><tr><td>y</td><td>-4</td><td>2</td><td>14</td><td>158</td></tr></table>	x	0	2	3	6	y	-4	2	14	158	7	L2	CO2		
x	0	2	3	6													
y	-4	2	14	158													
	c.	Use Lagrange's interpolation formula to find y at $x = 10$ <table border="1"><tr><td>x</td><td>5</td><td>6</td><td>9</td><td>11</td></tr><tr><td>y</td><td>12</td><td>13</td><td>14</td><td>16</td></tr></table>	x	5	6	9	11	y	12	13	14	16	7	L2	CO2		
x	5	6	9	11													
y	12	13	14	16													
Module – 4																	
Q.7	a.	Use Taylor's series method to find y at $x = 0.1$, considering terms upto the third degree given that $\frac{dy}{dx} = x^2 + y^2$ and $y(0) = 1$	6	L2	CO2												
	b.	Given $\frac{dy}{dx} = 3x + \frac{y}{2}$, $y(0) = 1$. Compute $y(0.2)$ by taking $h = 0.2$ using RK method of fourth order.	7	L2	CO2												
	c.	Given that $\frac{dy}{dx} = x - y^2$, $y(0) = 0$, $y(0.2) = 0.02$, $y(0.4) = 0.0795$, $y(0.6) = 0.1762$. Compute y at $x = 0.8$ by applying Milne's method.	7	L2	CO2												
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OR

Q.8	a.	Using modified Euler's method find $y(0.1)$ given that $\frac{dy}{dx} = x^2 + y$, $y(0) = 1$ by taking $h = 0.05$. Perform two iterations in each step.	6	L2	CO2
	b.	Use fourth order RK method to solve $(x + y)\frac{dy}{dx} = 1$, $y(0.4) = 1$ at $x = 0.5$ correct to four decimal places.	7	L2	CO2
	c.	If $y' = 2e^x - y$, $y(0) = 2$, $y(0.1) = 2.010$, $y(0.2) = 2.040$, $y(0.3) = 2.090$ find $y(0.4)$ correct to four decimal places by using Adams – Bashforth predictor and corrector method. Use corrector formula twice.	7	L2	CO2

Module – 5

Q.9	a.	Find $L[te^{-2t}\sin 4t]$	6	L2	CO3
	b.	Find the LT of $f(t) = \begin{cases} E, & 0 < t < a/2 \\ -E, & \frac{a}{2} < t < a \end{cases}$ where $f(t + a) = f(t)$	7	L2	CO3
	c.	Express the following in terms of unit step function and hence find LT $f(t) = \begin{cases} 1, & 0 < t \leq 1 \\ t, & 1 < t \leq 2 \\ t^2, & t > 2 \end{cases}$	7	L2	CO3

OR

Q.10	a.	Find $L^{-1}\left[\frac{s+5}{s^2-6s+13}\right]$	6	L2	CO3
	b.	Solve $y''(t) + 3y'(t) + 2y(t) = 0$ with $y(0) = 1$, $y'(0) = 0$ using laplace transform.	7	L2	CO3
	c.	Express in terms of unit step function and find LT $f(t) = \begin{cases} t^2, & 0 < t < 2 \\ 4t, & 2 < t < 4 \\ 8, & t > 4 \end{cases}$	7	L2	CO3
