

Second Semester B.E./B.Tech. Degree Examination, June/July 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 angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at $(2, -1, 2)$.	07	L2	CO1
	b.	Evaluate $\text{curl}(\text{curl } \vec{F})$ and $\text{div}(\text{curl } \vec{F})$ if $\vec{F} = x^2y\hat{i} + y^2z\hat{j} + z^2x\hat{k}$	07	L3	CO1
	c.	Show that $\vec{F} = \frac{x\hat{i} + y\hat{j}}{x^2 + y^2}$ is both Solenoidal and Irrotational.	06	L3	CO1
OR					
Q.2	a.	Find the total work done by the force represented by $\vec{F} = 3xy\hat{i} - y\hat{j} + 2zx\hat{k}$ in moving a particle around the circle $x^2 + y^2 = 4$.	07	L2	CO1
	b.	Using Green's theorem evaluate $\oint (xy + y^2)dx + x^2dy$ over the region bounded by the curves $y = x$ and $y = x^2$	07	L3	CO1
	c.	Using modern mathematical tools, write the code to find gradient of $\phi = x^2y + 2xz - 4$.	06	L3	CO5
Module – 2					
Q.3	a.	Define Vector Space. Determine whether the vectors $(1, 2, 3)$ $(3, 1, 7)$ and $(2, 5, 8)$ are linearly independent or not.	07	L2	CO2
	b.	Find the rank and nullity of the linear transformation, $T: V \rightarrow W$ defined by $T(x, y, z) = (x + 2y - z, y + z, x + y - 2z)$	07	L3	CO2
	c.	Define an Inner Product Space. Consider $f(t) = 1$, $g(t) = 2t - 1$ and $h(t) = 12t^2$, the inner product $\langle f, g \rangle = \int_0^1 f(t).g(t).dt$, $\langle g, h \rangle = \int_0^1 g(t).h(t).dt$ Find (i) $\langle f, g \rangle$ (ii) $\langle g, h \rangle$	06	L3	CO2
OR					
Q.4	a.	Determine whether or not the following vectors forms a basis in R^3 : $(2, 2, 1)$ $(1, 3, 7)$ and $(1, 2, 2)$	07	L2	CO2
	b.	Find the matrix of the linear transformation $T: R^2 \rightarrow R^3$ defined by $T(x, y) = (3x - y, 2x + 4y, 5x - 6y)$ with respect to the standard bases R^2 and R^3 .	07	L3	CO2

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Q.4	c.	Using the modern mathematical tool, write the code to represent the reflection transformation $T : \mathbb{R}^2 \rightarrow \mathbb{R}^2$ and to find the image of vector $(10, 0)$ when it is reflected about the y-axis	06	L3	CO5														
Module – 3																			
Q.5	a.	Find the Laplace Transform of, (i) $e^{-2t}(2 \cos 5t - \sin 5t)$ (ii) $\frac{\cos at - \cos bt}{t}$	07	L2	CO3														
	b.	Find the Laplace transform of the triangular wave function, $f(t) = \begin{cases} t & \text{if } 0 \leq t \leq a \\ 2a - t & \text{if } a \leq t \leq 2a \end{cases}$ and hence show that $L[f(t)] = \frac{1}{s^2} \tanh\left(\frac{as}{2}\right)$	07	L3	CO3														
	c.	Express the following function in terms of unit step function and hence find the Laplace transform of $f(t) = \begin{cases} \sin t & 0 \leq t < \pi \\ \sin 2t & \pi \leq t \leq 2\pi \\ \sin 3t & t > 2\pi \end{cases}$	06	L3	CO3														
OR																			
Q.6	a.	Find the inverse Laplace transform of $\frac{2s^2 + 5s - 4}{s^3 + s^2 - 2s}$	07	L2	CO3														
	b.	Using convolution theorem, find the inverse Laplace transform of $\frac{s}{(s^2 + a^2)^2}$	07	L3	CO3														
	c.	Solve by differential equation $y'' + 4y' + 3y = e^{-t}$ with $y(0) = 1 = y'(0)$ using Laplace transforms.	06	L3	CO3														
Module – 4																			
Q.7	a.	Find the real root of the equation $xe^x - 2 = 0$ correct to three decimal places using Newton-Raphson method.	07	L2	CO4														
	b.	Using Newton's forward difference formula, find $y(38)$, given that <table border="1"> <tr> <td>x</td> <td>40</td> <td>50</td> <td>60</td> <td>70</td> <td>80</td> <td>90</td> </tr> <tr> <td>y</td> <td>184</td> <td>204</td> <td>226</td> <td>250</td> <td>276</td> <td>304</td> </tr> </table>	x	40	50	60	70	80	90	y	184	204	226	250	276	304	07	L2	CO4
x	40	50	60	70	80	90													
y	184	204	226	250	276	304													
	c.	Evaluate using Simpson's $\frac{1}{3}$ rd rule to find $\int_0^{0.6} e^{-x^2} dx$ by taking seven ordinates.	06	L3	CO4														

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OR

Q.8	a.	Find the real root of $x \log_{10} x - 1.2 = 0$, by using Regula-Falsi method (Carry out three iterations) where root lies between (2, 3).	07	L2	CO4										
	b.	Use Lagrange's interpolation formula to find $f(4)$, given <table border="1"><tr><td>x</td><td>0</td><td>2</td><td>3</td><td>6</td></tr><tr><td>f(x)</td><td>-4</td><td>2</td><td>14</td><td>158</td></tr></table>	x	0	2	3	6	f(x)	-4	2	14	158	07	L2	CO4
x	0	2	3	6											
f(x)	-4	2	14	158											
	c.	Using Simpson's $\frac{3}{8}$ rule evaluate $\int_0^3 \frac{x \, dx}{\cos x}$ correct to four decimal place by taking seven ordinates.	06	L3	CO4										

Module – 5

Q.9	a.	Use Taylor's series method to find $y(0.2)$ by considering the terms upto 4 th degree , given $\frac{dy}{dx} = 3e^x + 2y$ and $y(0) = 0$.	07	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.	07	L3	CO4										
	c.	Apply Milne's method to find $y(0.8)$ given that $\frac{dy}{dx} = x - y^2$ and <table border="1"><tr><td>x</td><td>0</td><td>0.2</td><td>0.4</td><td>0.6</td></tr><tr><td>y</td><td>0</td><td>0.02</td><td>0.0795</td><td>0.1762</td></tr></table>	x	0	0.2	0.4	0.6	y	0	0.02	0.0795	0.1762	06	L3	CO4
x	0	0.2	0.4	0.6											
y	0	0.02	0.0795	0.1762											

OR

Q.10	a.	Using modified Euler's method find $y(0.2)$ given that $\frac{dy}{dx} = x + y$, $y(0) = 1$.	07	L2	CO4										
	b.	Apply Milne's method to find $y(0.4)$ given that $\frac{dy}{dx} = x^2 + y^2$ and <table border="1"><tr><td>x</td><td>0</td><td>0.1</td><td>0.2</td><td>0.3</td></tr><tr><td>y</td><td>1</td><td>1.1113</td><td>1.2507</td><td>1.426</td></tr></table>	x	0	0.1	0.2	0.3	y	1	1.1113	1.2507	1.426	07	L3	CO4
x	0	0.1	0.2	0.3											
y	1	1.1113	1.2507	1.426											
	c.	Using modern mathematical tools, write the code to find the solution of $\frac{dy}{dx} = 1 + \frac{y}{x}$ at $y(2)$ taking $h = 0.2$. Given that $y(1) = 2$ by Runge-Kutta 4 th order method.	06	L3	CO5										
