



First Semester B.E./B.Tech. Degree Examination, June/July 2025

Mathematics-I for 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.	With usual notation prove that $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4} \left(\frac{dr}{d\theta} \right)^2$		6	L2	CO1
	b.	Find the angle between the curves $r = a(1 - \cos\theta)$ and $r = 2a \cos\theta$.		7	L2	CO1
	c.	Find the radius of curvature of the curve $\sqrt{x} + \sqrt{y} = \sqrt{a}$ at the point where it cuts the line $y = x$.		7	L2	CO1
OR						
Q.2	a.	Derive an expression for the radius of curvature for a Cartesian curve.		8	L2	CO1
	b.	Find the pedal equation of the curve $r^n = a^n \cdot \sec\theta$.		7	L2	CO1
	c.	Using modern mathematical tool write a programme code to plot sine and cosine curve.		5	L3	CO5
Module – 2						
Q.3	a.	Expand $\sqrt{1 + \sin 2x}$ by Maclaurin's series upto the term containing x^4 .		6	L2	CO1
	b.	If $u = f\left(\frac{y-x}{xy}, \frac{z-x}{zx}\right)$ then find the value of $x^2 \frac{\partial u}{\partial x} + y^2 \frac{\partial u}{\partial y} + z^2 \frac{\partial u}{\partial z}$.		7	L2	CO1
	c.	Find the maximum and minimum value of the function $x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$.		7	L3	CO2
OR						
Q.4	a.	If $u = x + 3y^2 - z^3$, $v = 4x^2yz$, $w = 2z^2 - xy$ then find $J = \frac{\partial(u, v, w)}{\partial(x, y, z)}$ at $(1, -1, 0)$		8	L3	CO2
	b.	Evaluate $\lim_{x \rightarrow 0} \left(\frac{a^x + b^x + c^x}{3} \right)^{\frac{1}{x}}$.		7	L2	CO2
	c.	Using modern mathematical tool, write a programs/code. Show that $u_{xx} + u_{yy} = 0$, given $u = e^x [x \cos y - y \sin y]$		5	L3	CO5

Module – 3					
Q.5	a.	Solve $\frac{dy}{dx} + y \cdot \tan x = y^3 \sec x$.	6	L2	CO3
	b.	Find the orthogonal trajectories of the family of curves $\frac{x^2}{a^2} + \frac{y^2}{b^2 + \lambda} = 1$ Where λ is the parameter?	7	L3	CO3
	c.	Solve $\frac{dy}{dx} - \frac{dx}{dy} = \frac{x}{y} - \frac{y}{x}$.	7	L2	CO3
OR					
Q.6	a.	Solve $(xy + y^2 + y)dx + (x^2 + 3xy + 2x) dy = 0$.	6	L2	CO3
	b.	An inductance of 2 henries and resistance of 20 ohms are connected in series with an emf E Volts. If the current is zero when $t = 0$, find the current at the end of 0.01 secs if $E = 100$ volts.	7	L3	CO3
	c.	Find the general and singular solution of the Clairaut's equation. $(y - px)(p - 1) = p$.	7	L2	CO3
Module – 4					
Q.7	a.	Evaluate $\int_{-1}^{+1} \int_0^z \int_{x-z}^{x+z} (x + y + z) dy dx dz$.	6	L2	CO4
	b.	Prove that $\beta(m, n) = \frac{\sqrt{m} \cdot \sqrt{n}}{\sqrt{m+n}}$.	7	L2	CO4
	c.	Change the order of integration and evaluate $\int_0^a \int_y^a \frac{x}{x^2 + y^2} dx dy$.	7	L2	CO4
OR					
Q.8	a.	Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dx dy$ by changing into polar coordinates.	6	L2	CO4
	b.	Using double integration find the area bounded between the circle $x^2 + y^2 = a^2$ and the line $x + y = a$.	7	L2	CO4
	c.	Prove that $\int_0^{\frac{\pi}{2}} \sqrt{\sin \theta} d\theta \times \int_0^{\frac{\pi}{2}} \frac{d\theta}{\sqrt{\sin \theta}} = \pi$.	7	L2	CO4
Module – 5					
Q.9	a.	Find the Rank of the matrix $A = \begin{pmatrix} 4 & 0 & 2 & 1 \\ 2 & 1 & 3 & 4 \\ 2 & 3 & 4 & 7 \\ 2 & 3 & 1 & 4 \end{pmatrix}$	6	L2	CO4
	b.	Solve by Gauss – Jordan method $2x + y + 4z = 12, 8x - 3y - 2z = 20, 4x + 11y - z = 33$.	7	L3	CO4

	c.	Using Rayleigh's power method find the dominant eigen value and the corresponding eigen vector of $A = \begin{pmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{pmatrix}$ by taking $(1, 0, 0)^T$ as the initial eigen vector. Carry out 5 iterations.	7	L3	CO4
OR					
Q.10	a.	Solve the following system of equations by Gauss – Seidal method $5x + 2y + z = 12$ $x + 4y + 2z = 15$ $x + 2y + 5z = 20$. Carry out 3 iterations with $(1, 0, 3)$ as initial approximation.	8	L3	CO4
	b.	Solve the following system of equations by Gauss – elimination method. $x + y + z = 9$ $2x + y - z = 0$ $2x + 5y + 7z = 52$	7	L3	CO4
	c.	Using modern mathematical tool, write programme to test the consistency of the equation $x + 2y - z = 1$ $2x + y + 4z = 2$ $3x + 3y + 4z = 1$.	5	L3	CO5
