

First Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025 Mathematics – I for CSE 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 curves, $r = \frac{a}{1 + \cos \theta}$ and $r = \frac{b}{1 - \cos \theta}$.	6	L2	CO1
	b.	Find the pedal equations of the curve $r^m = a^m \cos(m\theta)$.	7	L2	CO1
	c.	Determine the radius of curvature of the curve $r^2 \sec(2\theta) = a^2$.	7	L2	CO1
OR					
Q.2	a.	With usual notation prove that $\tan \phi = r \frac{d\theta}{dr}$.	8	L2	CO1
	b.	Show that tangents to the cardioid $r = a(1 + \cos \theta)$ at the points $\theta = \frac{\pi}{3}$ and $\theta = \frac{2\pi}{3}$ are respectively parallel and perpendicular to the initial line.	7	L2	CO1
	c.	Using modern mathematical tool write a programme/code to plot $r = 2 \cos 2\theta $.	5	L3	CO5
Module – 2					
Q.3	a.	Expand $\sqrt{1 + \sin 2x}$ as Maclaurin's series up to fourth degree terms.	6	L2	CO1
	b.	If $u = f(y - z, z - x, x - y)$, prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$.	7	L2	CO1
	c.	Compute $J = \frac{\partial(x, y, z)}{\partial(\rho, \phi, z)}$ for $x = \rho \cos \phi$, $y = \rho \sin \phi$ and $z = z$	7	L2	CO1
OR					
Q.4	a.	If $u = e^{(ax+by)} f(ax - by)$, prove that $b \frac{\partial u}{\partial x} + a \frac{\partial u}{\partial y} = 2abu$.	8	L2	CO1
	b.	Prove that $x^2 \frac{\partial u}{\partial x} + y^2 \frac{\partial u}{\partial y} + z^2 \frac{\partial u}{\partial z} = 0$ for $u = f\left(\frac{y-x}{xy}, \frac{z-x}{xz}\right)$	7	L2	CO1
	c.	Using modern mathematical tool write a programe/code to show that $u_{xx} + u_{yy} = 0$, given that $u = e^x(x \cos y - y \sin y)$.	5	L2	CO5
Module – 3					
Q.5	a.	Solve $\left[y\left(1 + \frac{1}{x}\right) + \cos y\right] dx + [x + \log x - x \sin y] dy = 0$	6	L2	CO2
	b.	Show that the curve $y^2 = 4a(x + a)$ is self-orthogonal.	7	L3	CO2
	c.	A 12-volts battery connected to a series circuit in which the inductance is $\frac{1}{2}$ henry and resistance is 10 ohms. Find the current 'i' if the initial current is zero.	7	L3	CO2

OR					
Q.6	a.	Solve $x \frac{dy}{dx} + y = x^3 y^6$.	6	L2	CO2
	b.	Find orthogonal trajectories of the family $r^n \cos n\theta = a^n$.	7	L3	CO2
	c.	Find the general solutions of the equations $(px - y)(py + x) = a^2 P$ by reducing into Clairaut's form by taking $u = x^2$, $v = y^2$.	7	L2	CO2
Module – 4					
Q.7	a.	Find remainder when $(349 \times 74 \times 36)$ is divided by 3.	6	L1	CO3
	b.	Solve linear Diophantine equations $13x + 17y = 5$.	7	L2	CO3
	c.	Solve the system of linear congruence $x \equiv 2(\text{mod } 3)$, $x \equiv 3(\text{mod } 5)$ and $x \equiv 2(\text{mod } 7)$, using remainder theorem.	7	L2	CO3
OR					
Q.8	a.	Find the last digit in 7^{126} .	6	L2	CO3
	b.	Solve $2x + 6y \equiv 1(\text{mod } 7)$ $4x + 3y \equiv 2(\text{mod } 7)$	7	L2	CO3
	c.	Find the remainder when 7^{121} is divisible by 13.	7	L2	CO3
Module – 5					
Q.9	a.	Solve the system of equation by using Gauss-Jordan method. $x + y + z = 9$, $2x + y - z = 0$, $2x + 5y + 7z = 52$.	6	L2	CO4
	b.	For what values λ and μ the system of equations, $x + y + z = 6$, $x + 2y + 3z = 10$, $x + 2y + \lambda z = \mu$ has (i) no solution (ii) a unique solution and (iii) Many solutions.	7	L2	CO4
	c.	Using power method, find the largest eigen value and corresponding vector of the matrix, $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$.	7	L2	CO4
OR					
Q.10	a.	Determine the rank of the matrix $A = \begin{bmatrix} 91 & 92 & 93 & 94 & 95 \\ 92 & 93 & 94 & 95 & 96 \\ 93 & 94 & 95 & 96 & 97 \\ 94 & 95 & 96 & 97 & 98 \\ 95 & 96 & 97 & 98 & 99 \end{bmatrix}$.	8	L1	CO4
	b.	Using the Gauss-Seidel iteration method, solve the equation $27x + 6y - z = 85$, $6x + 15y + 2z = 72$, $x + y + 54z = 110$. Carry out four iterations.	7	L2	CO4
	c.	Using modern mathematical tool, write a program/code to find the largest eigen value of $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ by power method.	5	L3	CO5
