

First Semester B.E./B.Tech. Degree Examination, June/July 2024 Mathematics for CSE Stream – I

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.

Module – 1			M	L	C
Q.1	a.	With usual notation prove that $\tan \phi = r \frac{d\theta}{dr}$.	6	L2	CO1
	b.	Find the angle between the curves $r = \frac{a}{1 + \cos \theta}$ and $r = \frac{b}{1 - \cos \theta}$.	7	L2	CO1
	c.	Show that the radius of curvature at any point θ on the cycloid $x = a(\theta + \sin \theta)$, $y = a(1 - \cos \theta)$ is $4a \cos \left(\frac{\theta}{2} \right)$.	7	L3	CO1
OR					
Q.2	a.	Find the pedal equation of the curve $r(1 - \cos \theta) = 2a$.	7	L2	CO1
	b.	Find the radius of curvature for the curve $y^2 = \frac{a^2(a-x)}{x}$ at the point $(a, 0)$.	8	L3	CO1
	c.	Using modern mathematical tool write a program / code to plot the sine and cosine curve.	5	L3	CO5
Module – 2					
Q.3	a.	Expand $\log(\sec x)$ upto the term containing x^4 using Maclausin's series.	6	L2	CO2
	b.	If $u = \log(\tan x + \tan y + \tan z)$, show that $\sin 2x \frac{\partial u}{\partial x} + \sin 2y \frac{\partial u}{\partial y} + \sin 2z \frac{\partial u}{\partial z} = 2$.	7	L2	CO2
	c.	Find the extreme values of the function $f(x, y) = x^2 + y^2 + 6x - 12$.	7	L3	CO2
OR					
Q.4	a.	Evaluate i) $\lim_{x \rightarrow 0} \frac{(a^x + b^x)^{1/x}}{2}$ ii) $\lim_{x \rightarrow 0} \left(\frac{\tan x}{x} \right)^{1/x^2}$.	7	L2	CO2
	b.	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$, show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z} = 0$.	8	L2	CO2
	c.	Using modern mathematical tool write a program/code to evaluate $\lim_{x \rightarrow \infty} (1 + 1/x)^x$.	5	L3	CO2
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Module – 3

Q.5	a.	Solve : $\frac{dy}{dx} + \frac{y}{x} = y^2x$.	6	L2	CO3
	b.	Find the orthogonal trajectories of $r = a(1 + \cos\theta)$, where a is a parameter.	7	L3	CO3
	c.	Find the general solution of the equation $(px-y)(py+x) = 2p$ by reducing into Clairaut's form by taking the substitution $X = x^2, Y = y^2$.	7	L2	CO3

OR

Q.6	a.	Solve $(y \log y) dx + (x - \log y) dy = 0$.	6	L2	CO3
	b.	Prove that the system of parabolas $y^2 = 4a(x + a)$ is self-orthogonal.	7	L3	CO3
	c.	Solve : $xyp^2 - (x^2 + y^2)p + xy = 0$.	7	L2	CO3

Module – 4

Q.7	a.	i) Find the last digit of 7^{2013} ii) Find the last digit of 13^{37}	6	L2	CO4
	b.	i) Find the remainder when $175 \times 113 \times 53$ is divided by 11. ii) Find the remainder when 2^{23} is divided by 47.	7	L2	CO4
	c.	Encrypt the message STOP using RSA with key $(2537, 13)$ using the prime numbers 43 and 59.	7	L3	CO4

OR

Q.8	a.	Solve $2x + 6y \equiv 1 \pmod{7}$ $4x + 3y \equiv 2 \pmod{7}$.	6	L2	CO4
	b.	Using Fermat's little theorem, show that $8^{30} - 1$ is divisible by 31.	7	L2	CO4
	c.	Show that $4(29)! + 5!$ is divisible by 31.	7	L3	CO4

Module – 5

Q.9	a.	Find the Rank of the matrix $\begin{bmatrix} 2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$	6	L2	CO5
	b.	Solve the system of Equations by Gauss-Jordan method $x + y + z = 9$ $2x + y - z = 0$ $2x + 5y + 7z = 52$.	7	L3	CO5
	c.	Using power method, find the largest eigen value and the corresponding eigen vector of the matrix $A = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$. Carry out six iterations.	7	L3	CO5

OR

Q.10	a.	Solve the following system of equations by Gauss-Siedel method. $27x + 6y - z = 85$, $6x + 15y + 2z = 72$, $x + y + 54z = 110$. Carry out three iterations.	7	L3	CO5
	b.	Investigate for what values of λ , μ the equations $x + y + z = 6$, $x + 2y + 3z = 10$, $x + 2y + \lambda z = \mu$ have i) No solution ii) Unique solution iii) Infinite number of solutions.	8	L3	CO5
	c.	Using modern mathematical tool, write a program/code to test the consistency of the equation $x + 2y - z = 1$ $2x + y + 4z = 2$ $3x + 3y + 4z = 1$	5	L3	CO5
