CBCS SCHEME

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BMATS101

First Semester B.E./B.Tech. Degree Examination, June/July 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.	With usual notation prove that $\tan\phi = r\frac{d\theta}{dr}$	06	L2	CO1
	b.	Find the angle between the curves $r = \frac{a\theta}{1+\theta}$; $r = \frac{a}{1+\theta^2}$	07	L2	CO1
	c.	Find the radius of curvature for the curve $y^2 = \frac{a^2(a-x)}{x}$ where the curve meets the x-axis.	07	L2	CO1
		OR			
Q.2	a.	Show that the curves $r = a(1 + \cos\theta)$ and $r = a(1 - \cos\theta)$ cuts each other orthogonally.	08	L2	CO1
	b.	Find the pedal equation of the curve $\frac{\ell}{r} = 1 + e\cos\theta$	07	L2	CO1
	c.	Using modern mathematical tool write a programme code to plot the curve $r = 2(\cos 2\theta)$	05	L2	CO5
		Module – 2			
Q.3	a.	Expand $\log(\sec x)$ upto the term containing x^4 using Maclaurin's series.	06	L2	CO2
	b.	If $z = e^{ax+by} f(ax - by)$ prove that $b\frac{\partial z}{\partial x} + a\frac{\partial z}{\partial y} = 2abz$	07	L2	CO2
	c.	Find the extreme value of the function $f(x, y) = x^3 + y^3 - 3x - 12y + 20$	07	L2	CO2
		OR			
Q.4	a.	Evaluate $\lim_{x\to 0}\left[\frac{a^x + b^x + c^x + d^x}{4}\right]^{1/x}$	08	L3	CO2
	b.	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$	07	L2	CO2
	c.	Using modern mathematical tool write a programme / code to show that $u_{xx} + u_{yy} = 0$. Given $u = e^x[x\cos y - y\sin y]$	05	L3	CO5
		Module – 3			
Q.5	a.	Solve $x\frac{dy}{dx} + y = x^3y^6$	06	L3	CO3
	b.	Find the orthogonal trajectories of $y^2 = 4ax$ where a is parameter.	07	L2	CO3
	c.	Solve $\frac{dy}{dx} - \frac{dx}{dy} = \frac{x}{y} - \frac{y}{x}$	07	L3	CO3

		OR			
Q.6	a.	Solve $(xy^3 + y)dx + 2(x^2y^2 + x + y^4)dy = 0$	06	L3	CO3
	b.	Find the orthogonal trajectory of the cardioid $r = a(1 - \cos\theta)$.	07	L2	CO3
	c.	Find the general solution of the equation $(px - y)(py + x) = a^2p$ by reducing into Clairaut's form taking the substitution $X = x^2$, $Y = y^2$.	07	L2	CO3
		Module – 4			
Q.7	a.	Find the least positive values of x such that i) $71 \equiv x \pmod 8$ ii) $67 + x \equiv 1 \pmod 4$ iii) $89 \equiv (7 + 3) \pmod 5$	06	L2	CO4
	b.	Find the solutions of the linear congruence $14x \equiv 12 \pmod{18}$	07	L2	CO4
	c.	Encode STOP using RSA algorithm with key (2537, 13) using the prime numbers 43 and 59.	07	L3	CO4
		OR			
Q.8	a.	(i) Find the last digit of 7^{2013} (ii) Find the last digit of 13^{37}	06	L2	CO4
	b.	Solve the system of linear congruence $x \equiv 2(\text{mod } 3)$; $x \equiv 3(\text{mod } 5)$; $x \equiv 2(\text{mod } 7)$, using Remainder theorem.	07	L3	CO4
	c.	Show that $2^{340} \equiv 1 \bmod 31$ by Fermat's little theorem.	07	L2	CO4
		Module – 5			
Q.9	a.	Find the rank of the matrix $\begin{bmatrix} 1 & 3 & -1 & 2 \\ 0 & 11 & -5 & 3 \\ 2 & -5 & 3 & 1 \\ 4 & 1 & 1 & 5 \end{bmatrix}$	06	L2	CO4
	b.	Solve the system of equations by using Gauss-Jordan method. $2x + y + 3z = 1$; $4x + 4y + 7z = 1$; $2x + 5y + 9z = 3$	07	L3	CO4
	c.	Using power method find the largest eigen value and the corresponding eigen vector of the matrix $A = \begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$ by taking $[1\ 0\ 0]^T$ as the initial eigen vector upto two decimal places (Perform 5 iterations).	07	L2	CO4
		OR			
Q.10	a.	Solve the following system of equations by Gauss-Seidel method. $7x + 52y + 13z = 104$; $3x + 8y + 29z = 71$; $83x + 11y - 4z = 95$ (Carry out 4 iterations).	08	L3	CO4
	b.	For what values of a and b the system of equations $x + y + z = 6$; $x + 2y + 3z = 12$; $x + 2y + az = b$ has (i) no solution (ii) a unique solution and (iii) infinite number of solutions.	07	L2	CO4
	c.	Using modern mathematical tool write a programme / code to find the largest eigen value of $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$	05	L3	CO5

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