

# CBCS SCHEME

BMATS101

## First Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024 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.

<b>Module – 1</b>			<b>M</b>	<b>L</b>	<b>C</b>
Q.1	a.	With usual notation prove that $\tan \phi = r \cdot \frac{d\theta}{dr}$ .	6	L2	CO1
	b.	Find the angle between the curves $r = 6\cos\theta$ and $r = 2(1 + \cos\theta)$ .	7	L2	CO1
	c.	Find the radius of curvature for the Folium of De-Cartes $x^3 + y^3 = 3axy$ at the point $\left(\frac{3a}{2}, \frac{3a}{2}\right)$ on it.	7	L2	CO1

**OR**

Q.2	a.	Show that the curves $r = a(1 + \sin \theta)$ and $r = a(1 - \sin \theta)$ cut each other orthogonally.	8	L2	CO1
	b.	Find the pedal equation of $r^n = a(1 + \cos n\theta)$ .	7	L2	CO1
	c.	Using modern mathematical tool, write a program/code to plot the curve sine and cosine curve.	5	L3	CO5

**Module – 2**

Q.3	a.	Using Maclaurin's series, expand $\sqrt{1 + \sin 2x}$ in powers of $x$ upto the terms $x^4$ .	7	L2	CO1
	b.	If $U = e^{ax+by}f(ax-by)$ , prove that $b \frac{\partial U}{\partial x} + a \frac{\partial U}{\partial y} = 2abU$ .	6	L2	CO1
	c.	Find the extreme values of the function $\sin x + \sin y + \sin(x+y)$ .	7	L3	CO1

**OR**

Q.4	a.	Evaluate the $\lim_{x \rightarrow 0} \left[ \frac{a^x + b^x + c^x + d^x}{4} \right]^{\frac{1}{x}}$ .	8	L2	CO1
	b.	If $U = f(2x-3y, 3y-4z, 4z-2x)$ , prove that $\frac{1}{2} \frac{\partial U}{\partial x} + \frac{1}{3} \frac{\partial U}{\partial y} + \frac{1}{4} \frac{\partial U}{\partial z} = 0$ .	7	L2	CO1
	c.	Using modern mathematical tool, write a program/code to evaluate $\lim_{x \rightarrow \infty} \left(1 + \frac{1}{x}\right)^x$ .	5	L3	CO5

**Module – 3**

Q.5	a.	Solve $\frac{dy}{dx} + \frac{y}{x} = x^2 y^6$ .	6	L2	CO2
	b.	Find the orthogonal trajectories of the family $r = a(1 + \sin \theta)$ .	7	L3	CO2
	c.	Find the solution of the equation $x^2(y-Px) = P^2y$ by reducing into Clairaut's form using the substitution $X = x^2$ , $Y = y^2$ .	7	L2	CO2

**OR**

Q.6	a.	Solve $(8xy - 9y^2)dx + 2(x^2 - 3xy)dy = 0$ .	6	L2	CO2
	b.	A voltage $Ee^{-at}$ is applied at $t = 0$ to a circuit of inductance L and resistant R. Find the current at any time t given that the current is initially zero when $t = 0$ .	7	L3	CO2
	c.	Solve $x(y')^2 - (2x + 3y)y' + 6y = 0$ .	7	L2	CO2
<b>Module - 4</b>					
Q.7	a.	i) Find the last digit in $7^{289}$ . ii) Find the remainder when $135 \times 74 \times 48$ is divided by 7.	7	L2	CO3
	b.	Solve the linear congruence $6x \equiv 15 \pmod{21}$ .	6	L2	CO3
	c.	Using Wilson's theorem, show that $4(29)! + 5!$ is divisible by 31. <b>OR</b>	7	L2	CO3
Q.8	a.	Solve the set of simultaneous congruences $x \equiv 5 \pmod{3}$ , $x \equiv 2 \pmod{5}$ , $x \equiv 1 \pmod{11}$ .	7	L2	CO3
	b.	Solve $7x + 3y \equiv 10 \pmod{16}$ , $2x + 5y \equiv 9 \pmod{16}$ .	6	L2	CO3
	c.	Show that $2^{340} - 1$ is divisible by 31, using Fermat's little theorem.	7	L2	CO3
<b>Module - 5</b>					
Q.9	a.	Find the rank of the matrix	6	L2	CO4
		$\begin{bmatrix} 1 & 2 & 4 & 3 \\ 2 & 4 & 6 & 8 \\ 4 & 8 & 12 & 16 \\ 1 & 2 & 3 & 4 \end{bmatrix}$			
	b.	Solve the system of equation by using Gauss-Jordan method. $x + y + z = 8$ , $-x - y + 2z = -4$ , $3x + 5y - 7z = -14$	7	L3	CO4
	c.	Using Rayleigh's power method, find the largest eigen value and the corresponding eigen vector of the matrix $A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ by taking initial vector as $[1 \ 1 \ 1]^T$ . Perform 6 iterations. <b>OR</b>	7	L3	CO4
	a.	Solve the system of equation by using Gauss elimination method. $x + 2y + z = 3$ , $2x + 3y + 3z = 10$ , $3x - y + 2z = 13$	8	L3	CO4
	b.	Solve the following system of equations by Gauss-Seidal method $20x + y - 2z = 17$ , $3x + 20y - z = -18$ , $2x - 3y + 20z = 25$	7	L3	CO4
	c.	Using modern mathematical tool, write a programme/code to test the consistency of the equation: $x + 2y - z = 1$ , $2x + y + 4z = 2$ , $3x + 3y + 4z = 1$	5	L3	CO5

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