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BMATS101

First Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026 Mathematics – I for CSE Stream

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 $\tan \phi = r \frac{d\theta}{dr}$.	6	L2	CO1
	b.	Find the angle between the curves, $r^2 \sin 2\theta = 4$ and $r^2 = 16 \sin 2\theta$	7	L2	CO1
	c.	Show that the radius of curvature of the curve $r^n = a^n \cos n\theta$ varies inversely as r^{n-1} .	7	L3	CO1
OR					
Q.2	a.	Show that the curves $r^n = a^n \cos n\theta$ and $r^n = b^n \sin n\theta$ cuts each other orthogonally.	7	L2	CO1
	b.	Find the Pedal equation of the curve $\frac{2a}{r} = (1 + \cos \theta)$.	8	L2	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.	Using Maclaurin's series, prove that $\sqrt{1 + \sin 2x} = 1 + x - \frac{x^2}{2} - \frac{x^3}{6} + \frac{x^4}{24} \dots$	6	L2	CO1
	b.	If $U = f(x - y, y - z, z - x)$, Show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$.	7	L2	CO1
	c.	Find the extreme values of the function $f(x, y) = x^3 + y^3 - 3x - 12y + 20$.	7	L3	CO1
OR					
Q.4	a.	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ then show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z} = 0$	7	L2	CO1
	b.	If $u = \frac{yz}{x}$, $v = \frac{zx}{y}$, $w = \frac{xy}{z}$, show that $\frac{\partial(u, v, w)}{\partial(x, y, z)} = 4$.	8	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.	Solve : $xy p^2 + p(3x^2 - 2y^2) - 6xy = 0$.	7	L2	CO2

OR

Q.6	a.	Solve : $(y^3 - 3x^2 y)dx - (x^3 - 3xy^2)dy = 0$.	6	L2	CO2
	b.	Find the orthogonal trajectories of $\frac{x^2}{a^2} + \frac{y^2}{b^2 + \lambda} = 1$, where λ is a parameter.	7	L3	CO2
	c.	Find the general solution of the equation $(px - y)(py + x) = 2p$ by reducing into Clairaut's form by taking substitution $X = x^2, Y = y^2$.	7	L2	CO2

Module – 4

Q.7	a.	i) Find the remainder when 2^{301} is divided by 5. ii) Find the last digit in 7^{126} .	6	L2	CO3
	b.	Find the solution of the linear congruence $7x \equiv 9 \pmod{15}$.	7	L2	CO3
	c.	Encrypt the message "STOP" using RSA with key (2537, 13) using the prime numbers 43 and 59.	7	L2	CO3

OR

Q.8	a.	Using Fermat's Little theorem, show that $8^{30} - 1$ is divisible by 31.	6	L2	CO3
	b.	Solve the system of linear congruence $7x + 3y \equiv 10 \pmod{16}$ $2x + 5y \equiv 9 \pmod{16}$	7	L2	CO3
	c.	i) Find the remainder when $135 \times 74 \times 48$ is divided by 7. ii) Find last digit of 13^{37} .	7	L2	CO3

Module – 5

Q.9	a.	Find the rank of the matrix $A = \begin{bmatrix} -2 & -1 & -3 & -1 \\ 1 & 2 & 3 & 1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 \end{bmatrix}$	7	L2	CO4
	b.	Solve the system of equations by using Gauss-Jordan method $x + y + z = 9$ $x - 2y + 3z = 8$ $2x + y - z = 3$.	8	L2	CO4

	c.	Using modern mathematical tool, write a program/code to test the consistency of equations $x + 2y - z = 1$ $2x + y + 4z = 2$ $3x + 3y + 4z = 1$	5	L3	CO5
OR					
Q.10	a.	Solve the following system of equations by Gauss – Seidel method $10x + y + z = 12$ $x + 10y + z = 12$ $x + y + 10z = 12$ (perform 4 iterations) by taking the initial approximation (x, y, z) as (0, 0, 0).	6	L2	CO4
	b.	For what values of λ and μ the system of equations $x + y + z = 6$ $x + 2y + 3z = 10$ $x + 2y + \lambda z = \mu$, may have i) Unique solution ii) Infinite solution iii) No solution.	7	L2	CO4
	c.	Solve the system of equations by using Gauss elimination method $2x + y + 4z = 12$ $4x + 11y - z = 33$ $8x - 3y + 2z = 20$.	7	L2	CO4
