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CBCS SCHEME

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BMATC101

First Semester B.E./B.Tech. Degree Examination, June/July 2026
Mathematics – I for Civil Engg Stream

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.
3. VTU Formula Hand Book is permitted.

		Module – 1	M	L	C
Q.1	a.	With usual notations, prove that $\tan\phi = \frac{r d\theta}{dr}$.	6	L2	CO1
	b.	Find the angle between the curve $r = a(1 + \cos\theta)$ and $r = a(1 - \cos\theta)$	7	L2	CO1
	c.	Find the radius of curvature for the curve $\sqrt{x} + \sqrt{y} = \sqrt{a}$ at the point $\left(\frac{a}{4}, \frac{a}{4}\right)$.	7	L2	CO1
		OR			
Q.2	a.	Derive an expression for the radius of curvature for a polar curve.	7	L2	CO1
	b.	Find the pedal equation of the curve $r = 4(1 + \cos\theta)$	8	L2	CO1
	c.	Using modern mathematical tool, write a program/code to plot the curve $r = 2\lvert\cos 2\theta\rvert$.	5	L3	CO5
		Module – 2			
Q.3	a.	Expand sinx by Maclaurin's series upto the term containing x^4.	6	L2	CO1
	b.	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$	7	L2	CO1
	c.	Examine the function $f(x, y) = xy(a - x - y)$ for extreme values.	7	L3	CO1

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		OR			
Q.4	**a.**	If $z = e^{ax+by} f(ax - by)$, show that $b\frac{\partial z}{\partial x} + a\frac{\partial z}{\partial y} = 2abz$.	**7**	**L2**	**CO1**
	b.	If $u = x + 3y^2 - z^3$, $v = 4x^2yz$. $w = 2z^2 - xy$, find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$ at (1, -1, 0)	**8**	**L3**	**CO1**
	c.	Using modern mathematical tool, write program/code to evaluate $\lim_{x\to\infty}\left(1+\frac{1}{x}\right)^x$	**5**	**L3**	**CO5**
		Module – 3			
Q.5	**a.**	Solve $\frac{dy}{dx} + xy = xy^2$	**6**	**L2**	**CO2**
	b.	Find the orthogonal trajectories of the family of the curves $r^n \sin n\theta = a^n$, where a is the parameter	**7**	**L3**	**CO2**
	c.	Solve $xyp^2 - (x^2 + y^2)p + xy = 0$.	**7**	**L2**	**CO2**
		OR			
Q.6	**a.**	Solve $y = (2xy + 1)dx - x\,dy = 0$	**6**	**L2**	**CO2**
	b.	A body in air at 25°C cool from 100°C to 75°C in one minutes. Find the temperature of the body at the end of 3 minutes.	**7**	**L2**	**CO2**
	c.	Find the general solution of the equation $(px - y)(py + x) = 2p$ by reducing in to Clairaut's form taking the substitution $x = x^2$, $y = y^2$.	**7**	**L2**	**CO2**
		Module – 4			
Q.7	**a.**	Solve $(D^4 - 5D^3 + 6D^2 + 4D - 8)y = 0$.	**6**	**L2**	**CO3**
	b.	Solve $(D + 1)^2 y = e^{2x} + \sin 2x + x^2$.	**7**	**L2**	**CO3**
	c.	Solve $(1 + x)^2 \frac{d^2y}{dx^2} + (1 + x)\frac{dy}{dx} + y = 2 \sin[\log(1 + x)]$	**7**	**L3**	**CO3**

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		OR			
Q.8	**a.**	Solve $(D^2 + 5D + 4)\, y = 3 - 2x$.	**6**	**L2**	**CO3**
	b.	Solve by method of variation of parameters $\frac{d^2y}{dx^2} + y = \frac{1}{1+\sin x}$	**7**	**L3**	**CO3**
	c.	Solve $x^2 \frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = \log x$.	**7**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	Find the rank of the matrix $\begin{bmatrix} 4 & 0 & 2 & 1 \\ 2 & 1 & 3 & 4 \\ 2 & 3 & 4 & 7 \\ 2 & 3 & 1 & 4 \end{bmatrix}$	**6**	**L2**	**CO4**
	b.	Solve the system of equations by Gauss – Jordan method $x + y + z = 9$, $x - 2y + 3z = 8$, $2x + y - z = 3$.	**7**	**L2**	**CO4**
	c.	Using power method, find the largest eigen value and the corresponding eigen vectors of $\begin{bmatrix} 1 & -3 & 2 \\ 1 & 4 & -1 \\ 6 & 3 & 5 \end{bmatrix}$ by taking $(1, 0, 0)^T$ as initial eigen vector.	**7**	**L3**	**CO4**
		OR			
Q.10	**a.**	Solve the system of equations $2x - 3y + 20z = 25$, $20x + y + z = 17$, $3x + 20y - z = -18$, using Gauss – seidel method, taking (0, 0, 0) as an initial approximation carryout 4 iterations.	**7**	**L2**	**CO4**
	b.	For what values of λ and μ the system of equations $2x + 3y + 5z = 9$, $7x + 3y - 2z = 8$, $2x + 3y + \lambda z = \mu$ has i) no solution ii) a unique solution iii) infinite number of solutions.	**8**	**L2**	**CO4**
	c.	Using Modern mathematical tool write a program/code to find the largest eigne value of $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$	**5**	**L3**	**CO5**

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