

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

- Notes:*
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 $\tan \phi = \frac{rd\theta}{dr}$.		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 \cos 2\theta $.		5	L3	CO5
Module – 2						
Q.3	a.	Expand $\sin x$ 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

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 $\lim_{x \rightarrow \infty} \left(1 + \frac{1}{x}\right)^x$	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 $(1+x)^2 \frac{d^2 y}{dx^2} + (1+x) \frac{dy}{dx} + y = 2 \sin [\log (1+x)]$	7	L3	CO3

Module – 4

7	a.	Evaluate : $\int_{-c}^c \int_{-b}^b \int_{-a}^a (x^2 + y^2 + z^2) dz dy dx.$	6	L2	CO3
	b.	Evaluate : $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dx dy$ by changing to polar coordinates.	7	L3	CO3
	c.	Derive the relation between beta and gamma function.	7	L2	CO3
OR					
8	a.	Evaluate by changing the order integration and evaluate : $\int_0^a \int_{x^2/4a}^{2\sqrt{ax}} xy dy dx.$	6	L2	CO3
	b.	Evaluate $\int_0^{\pi/2} \sqrt{\cot \theta}$ by expressing interms of beta gamma function.	7	L2	CO3
	c.	Using double integration find the area between the parabola $y^2 = 4ax$ and $x^2 = 4ay$.	7	L3	CO3

Module – 5

9	a.	Find the rank of the matrix : $\begin{bmatrix} 2 & 1 & -1 & -3 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$	6	L2	CO4
	b.	Solve by using Gauss Elimination Method : $x + y + z = 9$ $x - 2y + 3z = 8$ $2x + y - z = 3.$	7	L3	CO4
	c.	Using Rayleigh's Power Method find the dominant eigen value and the corresponding Eigen vector of : $\begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$ by taking $[1 \ 0 \ 0]^T$ as initial Eigen vector [5 iteration].	7	L3	CO4
OR					
10	a.	Test for consistency and solve : $5x + 3y + 7z = 4$ $3x + 26y + 2z = 9$ $7x + 2y + 10z = 5.$	6	L2	CO4
	b.	Solve by using Gauss-Seidel Method : $20x + y - 2z = 17$ $3x + 20y - z = -18$ and $2x - 3y + 20z = 25.$	7	L3	CO4
	c.	Using modern mathematical tool, write a program/code to find the largest Eigen value of $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ By Power Method.	7	L3	CO5
