# CBCS SCHEME



USN | | | | | | | | | | |  **BMATC101**

## First Semester B.E/B.Tech. Degree Examination, Dec.2024/Jan.2025
## Mathematics–I for Civil Engineering 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 Handbook is permuted.*

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| 1 | a. | With usual notation prove that $\tan\phi = r\dfrac{d\theta}{dr}$. | 6 | L2 | CO1 |
| | b. | Find the angle between the curves $r = 4\sec^2(\theta/2)$ and $r = 9\,\text{cosec}^2(\theta/2)$. | 7 | L2 | CO1 |
| | c. | Find the radius of curvature of the curve. $\sqrt{x}+\sqrt{y}=\sqrt{a}$ at $\left(a/4, a/4\right)$. | 7 | L3 | CO1 |
| | | **OR** | | | |
| 2 | a. | Find the pedal equation of the curve $r^m = a^m(\cos m\theta + \sin m\theta)$. | 6 | L2 | CO1 |
| | b. | Derive the radius of curvature in Cartesian form. | 7 | L2 | CO1 |
| | c. | Using modern mathematical tool write a program to plot the curve $r = 2(1+\cos\theta)$. | 7 | L3 | CO5 |
| | | **Module – 2** | | | |
| 3 | a. | Using Maclaurin's series expand $e^{\sin x}$ in powers of x upto the term containing $x^5$. | 6 | L2 | CO2 |
| | b. | If $u = f\left(\dfrac{x}{y},\dfrac{y}{z},\dfrac{z}{x}\right)$ prove that $x\dfrac{\partial u}{\partial x}+y\dfrac{\partial u}{\partial y}+z\dfrac{\partial u}{\partial z}=0$. | 7 | L3 | CO2 |
| | c. | Find the extreme values of the function : $f(x,y)=x^3+y^3-3x-12y+20$. | 7 | L3 | CO2 |
| | | **OR** | | | |
| 4 | a. | Evaluate : i) $\lim\limits_{x\to 0}\left(\dfrac{\tan x}{x}\right)^{1/x^2}$ ii) $\lim\limits_{x\to 0}(\sin x)^{\tan x}$. | 6 | L2 | CO2 |
| | b. | If : $u = x+3y^2-z^3$ ; $v = 4x^2yz$ ; $w = 2z^2-xy$ find $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}$ at (1, –1, 0). | 7 | L3 | CO2 |
| | c. | Using modern mathematical tool write a program to evaluate $\lim\limits_{x\to 0}(\sin x)^{\tan x}$. | 7 | L3 | CO5 |

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| | | **Module – 3** | | | |
| **5** | a. | Solve : $x\dfrac{dy}{dx} + y\log y = xye^{x}$. | **6** | **L2** | **CO3** |
| | b. | Find the orthogonal trajectories of the family of curves $y^2 = 4ax$. | **7** | **L3** | **CO3** |
| | c. | Solve : $yp^2 + (x - y)p - x = 0$. | **7** | **L3** | **CO3** |
| | | **OR** | | | |
| **6** | a. | Solve $(4xy + 3y^2 - x)dx + x(x + 2y)dy = 0$. | **6** | **L2** | **CO3** |
| | b. | A bottle of mineral water at a room temperature of 72°F is kept in a refrigerator where the temperature is 44°F. After half am hour water cooled to 61°F. What is the temperature of the water in another half an hour? | **7** | **L3** | **CO3** |
| | c. | Find the general and singular solution of $xp^2 - py + kp + a = 0$. | **7** | **L3** | **CO3** |
| | | **Module – 4** | | | |
| **7** | a. | Solve $(D^4 + 18D^2 + 81)y = 0$. | **6** | **L2** | **CO3** |
| | b. | Solve $D^3y + 8y = \sin(2x)$. | **7** | **L2** | **CO3** |
| | c. | Solve Legendre's linear differential equation : $(1+x)^2\dfrac{d^2y}{dx^2} + (1+x)\dfrac{dy}{dx} + y = 4\cos[\log(1+x)]$. | **7** | **L2** | **CO3** |
| | | **OR** | | | |
| **8** | a. | Solve $D^2y + 3Dy + 2y = 12x^2$. | **6** | **L2** | **CO3** |
| | b. | Solve by method of variation of parameters $\dfrac{d^2y}{dx^2} + y = \sec x \tan x$. | **7** | **L2** | **CO3** |
| | c. | Solve $x^2\dfrac{d^2y}{dx^2} + 5x\dfrac{dy}{dx} + 4y = x^4$. | **7** | **L2** | **CO3** |

| | | Module – 5 | | | |
|---|---|---|---|---|---|
| 9 | a. | Find the rank of the matrix $A = \begin{bmatrix} 0 & 2 & 3 & 4 \\ 2 & 3 & 5 & 4 \\ 4 & 8 & 13 & 12 \end{bmatrix}$. | 6 | L2 | CO4 |
| | b. | Using Gauss-elimination method solve :<br>$x + y + z = 9$<br>$x - 2y + 3z = 8$<br>$2x + y - z = 3$. | 7 | L3 | CO4 |
| | c. | Using Rayleigh's power method find the dominant eigen value and the corresponding eigen vector of the matrix $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$, taking initial vector as $[1, 1,1]^T$. | 7 | L3 | CO4 |
| | | OR | | | |
| 10 | a. | Apply Gauss – Jordan method to solve the equations :<br>$x + y + z = 9$<br>$2x - 3y + 4z = 13$<br>$3x + 4y + 5z = 40$. | 6 | L2 | CO4 |
| | b. | Test for consistency and solve :<br>$x + y + z = 6$<br>$x - y + 2z = 5$<br>$3x + y + z = 8$. | 7 | L2 | CO4 |
| | c. | Write a program to solve the system of equations using Gauss – Seidel method by taking initial approximations (0, 0, 0). Carry out 3 iterations.<br>$x + y + 54z = 110$<br>$27x + 6y - z = 85$<br>$6x + 15y + 2z = 72$. | 7 | L3 | CO5 |

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