# CBCS SCHEME

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BMATM101

## First Semester B.E./B.Tech. Degree Examination, June/July 2023
## Mathematics-I for ME 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.*

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | Find the angle of intersection of the curves $r^2\sin 2\theta = 4$, $r^2 = 16\sin 2\theta$. | 06 | L2 | CO1 |
| | b. | With usual notations prove that for the curve $r = f(\theta)$, $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\theta}\right)^2$. | 07 | L2 | CO1 |
| | c. | Show that for the curve $r = a(1 + \cos\theta)$, $\frac{\rho^2}{r}$ is a constant. | 07 | L2 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Find the Pedal equation of the curve $\frac{2a}{r} = (1 + \cos\theta)$ | 07 | L2 | CO1 |
| | b. | Derive the radius of curvature in Cartesian form as $\rho = \frac{(1 + y_1^2)^{3/2}}{y_2}$ | 08 | L2 | CO1 |
| | c. | Using modern mathematical tool write a program/code to plot the sine and cosine curve. | 05 | L2 | CO5 |
| | | **Module – 2** | | | |
| Q.3 | a. | Expand $\log(\sec x)$ upto the term containing $x^4$, using Maclaurin's series. | 06 | L2 | CO2 |
| | b. | If $u = f(y + ax) + g(y - ax)$ show that $\frac{\partial^2 u}{\partial x^2} = a^2 \frac{\partial^2 u}{\partial y^2}$ | 07 | L2 | CO2 |
| | c. | Find the extreme values of the function $x^3y^2(1 - x - y)$ | 07 | L3 | CO2 |
| | | **OR** | | | |
| Q.4 | a. | Evaluate $\lim_{x \to 0}\left(\frac{\tan x}{x}\right)^{\frac{1}{x^2}}$ | 06 | L2 | CO2 |
| | b. | If $u = f\left(\frac{y-x}{xy}, \frac{z-x}{xz}\right)$, prove that $x^2\frac{\partial u}{\partial x} + y^2\frac{\partial u}{\partial y} + z^2\frac{\partial u}{\partial z} = 0$ | 07 | L2 | CO2 |
| | c. | Using modern mathematical tool write a program/code to evaluate $\underset{x \to \infty}{\text{lt}}\left(1 + \frac{1}{x}\right)^x$ | 07 | L3 | CO5 |
| | | **Module – 3** | | | |
| Q.5 | a. | Solve : $\frac{dy}{dx} + y\tan x = y^3\sec x$ | 06 | L2 | CO3 |
| | b. | Find the orthogonal trajectories of the family of curves $r = a(1 + \cos\theta)$, where a is the parameter. | 07 | L3 | CO3 |
| | c. | Solve : $\frac{dy}{dx} - \frac{dx}{dy} = \frac{x}{y} - \frac{y}{x}$ | 07 | L2 | CO3 |
| | | **OR** | | | |
| Q.6 | a. | Solve : $(y^4 + 2y)dx + (xy^3 + 2y^4 - 4x)dy = 0$ | 06 | L2 | CO3 |

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|---|---|---|---|---|---|
| Q.6 | b. | If the temperature of the air is 30°C and a metal ball cools from 100°C to 70°C in 15 min, find how long will it take for the metal ball to reach a temperature of 40°C. | 07 | L3 | CO3 |
| | c. | Solve the equation $(px - y)(py + x) = 2p$ by reducing into Clairaut's form, taking the substitution $X = x_2$ , $Y = y^2$ . | 07 | L2 | CO3 |
| | | **Module – 4** | | | |
| Q.7 | a. | Solve : $(D^3 + 6D^2 + 11D + 6)y = 0$ | 06 | L2 | CO3 |
| | b. | Solve : $(D^2 - 6D + 9)y = 6e^{3x} + 7e^{-2x} - \log 2$ | 07 | L2 | CO3 |
| | c. | Solve $\frac{d^2y}{dx^2} + y = \tan x$ by the method of variation of parameters. | 07 | L2 | CO3 |
| | | **OR** | | | |
| Q.8 | a. | Solve : $(D^4 - 2D^3 + 5D^2 - 8D + 4)y = 0$ | 06 | L2 | CO3 |
| | b. | Solve : $\frac{d^2y}{dx^2} + 4y = x^2 + \cos 2x + 2^{-x}$ | 07 | L2 | CO3 |
| | c. | Solve : $(3x+2)^2 \frac{d^2y}{dx^2} + 3(3x+2)\frac{dy}{dx} - 36y = 8x^2 + 4x + 1$ | 07 | L2 | CO3 |
| | | **Module – 5** | | | |
| Q.9 | a. | Find the rank of the matrix $\begin{bmatrix} 1 & 0 & 2 & -2 \\ 2 & -1 & 0 & -1 \\ 1 & 0 & 2 & -1 \\ 4 & -1 & 3 & -1 \end{bmatrix}$ | 06 | L2 | CO4 |
| | b. | Solve the system of equations by Gauss-Jordon method : $2x + y + z = 10$ ; $3x + 2y + 3z = 18$ ; $x + 4y + 9z = 16$. | 07 | L3 | CO4 |
| | c. | Solve the system of equations by Gauss-Seidel method : $10x + 2y + z = 9$ ; $x + 10y - z = -22$ ; $-2x + 3y + 10z = 22$. (Carry out 3 iterations) | 07 | L3 | CO4 |
| | | **OR** | | | |
| Q.10 | a. | Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 & 4 \\ -2 & -3 & 1 & 2 \\ -3 & -4 & 5 & 8 \\ 1 & 3 & 10 & 14 \end{bmatrix}$ | 07 | L2 | CO4 |
| | b. | For what values of $\lambda$ and $\mu$ the system of equations $x + y + z = 6$ ; $x + 2y + 2z = 10$ ; $x + 2y + \lambda z = \mu$ may have i) Unique solution ii) Infinite solution iii) No solution | 08 | L2 | CO4 |
| | c. | Using modern mathematical tool write a program/code to find the largest eigen value of $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ | 05 | L3 | CO5 |

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