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BMATE101

## First Semester B.E./B.Tech. Degree Supplementary Examination, June/July 2024
## Mathematics – I for EEE 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. | With usual notations prove that $\cot\phi = \dfrac{1}{r}\left(\dfrac{dr}{d\theta}\right)$ | 6 | L2 | CO1 |
| | b. | Find the angle between the curves $r = 6\cos\theta$ and $r = 2(1+\cos\theta)$ | 7 | L2 | CO1 |
| | c. | Find the radius of curvature of the curve $\sqrt{x}+\sqrt{y}=4$ at the point where it cuts the line passing through the origin making an angle $45°$ with the X-axis. | 7 | L3 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Find the Pedal equation of the curve $r^2 = a^2 \sec 2\theta$ | 7 | L2 | CO1 |
| | b. | Show that for the curve $r = a(1+\cos\theta)$ is $p^2/r =$ constant. | 8 | L3 | 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. | Expand $\log(\sec x)$ up to the term containing $x^4$ using Maclaurin's series. | 6 | L2 | CO1 |
| | b. | If $u = f(x-y, y-z, z-x)$, show that $\dfrac{\partial u}{\partial x}+\dfrac{\partial u}{\partial y}+\dfrac{\partial u}{\partial z}=0$ | 7 | L2 | CO1 |
| | c. | If $x = r\sin\theta\cos\phi$, $y = r\sin\theta\sin\phi$, $z = r\cos\theta$ find the value of $\dfrac{\partial(x,y,z)}{\partial(r,\theta,\phi)}$ | 7 | L3 | CO1 |
| | | **OR** | | | |
| Q.4 | a. | If $z = e^{ax+by} f(ax-by)$, show that $b\dfrac{\partial z}{\partial x}+a\dfrac{\partial z}{\partial y}=2abz$ | 7 | L2 | CO1 |
| | b. | Find the extreme values of the function $f(x, y) = x^3 + y^3 - 3x - 12y + 20$ | 8 | L3 | CO1 |

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|---|---|---|---|---|---|
| | c. | Using modern mathematical tool, write a program/code to evaluate $\displaystyle \underset{x \to \infty}{\text{lt}}\left(1+\frac{1}{x}\right)^{x}$ | 5 | L3 | CO5 |

## Module – 3

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|---|---|---|---|---|---|
| Q.5 | a. | Solve $\dfrac{dy}{dx}+\dfrac{y}{x}=y^{2}x$ | 6 | L2 | CO2 |
| | b. | Find the orthogonal trajectories of the family of curves $\dfrac{x^{2}}{a^{2}}+\dfrac{y^{2}}{b^{2}+\alpha}=1$, where $\alpha$ is a parameter. | 7 | L3 | CO2 |
| | c. | Solve $xyp^{2}-(x^{2}+y^{2})p+xy=0$. | 7 | L2 | CO3 |

## OR

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|---|---|---|---|---|---|
| Q.6 | a. | Solve $\dfrac{dy}{dx}+\dfrac{y\cos x+\sin y+y}{\sin x+x\cos y+x}=0$ | 6 | L2 | CO2 |
| | b. | Show that a differential equation for the current i in an electrical circuit containing an inductance L and resistance R in series and acted on by an electromotive force E sin wt, satisfies the equation $L\dfrac{di}{dt}+Ri=E\sin wt$. Find the value of the current at any time t, if initially there is no current in the circuit. | 7 | L3 | CO2 |
| | c. | Solve 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

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|---|---|---|---|---|---|
| Q.7 | a. | Evaluate $\displaystyle\int_{-1}^{1}\int_{0}^{z}\int_{x-z}^{x+z}(x+y+z)\,dy\,dx\,dz$ | 6 | L2 | CO3 |
| | b. | Evaluate $\displaystyle\int_{-2}^{2}\int_{0}^{\sqrt{4-x^{2}}}(2-x)\,dy\,dx$ by changing the order of integration. | 7 | L2 | CO3 |
| | c. | Prove that $\displaystyle\int_{0}^{\pi/2}\dfrac{d\theta}{\sqrt{\sin\theta}}\times\int_{0}^{\pi/2}\sqrt{\sin\theta}\,d\theta=\pi$ | 7 | L2 | CO3 |

## OR

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|---|---|---|---|---|---|
| Q.8 | a. | Evaluate $\displaystyle\int_{0}^{\infty}\int_{0}^{\infty}e^{-(x^{2}+y^{2})}\,dx\,dy$ by changing into polar coordinates. | 6 | L2 | CO3 |
| | b. | Derive the relation between beta and gamma function. | 7 | L2 | CO3 |
| | c. | Find the volume bounded by the cylinder $x^{2}+y^{2}=4$ and the planes $y+z=4$, $z=0$. | 7 | L3 | CO3 |

## Module – 5

| Q.9 | a. | Find the rank of the matrix $$\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$$ | 6 | L2 | CO4 |
|---|---|---|---|---|---|
| | b. | Solve the system of equations by Gauss elimination method<br>$2x + y + 4z = 12$<br>$4x + 11y - z = 33$<br>$8x - 3y + 2z = 20$ | 7 | L3 | CO4 |
| | c. | Solve the following system of equations by Gauss-Seidel method<br>$20x + y - 2z = 17$<br>$3x + 20y - z = -18$<br>$2x - 3y + 20z = 25$ | 7 | L3 | CO4 |

### OR

| Q.10 | a. | Using Gauss Jordan method, solve<br>$2x + 5y + 7z = 52$, $2x + y - z = 0$, $x + y + z = 9$ | 7 | L3 | CO4 |
|---|---|---|---|---|---|
| | b. | Using Rayleigh's power method find the dominant eigenvalue and the corresponding eigenvector of $$\begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$$ by taking $[1, 0, 0]^T$ as initial eigen vector [carryout 5 iterations]. | 8 | L3 | CO5 |
| | c. | Using modern mathematical tool. Write a program/code to test the consistency of equations:<br>$x + 2y - z = 1$<br>$2x + y + 4z = 2$<br>$3x + 3y + 4z = 1$ | 5 | L3 | CO5 |

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