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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 $\cot \phi = \frac{1}{r} \left( \frac{dr}{d\theta} \right)$	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 $45^\circ$ with the X-axis.	7	L3	CO1
<b>OR</b>					
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 $p^2/r = \text{constant}$ .	8	L3	CO1
	c.	Using modern mathematical tool, write a program/code to plot the sine and cosine curve.	5	L3	CO5
<b>Module – 2</b>					
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 $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$	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 $\frac{\partial(x, y, z)}{\partial(r, \theta, \phi)}$	7	L3	CO1
<b>OR</b>					
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.	Find the extreme values of the function $f(x, y) = x^3 + y^3 - 3x - 12y + 20$	8	L3	CO1
1 of 3					

	c.	Using modern mathematical tool, write a program/code to evaluate $\lim_{x \rightarrow \infty} \left(1 + \frac{1}{x}\right)^x$	5	L3	CO5
<b>Module – 3</b>					
Q.5	a.	Solve $\frac{dy}{dx} + \frac{y}{x} = y^2x$	6	L2	CO2
	b.	Find the orthogonal trajectories of the family of curves $\frac{x^2}{a^2} + \frac{y^2}{b^2 + \alpha} = 1$ , where $\alpha$ is a parameter.	7	L3	CO2
	c.	Solve $xyp^2 - (x^2 + y^2)p + xy = 0$ .	7	L2	CO3
<b>OR</b>					
Q.6	a.	Solve $\frac{dy}{dx} + \frac{y \cos x + \sin y + y}{\sin x + x \cos y + x} = 0$	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 $E \sin \omega t$ , satisfies the equation $L \frac{di}{dt} + Ri = E \sin \omega t$ . 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
<b>Module – 4</b>					
Q.7	a.	Evaluate $\int_{-1}^1 \int_0^z \int_{x-z}^{x+z} (x + y + z) dy dx dz$	6	L2	CO3
	b.	Evaluate $\int_{-2}^2 \int_0^{\sqrt{4-x^2}} (2-x) dy dx$ by changing the order of integration.	7	L2	CO3
	c.	Prove that $\int_0^{\pi/2} \frac{d\theta}{\sqrt{\sin \theta}} \times \int_0^{\pi/2} \sqrt{\sin \theta} d\theta = \pi$	7	L2	CO3
<b>OR</b>					
Q.8	a.	Evaluate $\int_0^{\infty} \int_0^{\infty} e^{-(x^2+y^2)} dx dy$ 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 $2x + y + 4z = 12$ $4x + 11y - z = 33$ $8x - 3y + 2z = 20$	7	L3	CO4
	c.	Solve the following system of equations by Gauss-Seidel method $20x + y - 2z = 17$ $3x + 20y - z = -18$ $2x - 3y + 20z = 25$	7	L3	CO4
OR					
Q.10	a.	Using Gauss Jordan method, solve $2x + 5y + 7z = 52, 2x + y - z = 0, x + y + z = 9$	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: $x + 2y - z = 1$ $2x + y + 4z = 2$ $3x + 3y + 4z = 1$	5	L3	CO5

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