

Model Question Paper- I with effect from 2022

CBCS SCHEME

First Semester B.E Degree Examination

Mathematics-I for Electrical Engineering Stream (BMATE101)

TIME: 03Hours

Max.Marks:100

- Note: Answer any FIVE full questions, choosing at least ONE question from each MODULE
- VTU Formula Hand Book is Permitted
- M: Marks, L: Bloom's level, C: Course outcomes.

		Module - 1	M	L	C
Q.1	a	With usual notations prove that $\tan \phi = r \frac{d\theta}{dr}$.	6	L2	CO1
	b	Find the angle between the curves $r = a(1 + \cos\theta)$ and $r = b(1 - \cos\theta)$.	7	L2	CO1
	c	Show that the radius of curvature at any point of the cycloid $x = a(\theta + \sin\theta)$, $y = a(1 - \cos\theta)$ is $4a \cos\left(\frac{\theta}{2}\right)$.	7	L3	CO1
OR					
Q.2	a	With usual notations prove that for the curve $r = f(\theta)$, $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4} \left(\frac{dr}{d\theta}\right)^2$.	7	L2	CO1
	b	Find the pedal equation of the curve $r^m = a^m (\cos m\theta + \sin m\theta)$.	8	L2	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 $e^{\sin x}$ by Maclaurin's series up to the term containing x^6 .	6	L2	CO1
	b	If $u = f(2x - 3y, 3y - 4z, 4z - 2x)$, show that $6\frac{\partial u}{\partial x} + 4\frac{\partial u}{\partial y} + 3\frac{\partial u}{\partial z} = 0$.	7	L2	CO1
	c	Show that the function $f(x, y) = x^3 + y^3 - 3xy + 1$ is minimum at point (1, 1).	7	L3	CO1
OR					
Q.4	a	If $u = \tan^{-1}\left(\frac{y}{x}\right)$ then find the value of $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}$.	7	L2	CO1
	b	If $x + y + z = u$, $y + z = uv$, $z = uvw$ find $\frac{\partial(x, y, z)}{\partial(u, v, w)}$.	8	L3	CO1
	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
Module - 3					

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Q.5	a	Solve $x \frac{dy}{dx} + y = x^3 y^6$.	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 α is a parameter.	7	L3	CO2
	c	Solve $xyp^2 - (x^2 + y^2)p + xy = 0$	7	L2	CO2
OR					
Q.6	a	Solve $(x^2 + y^2 + x)dx + xydy = 0$	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 $\frac{di}{dt} + Ri = E \sin \omega t$. Find the value of the current at any time t , if initially there is no current in the circuit.	7	L3	CO2
	c	Find the general and singular solution of the equation $(px - y)(py + x) = a^2 p$ reducing into Clairaut's form, using the substitution $X = x^2, Y = y^2$.	7	L2	CO2
Module – 4					
Q.7	a	Evaluate $\int_{-c}^c \int_{-b}^b \int_{-a}^a (x^2 + y^2 + z^2) dx dy dz$.	6	L2	CO3
	b	Change the order of integration and evaluate $\int_0^1 \int_{\sqrt{y}}^y dx dy$.	7	L2	CO3
	c	Prove that $\int_0^{\frac{\pi}{2}} \sqrt{\sin \theta} d\theta \times \int_0^{\frac{\pi}{2}} \frac{1}{\sqrt{\sin \theta}} d\theta = \pi$.	7	L2	CO3
OR					
Q.8	a	Evaluate $\int_0^1 \int_0^{\sqrt{1-y^2}} (x^2 + y^2) dx dy$ by changing to polar coordinates.	6	L2	CO3
	b	Derive the relation between beta and gamma function.	7	L2	CO3
	c	Using double integration find the area between the parabolas $y^2 = 4ax, x^2 = 4ay$.	7	L3	CO3
Module – 5					

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Q.9	a	Find the rank of the matrix $\begin{bmatrix} 2 & 1 & -1 & 3 \\ 1 & 2 & 4 & 3 \\ 3 & 6 & 12 & 9 \\ 3 & 3 & 3 & 6 \end{bmatrix}$.	6	L2	CO4
	b	Solve the system of equations by Jordan method. $x + y + z = 10$, $2x - y + 3z = 19$, $x + 2y + 3z = 22$.	7	L3	CO4
	c	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 the initial eigenvector [carry out 6 iterations].	7	L3	CO4
OR					
Q.10	a	Find the rank of the matrix $\begin{bmatrix} 11 & 12 & 13 & 14 \\ 12 & 13 & 14 & 15 \\ 13 & 14 & 15 & 16 \\ 14 & 15 & 16 & 17 \end{bmatrix}$.	7	L2	CO4
	b	Solve the system of equations using Gauss-Seidel method by taking (0, 0, 0) as an initial approximate root $2x - 3y + 20z = 25$, $20x + y - 2z = 17$, $3x + 20y - z = -18$	8	L3	CO4
	c	Using modern mathematical tool write a program/code to test the consistency of the equations, $x + 2y - z = 1$, $2x + y + 4z = 2$, $3x + 3y + 4z = 1$.	5	L3	CO5