

Model Question Paper- I with effect from 2022

CBCS SCHEME

First Semester B.E Degree Examination _____

Mathematics-I for Mechanical Engineering Stream (BMATM101)

TIME: 03Hours

Max.Marks:100

1. Note: Answer any **FIVE** full questions, choosing at least **ONE** 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 $r = \sin \theta + \cos \theta, r = 2 \sin \theta$.	6	L2	CO1
	b	With usual notations prove that for the curve $r = f(\theta), \frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4} \left(\frac{dr}{d\theta}\right)^2$	7	L2	CO1
	c	Find the radius of curvature for the curve $y = ax^2 + bx + c$ at $x = \frac{1}{2a}(\sqrt{a^2 - 1} - b)$.	7	L3	CO1
OR					
Q.2	a	Show that the pedal equation for the curve $r^m = a^m \cos m\theta$ is $pa^m = r^{m+1}$.	8	L2	CO1
	b	Derive the radius of curvature in Cartesian form.	7	L2	CO1
	c	Using modern mathematical tool write a program/code to plot the curve $r = 2 \cos 2\theta $.	5	L3	CO5
Module – 2					
Q.3	a	Expand $e^{\cos x}$ by Maclaurin's series up to the term containing x^6 .	6	L2	CO2
	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	CO2
	c	Examine the function $f(x, y) = x^3 + 3xy^2 + 15x^2 - 15y^2 + 72x$ for extreme values.	7	L3	CO2
OR					
Q.4	a	Evaluate $\lim_{x \rightarrow 0} \left(\frac{a^x + b^x + c^x + d^x}{4} \right)^{\frac{1}{x}}$.	7	L2	CO2
	b	If $u = x^2 + y^2 + z^2, v = xy + yz + zx, w = x + y + z$ find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$.	8	L3	CO2
	c	Using modern mathematical tool write a program/code to show that $u_{xx} + u_{yy} = 0$ given $u = e^x(x \cos y - y \sin y)$.	5	L3	CO5

Model Question Paper- I with effect from 2022

Module – 3					
Q.5	a	Solve $\frac{dy}{dx} + x \sin 2y = x^2 \cos^2 y$.	6	L2	CO3
	b	Solve $(x^3 + y^3 + 6x)dx + (xy^2)dy = 0$.	7	L2	CO3
	c	Find the orthogonal trajectories of cardioid $r = a(1 - \cos \theta)$.	7	L3	CO3
OR					
Q.6	a	Solve $\frac{dy}{dx} + \frac{y \cos x + \sin y + y}{\sin x + x \cos y + x} = 0$	6	L2	CO3
	b	A body is heated to 110°C and placed in air at 10°C . After an hour its temperature becomes 60°C . How much additional time is required for it to cool 30°C .	7	L3	CO3
	c	Find the general and singular solution of the equation $x^2(y - px) = p^2y$ reducing into Clairaut's form, using the substitution $X = x^2, Y = y^2$.	7	L2	CO3
Module – 4					
Q.7	a	Solve $(D^4 - 4D^3 + 8D^2 - 8D + 4)y = 0$	6	L2	CO3
	b	Solve $(D^2 - 6D + 9)y = 6e^{3x} + 7e^{-2x} - \log 2$.	7	L3	CO3
	c	Solve by variation of parameters $(D^2 - 1)y = \frac{2}{1 + e^x}$	7	L2	CO3
OR					
Q.8	a	Solve $(D^3 - 3D^2 + 3D - 1)y = 0$.	6	L2	CO3
	b	Solve $(D^3 + 2D^2 + D)y = \sin 2x$.	7	L2	CO3
	c	Solve $(2x + 3)^2 \frac{d^2y}{dx^2} - (2x + 3) \frac{dy}{dx} - 12y = 6x$.	7	L2	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-Jordan method $x + y + z = 8, -x - y + 2z = -4, 3x + 5y - 7z = 14$.	7	L3	CO4

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	c	Solve the system of equations using Gauss-Seidel method by taking (0, 0, 0) as an initial approximate root $5x + 2y + z = 12$, $x + 4y + 2z = 15$, $x + 2y + 5z = 20$	7	L3	CO4
OR					
Q.10	a	Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 4 & 3 \\ 2 & 4 & 6 & 8 \\ 4 & 8 & 12 & 16 \\ 1 & 2 & 3 & 4 \end{bmatrix}$.	7	L2	CO4
	b	For what values λ and μ the system of equations $2x + 3y + 5z = 9$, $7x + 3y - 2z = 8$, $2x + 3y + \lambda z = \mu$, has (i) no solution (ii) a unique solution and (iii) infinite number of solutions.	8	L2	CO4
	c	Using modern mathematical tool write a program/code to find the largest eigen value of $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ by power method.	5	L3	CO5