

## Model Question Paper-2 with effect from 2022 (CBCS Scheme)

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### First Semester B.E Degree Examination

### Mathematics-I for Mechanical Engineering Stream (22MATM11)

**TIME: 03 Hours**

**Max. Marks: 100**

Note: Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

Module -1			Marks
Q.01	a	Find the angle between the polar curves $r = a(1 + \cos \theta)$ and $r^2 = a^2 \cos 2\theta$	06
	b	Prove with usual notations $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4} \left( \frac{dr}{d\theta} \right)^2$	07
	c	Find the radius of curvature for the curve $y = ax^2 + bx + c$ at $x = \frac{1}{2a}(\sqrt{a^2 - 1} - b)$ .	07
OR			
Q.02	a	Show that the pedal equation for the curve $r^m = a^m \cos m\theta$ is $pa^m = r^{m+1}$	06
	b	Derive the radius of curvature in Cartesian form.	07
	c	Show that for the curve $r = a(1 - \cos \theta)$ is $\frac{\rho^2}{r} = \text{constant}$ .	07
Module-2			
Q. 03	a	Expand $e^{\cos x}$ up to the terms containing fourth degree using Maclaurin's series.	06
	b	If $u = f(x - y, y - z, z - x)$ show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$	07
	c	Find the extreme values of the function $f(x, y) = x^3 + 3xy^2 + 15x^2 - 15y^2 + 72x$	07
OR			
Q.04	a	Evaluate $\lim_{x \rightarrow 0} \left( \frac{a^x + b^x + c^x + d^x}{4} \right)^{\frac{1}{x}}$	06
	b	Find the total derivative $\frac{du}{dx}$ for $u = xy^2 + x^2y$ ; $x = at$ ; $y = 2at$	07
	c	If $u = x^2 + y^2 + z^2$ , $v = xy + yz + zx$ , $w = x + y + z$ find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$	07
Module-3			
Q. 05	a	Solve $\frac{dy}{dx} + x \sin 2y = x^3 \cos^2 y$	06

	b	Solve $(x^3 + y^3 + 6x) dx + (xy^2) dy = 0$	<b>07</b>
	c	Find the orthogonal trajectories of cardioid $r = a(1 - \cos\theta)$	<b>07</b>
<b>OR</b>			
Q. 06	a	Solve $\frac{dy}{dx} + \frac{y\cos x + \sin y + y}{\sin x + x\cos y + x} = 0$	<b>06</b>
	b	A body is heated to $110^\circ\text{C}$ and placed in air at $10^\circ\text{C}$ . After an hour its temperature becomes $60^\circ\text{C}$ . How much additional time is required for it to cool to $30^\circ\text{C}$ .	<b>07</b>
	c	Find the general solution of $x^2(y - px) = p^2y$ by reducing it to Clairaut's form using the substitution $X = x^2, Y = y^2$ .	<b>07</b>
<b>Module-4</b>			
Q. 07	a	Solve $[D^4 - 4D^3 + 8D^2 - 8D + 4]y = 0$ .	<b>06</b>
	b	Solve $[D^2 - 6D + 9]y = 6e^{3x} + 7e^{-2x} - \log 2$	<b>07</b>
	c	Solve by the method of variation of parameter $\frac{d^2y}{dx^2} - y = \frac{2}{1+e^x}$	<b>07</b>
<b>OR</b>			
Q. 08	a	Solve $(D^3 - 3D^2 + 3D - 1)y = 0$	<b>06</b>
	b	Solve $[D^3 + 2D^2 + D]y = \sin 2x$	<b>07</b>
	c	Solve $(2x + 3)^2 \frac{d^2y}{dx^2} - (2x + 3) \frac{dy}{dx} - 12y = 6x$	<b>07</b>
<b>Module-5</b>			
Q. 09	a	Find the rank of the matrix $A = \begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$	<b>06</b>
	b	Solve the system of equations by Gauss-Jordan method $x + y + z = 8; -x - y + 2z = -4; 3x + 5y + -7 = 14$	<b>07</b>
	c	Using Rayleigh's power method find the dominant eigenvalue and the corresponding eigenvector of $A = \begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}$ by taking $(1,0,0)^T$ as initial eigenvector by carrying out 6 iterations.	<b>07</b>
<b>OR</b>			

Q. 10	a	Find the rank of the matrix $A = \begin{bmatrix} 1 & 2 & 4 & 3 \\ 2 & 4 & 6 & 8 \\ 4 & 8 & 12 & 16 \\ 1 & 2 & 3 & 4 \end{bmatrix}$	06
	b	Investigate the value of $\lambda$ and $\mu$ so that the equations $2x + 3y + 5z = 9$ , $7x + 3y - 2z = 8$ , $2x + 3y + \lambda z = \mu$ may have i) unique solution ii) many solution iii) no solution.	07
	c	Solve the system of equations using Gauss-Seidel method by taking (0, 0, 0) as an initial approximate root. $5x + 2y + z = 12$ $x + 4y + 2z = 15$ $x + 2y + 5z = 20$	07

Table showing the Bloom's Taxonomy Level, Course Outcome and Program Outcome				
Question		Bloom's Taxonomy Level attached	Course Outcome	Program Outcome
Q.1	(a)	L1	CO 01	PO 01
	(b)	L2	CO 01	PO 01
	(c)	L3	CO 01	PO 02
Q.2	(a)	L1	CO 01	PO 01
	(b)	L2	CO 01	PO 01
	(c)	L3	CO 01	PO 02
Q.3	(a)	L2	CO 02	PO 01
	(b)	L2	CO 02	PO 01
	(c)	L3	CO 02	PO 02
Q.4	(a)	L2	CO 02	PO 01
	(b)	L2	CO 02	PO 01
	(c)	L3	CO 02	PO 03
Q.5	(a)	L2	CO 03	PO 01
	(b)	L3	CO 03	PO 02
	(c)	L2	CO 03	PO 01
Q.6	(a)	L2	CO 03	PO 01
	(b)	L3	CO 03	PO 02
	(c)	L2	CO 03	PO 01
Q.7	(a)	L2	CO 04	PO 01
	(b)	L2	CO 04	PO 01
	(c)	L2	CO 04	PO 02
Q.8	(a)	L2	CO 04	PO 01
	(b)	L2	CO 04	PO 01
	(c)	L2	CO 04	PO 02
Q.9	(a)	L2	CO 05	PO 01
	(b)	L3	CO 05	PO 01
	(c)	L3	CO 05	PO 02

<b>Q.10</b>	(a)	L2	CO 05	PO 01
	(b)	L3	CO 05	PO 01
	(c)	L3	CO 05	PO 02
<b>Lower order thinking skills</b>				
<b>Bloom's Taxonomy Levels</b>	Remembering (knowledge):L <sub>1</sub>	Understanding (Comprehension): L <sub>2</sub>	Applying (Application): L <sub>3</sub>	
	<b>Higher order thinking skills</b>			
	Analyzing (Analysis):L <sub>4</sub>	Valuating (Evaluation): L <sub>5</sub>	Creating (Synthesis): L <sub>6</sub>	