CBCS SCHEME

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BMATM101

First Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Mathematics – I for ME 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.	Show that pair of polar curves $r = a(1 + \sin\theta)$ and $r = a(1 - \sin\theta)$ intersect orthogonally.	06	L2	CO1
	b.	Find the pedal equation for the equiangular spiral $r = ae^{\theta\cot\alpha}$, where a and α are constants.	07	L2	CO1
	c.	Find the radius of curvature for the curve $y = a\log[\sec(x/a)]$.	07	L2	CO1
		OR			
Q.2	a.	Derive the radius of curvature for Cartesian curve $y = f(x)$ in the form $\rho = \dfrac{(1+y_1^2)^{3/2}}{y_2}$	06	L3	CO1
	b.	Find the angle between the curves $r = a(1 - \cos\theta)$ and $r = 2a\cos\theta$	07	L2	CO1
	c.	Using modern mathematical tool, write a program/code to plot the curve $r = 2\lvert\cos 2\theta\rvert$.	07	L2	CO1
		Module – 2			
Q.3	a.	Expand $f(x) = \sin x + \cos x$ in the powers of x by Maclaurin's theorem upto x^4.	06	L2	CO2
	b.	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$, prove that $xu_x + yu_y + zu_z = 0$.	07	L3	CO2
	c.	Find the extreme values of $f(x, y) = x^3 + 3x^2y + 15x^2 - 15y^2 + 72x$	07	L2	CO2
		OR			
Q.4	a.	Evaluate $\lim_{x\to 0}(\cos x)^{1/x^2}$	07	L2	CO2
	b.	If $u = \frac{yz}{x}$, $v = \frac{zx}{y}$, $w = \frac{xy}{z}$, show that $\frac{\partial(u,v,w)}{\partial(x,y,z)} = 4$	08	L3	CO2
	c.	Using modern mathematical tool, write a program/code to show that $u_{xx} + u_{yy} = 0$. Given $U = e^x(x\cos y - y\sin y)$.	05	L3	CO2
		Module – 3			
Q.5	a.	Solve, $(x^2 - 4xy - 2y^2)dx + (y^2 - 4xy - 2x^2)dy = 0$	06	L2	CO3
	b.	Prove that family of parabolas $y^2 = 4a(x + a)$ is a self-orthogonal.	07	L3	CO3
	c.	Solve, $xyp^2 + p(3x^2 - 2y^2) - 6xy = 0$.	07	L3	CO3

		OR			
Q.6	a.	Solve, $\frac{dy}{dx} + y\tan x = y^3 \sec x$	06	L2	CO3
	b.	A body originally at 80°C cools down 60°C in 20 minutes, the temperature of the air being 40°C. what will be the temperature of the body after 40 minutes from the original?	07	L2	CO3
	c.	Find the general and singular solution of $\sin px \cdot \cos y = \cos px \cdot \sin y + p$	07	L2	CO3
		Module – 4			
Q.7	a.	Solve $(D^3 + 1)y = \cos(2x - 1)$	06	L3	CO4
	b.	Solve, $\frac{d^2y}{dx^2} + \frac{dy}{dx} = x^2 + 2x + 4$	07	L2	CO4
	c.	Solve by variation of parameters method. $\frac{d^2y}{dx^2} + a^2y = \sec(ax)$	07	L2	CO4
		OR			
Q.8	a.	Solve, $[D^4 + 4D^3 - 5D^2 - 36D - 36]y = 0$	06	L2	CO4
	b.	Solve, $\frac{d^2y}{dx^2} + 4y = x^2 + 2^{-x}$	07	L3	CO4
	c.	Solve, $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + 9y = \sin(3\log x)$	07	L2	CO4
		Module – 5			
Q.9	a.	Find the ranks of the matrix $\begin{bmatrix} 0 & 2 & 3 & 4 \\ 2 & 3 & 5 & 4 \\ 4 & 8 & 13 & 12 \end{bmatrix}$	06	L2	CO5
	b.	Using Gauss-Jordan method, solve $x + y + z = 9$; $x - 2y + 3z = 8$; $2x + y - z = 3$	07	L2	CO5
	c.	Find the dominant eigen value and corresponding eigen vector of the matrix $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ by power method taking the initial eigen vector as $[1, 1, 1]^T$. Carry out four iterations.	07	L2	CO5
		OR			
Q.10	a.	Test for consistency and solve $2x + y + 4z = 12$; $4x + 11y - z = 33$; $8x - 3y + 2z = 20$	06	L3	CO5
	b.	Using Gauss Seidal iteration method, solve the system of equations carry out 3 iterations. $20x + y - 2z = 17$; $3x + 20y - z = -18$; $2x - 3y - 20z = 25$	07	L2	CO5
	c.	Using modern mathematical tool, write a program/code to find largest eigen value of $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ by power method.	07	L3	CO5

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