CBCS SCHEME - Summer Semester

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BMATM101

First Semester B.E/B.Tech. Degree Examination, June/July 2025
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. M : Marks , L: Bloom's level , C: Course outcomes.
3. VTU Formula Hand Book is permitted.

		Module – 1	M	L	C
1	a.	Prove with usual notations $\tan\phi = \frac{r\,d\theta}{dr}$.	6	L2	CO1
	b.	Prove that the polar curves $r^n = a^n \cos n\theta$ and $r^n = b^n \sin n\theta$ intersect orthogonally.	7	L2	CO1
	c.	Find the radius of curvature of the curve $y^2 = \frac{a^2(a-x)}{x}$ at the point (a, 0).	7	L3	CO1
		OR			
2	a.	Show that the pedal equation of the curve $\frac{2a}{r} = 1 - \sin\theta$ is $P^2 = ar$.	8	L2	CO1
	b.	Find the radius of curvature of the curve $x^3 + y^3 = 3axy$ at the point $\left(\frac{3a}{2}, \frac{3a}{2}\right)$.	7	L2	CO1
	c.	Using modern mathematical tool write a program to plot the curve $r = 2\lvert\cos 2\theta\rvert$.	5	L3	CO5
		Module – 2			
3	a.	Evaluate i) $\lim\limits_{x\to 0}\left[\frac{a^x + b^x + c^x}{3}\right]^{1/x}$ ii) $\lim\limits_{x\to \frac{\pi}{2}} (\sec x)^{\cot x}$.	6	L3	CO2
	b.	If $u = f\left(\frac{y-x}{xy}, \frac{z-x}{xz}\right)$, then prove that $x^2\frac{\partial u}{\partial x} + y^2\frac{\partial u}{\partial y} + z^2\frac{\partial u}{\partial z} = 0$.	7	L3	CO2
	c.	If $u = \frac{xy}{z}$, $v = \frac{yz}{x}$, $w = \frac{xz}{y}$, then find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$.	7	L2	CO2
		OR			

4	a.	Expand tan x by Maclaurin's series upto the term containing x^5.	8	L3	CO2
	b.	If $Z = \dfrac{x^2+y^2}{x+y}$, then show that $\left(\dfrac{\partial z}{\partial x} - \dfrac{\partial z}{\partial y}\right)^2 = 4\left[1 - \dfrac{\partial z}{\partial x} - \dfrac{\partial z}{\partial y}\right]$.	7	L3	CO2
	c.	Using Modern Mathematical Tool, write a program / code evaluate $\underset{x \to 0}{\text{Lt}} (1 + 1/x)^x$.	5	L3	CO5
		Module – 3			
5	a.	Solve $\dfrac{dy}{dx} + y \tan x = y^3 \sec x$	6	L3	CO5
	b.	Solve $(6x^2 + 4y^3 + 12y)\,dx + 3x(1 + y^2)dy = 0$.	7	L2	CO3
	c.	Solve $(px - y)(py + x) = a^2 p$ by taking the substitutions $u = x^2$ and $v = y^2$.	7	L3	CO3
		OR			
6	a.	Solve $(xy^3 + y)\,dx + 2(x^2y^2 + x + y^4)\,dy = 0$.	6	L2	CO3
	b.	A body originally at 80° C cools down to 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?	7	L2	CO3
	c.	Find the orthogonal trajectories of ellipses $\dfrac{x^2}{a^2} + \dfrac{y^2}{a^2+\lambda} = 1$, where λ is a parameter.	7	L2	CO3
		Module – 4			
7	a.	Solve : $(D^3 - 6D^2 + 11D - 6)y = e^{2x}$.	6	L2	CO3
	b.	Solve $(D-2)^2\, y = 8[x^2 + \sin 2x]$.	7	L2	CO3
	c.	Solve $(D^2 + a^2)y = \sec ax$ by method of variation of parameter.	7	L2	CO3
		OR			
8	a.	Solve $\dfrac{d^2y}{dx^2} - 6\dfrac{dy}{dx} + 9y = 6e^{3x} + \log 2$.	6	L2	CO3
	b.	Using the method of variation of parameters Solve $\dfrac{d^2y}{dx^2} + 4y = \tan 2x$.	7	L2	CO3
	c.	Solve $x^2\dfrac{d^2y}{dx^2} - x\dfrac{dy}{dx} + y = \log x$.	7	L2	CO3

		Module – 5			
9	a.	Find the rank of matrix $A = \begin{bmatrix} 1 & 0 & 2 & 1 \\ 0 & 1 & -2 & 1 \\ 0 & -1 & 4 & 0 \\ -2 & 2 & 8 & 0 \end{bmatrix}$	6	L2	CO4
	b.	Solve the system of equations $10x + 2y + z = 9$, $2x + 20y - 2z = -44$, $-2x + 3y + 10z = 22$ by Gauss – Seidal Iteration Method.	7	L3	CO4
	c.	Using Rayleigh's Power Method , find the dominant eigen value and corresponding eigen vector of a matrix $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & 1 \\ 2 & -1 & 3 \end{bmatrix}$	7	L3	CO5
		OR			
10	a.	Find the rank of a matrix $A = \begin{bmatrix} 1 & 2 & -2 & 3 \\ 2 & 5 & -4 & 6 \\ -1 & -3 & 2 & -2 \\ 2 & 4 & -1 & 6 \end{bmatrix}$.	8	L3	CO4
	b.	Solve the system of equations $x + y + z = 9$, $x - 2y + 3z = 8$, $2x + y - z = 3$ by Gauss – Jordan Method.	7	L2	CO4
	c.	Using Modern Mathematical Tool write a program / code to test the consistency of the equation $x + 2y - z = 1$, $2x + y + 4z = 2$, $3x + 3y + 4z = 1$.	5	L3	CO5

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