CBCS SCHEME

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BMATM101

First Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.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. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Prove with usual notations, $\tan\phi = r\cdot\frac{d\theta}{dr}$	06	L2	CO1
	b.	Find the angle between the curves, $r = a(1+\cos\theta)$ and $r = b(1-\cos\theta)$	07	L2	CO1
	c.	Find the pedal equation to the curves $r^n = a^n \cos n\theta$	07	L2	CO1
		OR			
Q.2	a.	Prove that for the radius of curvature in Cartesian form $\rho = \frac{(1+y_1^2)^{3/2}}{y_2}$	07	L2	CO1
	b.	Find the radius of curvature for the curve $x^3 + y^3 = 3axy$ at the point $\left(\frac{3a}{2}, \frac{3a}{2}\right)$ on it.	08	L2	CO1
	c.	Using modern mathematical tools write the code to find the radius of curvature $r = 4(1+\cos t)$ at $t = \pi/2$	05	L3	CO5
		Module – 2			
Q.3	a.	Expand $e^{\sin x}$ by Maclaurin's series upto the terms containing x^4.	06	L2	CO2
	b.	Evaluate : $\lim_{x\to 0}\left(\frac{a^x+b^x+c^x+d^x}{4}\right)^{1/x}$	07	L2	CO2
	c.	If $u = \log(x^3+y^3+z^3-3xyz)$ then prove that $\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}+\frac{\partial u}{\partial z} = \frac{3}{x+y+z}$	07	L2	CO2
		OR			
Q.4	a.	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	L2	CO2
	b.	If $u = \frac{yz}{z}$, $v = \frac{zx}{y}$, $w = \frac{xy}{z}$, show that $\frac{\partial(u,v,w)}{\partial(x,y,z)} = 4$	08	L2	CO2
	c.	Using modern mathematical tools, write the code to solve : $y'' - 5y' + 6y = \cos 4x$	05	L3	CO5
		Module – 3			
Q.5	a.	Solve : $xy(1+xy^2)\frac{dy}{dx} = 1$	06	L2	CO3
	b.	Solve : $(x^2+y^2+x)dx + xy\,dy = 0$	07	L2	CO3
	c.	Find the orthogonal trajectories of the family of curves $\frac{x^2}{a^2}+\frac{y^2}{b^2+\lambda} = 1$ where λ is the parameter.	07	L2	CO3

		OR			
Q.6	**a.**	Solve : $\frac{dy}{dx}-\frac{dx}{dy}=\frac{x}{y}-\frac{y}{x}$	**06**	**L2**	**CO3**
	b.	Solve the equation $(px - y)(py + x) = 2$ by reducing in to Clairaut's form, taking the substitution. $X = x^2$, $Y = y^2$.	**07**	**L2**	**CO3**
	c.	If the temperature of the air is 30°C and a metal ball cools from 100°C to 70°C in 15 minutes, find how long will it take for the metal ball to reach a temperature of 40°C.	**07**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Solve : $(4D^4 - 4D^3 - 23D^2 + 12D + 36)y = 0$	**06**	**L2**	**CO3**
	b.	Solve : $\frac{d^2y}{dx^2}-4y=\cosh(2x-1)+3^x$	**07**	**L2**	**CO3**
	c.	Solve : $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=4\cos^2 x$	**07**	**L2**	**CO3**
		OR			
Q.8	**a.**	Solve : $\frac{d^2y}{dx^2}+y=\tan x$ by the method of variation of parameters.	**06**	**L2**	**CO3**
	b.	Solve : $x^2\frac{d^2y}{dx^2}-3x\frac{dy}{dx}+4y=(1+x)^2$, using Cauchy's equation.	**07**	**L3**	**CO3**
	c.	Solve the Legendre's linear equation $(1+x)^2\frac{d^2y}{dx^2}+(1+x)\frac{dy}{dx}+y=2\sin\log(1+x)$	**07**	**L3**	**CO3**
		Module – 5			
Q.9	**a.**	Find the rank of a matrix by elementary row transformation $A=\begin{bmatrix}4&0&2&1\\2&1&3&4\\2&3&4&7\\2&3&1&4\end{bmatrix}$	**06**	**L2**	**CO4**
	b.	Investigate the values of λ and μ such that the system of equations: $x + y + z = 6$; $x + 2y + 3z = 10$; $x + 2y + \lambda z = \mu$	**07**	**L2**	**CO4**
	c.	Solve the following system of equations by Gauss-Jordan method. $x + y + z = 9$; $x - 2y + 3z = 8$; $2x + y - z = 3$	**07**	**L2**	**CO4**
		OR			
Q.10	**a.**	Using Rayleigh's power method, find numerically the largest eigen value and the corresponding eigen vectors of the matrix $A=\begin{bmatrix}6&-2&2\\-2&3&-1\\2&-1&3\end{bmatrix}$	**07**	**L2**	**CO4**
	b.	Solve the following system of equations by Gauss-Seidel method. $10x + y + z = 12$; $x + 10y + z = 12$; $x + y + 10z = 12$	**08**	**L2**	**CO4**
	c.	Using modern mathematical tools, write the code to check whether the following system of homogeneous linear equation has non-trivial solution: $x_1 + 2x_2 - x_3 = 0$; $2x_1 + x_2 + 4x_3 = 0$; $3x_1 + 3x_2 + 4x_3 = 0$	**05**	**L3**	**CO5**

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