CBCS SCHEME

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BMATM101

First Semester B.E./B.Tech. Degree Supplementary Examination, June/July 2024

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.	With usual notations prove that $\tan \phi = r.\frac{d\theta}{dr}$.	6	L2	CO1
	b.	Find the angle of intersection for the pair of curves $r = a(1 + \cos\theta)$, $r = b(1 - \cos\theta)$.	7	L2	CO1
	c.	Find the Pedal equation for the curve $r^n = a^n \cos n\theta$.	7	L2	CO1
		OR			
Q.2	a.	Derive an expression for radius of curvature in Cartesian form $\rho = \frac{[1 + y_1^2]^{3/2}}{y_2}$.	7	L1	CO1
	b.	Show that the pair of curves intersect each other orthogonally. $r^n = a^n \cos n\theta$ and $r^n = b^n \sin n\theta$.	8	L3	CO1
	c.	Using modern mathematical tool write a program to plot sine and cosine curve.	5	L3	CO5
		Module – 2			
Q.3	a.	Expand $\log(1 + x)$ upto the term containing x^4, using Maclaurins series.	6	L2	CO2
	b.	If $u = f(p, q, r)$ where $p = x-y$, $q = y-z$, $r = z-x$. Show that, $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$	7	L2	CO2
	c.	Show that $z(x, y) = x^3 + y^3 - 3xy + 1$ is minimum at $(1, 1)$.	7	L3	CO2
		OR			
Q.4	a.	Evaluate the $\lim_{x \to 0}\left[\frac{a^x + b^x + c^x}{3}\right]^{1/x}$.	8	L2	CO2
	b.	If $u = x^2 + y^2 + z^2$, $v = xy + yz + zx$, $w = x + y + z$ find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$.	7	L2	CO2

	c.	Using modern mathematical tool, write a program/code to evaluate: $\lim_{x \to \infty} \left(1+\frac{1}{x}\right)^x$.	5	L5	CO5
		Module – 3			
Q.5	a.	Solve the Bernoulli's differential equation: $\frac{dy}{dx}+\frac{y}{x}=y^2x$.	6	L2	CO3
	b.	Find the orthogonal trajectories of the family $y^2 = cx^3$.	7	L3	CO3
	c.	Solve : $y \cdot p^2 + (x - y)\, p - x = 0$.	7	L2	CO3
		OR			
Q.6	a.	Solve : $(5x^4 + 3x^2y^2 - 2xy^3)dx + (2x^3y - 3x^2y^2 - 5y^4)dy = 0$.	6	L2	CO3
	b.	A body in air at 25°C cools from 100°C to 75°C in 1 minute. Find the temperature of the body at the end of 3 minutes.	7	L3	CO3
	c.	Modify the equation into Clairaut's form. Hence find the general and singular solution of $xp^2 - py + kp + a = 0$.	7	L2	CO3
		Module – 4			
Q.7	a.	Solve : $(D^3 - 2D^2 + 4D - 8)\, y = 0$.	6	L2	CO3
	b.	Solve : $(6D^2 + 17D + 12)\, y = e^{-x}$.	7	L2	CO3
	c.	Solve by variation of parameters $(D^2 + 1)y = \tan x$.	7	L2	CO3
		OR			
Q.8	a.	Solve : $(D^3 + 1)\, y = 0$	6	L2	CO3
	b.	Solve : $y'' + 2y' + y = 2x + x^2$	7	L2	CO3
	c.	Solve : $x^2y'' - 2y = x^2$	7	L2	CO3
		Module – 5			
Q.9	a.	Find the rank of the matrix $A = \begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$	6	L2	CO4
	b.	Solve the system of equation by using Gauss elimination method $x + 2y + z = 3,\ 2x + 3y + 3z = 10,\ 3x - y + 2z = 13$	7	L3	CO4

	c.	Using Rayleigh's power method, find the largest eigen value and the corresponding eigen vector of the matrix, $A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ by taking initial vector as $[1\ 1\ 1]^T$.	7	L3	CO4
		OR			
Q.10	a.	Solve the system of equation by using Gauss-Jordan method. $x + y + z = 8, -x - y + 2z = -4, 3x + 5y - 7z = -14$	7	L3	CO4
	b.	Solve the system of equations by Gauss-Seidel method $20x + y - 2z = 17, 3x + 20y - z = -18, 2x - 3y + 20z = 25.$	8	L3	CO4
	c.	Using modern mathematical tool write a program/code to test the consistency of the equations $x + 2y - z = 1, 2x + y + 4z = 2, 3x + 3y + 4z = 1.$	5	L3	CO5

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