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 $\int = \frac{\left[1+y_1^2\right]^{3/2}}{y_2}$.	**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: $\lim\limits_{x \to \infty}\left(1+\frac{1}{x}\right)^{x}$.	**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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