CBCS SCHEME

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BMATM101

First Semester B.E./B.Tech. Degree Examination, June/July 2024
Mathematics – I for Mechanical Engineering 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.	Find the angle of intersection of the curves $r = a(1 + \cos\theta)$, $r = b(1 - \cos\theta)$	06	L2	CO1
	b.	With the usual notations prove that for the given curve $r = f(\theta)$, $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\theta}\right)^2$.	07	L2	CO1
	c.	Find the radius of curvature of the curve $x^4 + y^4 = 2$ at (1, 1)	07	L3	CO1
		OR			
Q.2	a.	Find the pedal equation for the curve $a^m = r^m \cos m\theta$.	08	L2	CO1
	b.	Find the radius of curvature for the curves $x = a(\cos t + t\sin t)$ and $y = a(\sin t - t\cos t)$	07	L3	CO1
	c.	Using modern mathematical tool write a program/code to plot the curve $r = 2\,\lvert\cos 2\theta\rvert$	05	L3	CO5
		Module – 2			
Q.3	a.	Using Maclaurin's theorem prove that $\sqrt{1+\sin x} = 1 + x - \frac{x^2}{2} - \frac{x^3}{6} + \frac{x^4}{24} - \ldots\ldots$	06	L2	CO2
	b.	If $u = f(2x - 3y, 3y - 4z, 4z - 2x)$ then find $6U_x + 4U_y + 3U_z = 0$	07	L2	CO2
	c.	Examine the function $f(x, y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$ for extreme value.	07	L3	CO2
		OR			
Q.4	a.	If $u = x + 3y^2 - z^3$, $v = x^2yz$, $w = 2x^2 - xy$, evaluate $\frac{\partial(u,v,w)}{\partial(x,y,z)}$	08	L3	CO2
	b.	If $u = x^3y^2 + x^2y^3$ where $x = at^2$, $y = 2at$ find $\frac{du}{dt}$	07	L3	CO2
	c.	Using modern mathematical tool write a program/code to evaluate $\lim_{x\to\infty}\left(1+\frac{1}{x}\right)^x$	05	L3	CO5
		Module – 3			
Q.5	a.	Solve $\frac{dy}{dx} + \frac{y\cos x + \sin y + y}{\sin x + x\cos y + x} = 0$	06	L2	CO3
	b.	Find the orthogonal trajectories of cardiod $r = a(1 + \cos\theta)$	07	L2	CO3
	c.	Solve $yp^2 + (x - y)p - x = 0$	07	L2	CO3

		OR			
Q.6	**a.**	Solve $\frac{dy}{dx}+\frac{y}{x}=y^2x$	**06**	**L2**	**CO3**
	b.	A body is originally at 80°C and cools down at 60°C in 20 minutes. If the temperature of the air is 40°C, find the temperature of the body after 40 minutes.	**07**	**L3**	**CO3**
	c.	Find the general and singular solution of $xp^2+xp-yp+1-y=0$	**07**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Solve $(4D^4-8D^3-7D^2+11D+6)y=0$	**06**	**L2**	**CO3**
	b.	Solve $(D^2-6D+9)y=6e^{3x}-\log 2$	**07**	**L3**	**CO3**
	c.	Solve $(1+x)^2\frac{d^2y}{dx^2}+(1+x)\frac{dy}{dx}+y=\sin 2[\log(1+x)]$	**07**	**L2**	**CO3**
		OR			
Q.8	**a.**	Solve $(D^2-4D+13)y=\cos 2x$	**06**	**L2**	**CO3**
	b.	Solve by variation of parameters $(D^2+1)y=\tan x$	**07**	**L2**	**CO3**
	c.	Solve $x^2\frac{d^2y}{dx^2}-3x\frac{dy}{dx}+4y=(1+x)^2$	**07**	**L2**	**CO3**
		Module – 5			
Q.9	**a.**	Find the rank of the matrix $\begin{bmatrix}21&22&23&24\\22&23&24&25\\23&24&25&26\\24&25&26&27\end{bmatrix}$	**06**	**L2**	**CO4**
	b.	For what value of λ and μ the system of equations $2x+3y+5z=9$, $7x+3y-2z=8$, $2x+3y+\lambda z=\mu$ has i) no solution ii) a unique solution iii) infinite number of solutions.	**07**	**L2**	**CO4**
	c.	Using Rayleigh's power method find the dominant eigen value and the corresponding eigen vector of $\begin{bmatrix}2&-1&0\\-1&2&-1\\0&-1&2\end{bmatrix}$ by taking $[1, 0, 0]^T$ as the initial eigen vector. (Carry out 6 iterations).	**07**	**L3**	**CO4**
		OR			
Q.10	**a.**	Solve the system of equation by Gauss Elimination method. $2x+y+4z=12$, $4x+11y-z=33$, $x+2y+5z=20$	**07**	**L3**	**CO4**
	b.	Solve the system of equations using Gauss-Seidel method by taking (0,0,0) as an initial approximate root. $5x+2y+z=12$, $x+4y+2z=15$, $x+2y+5z=20$	**08**	**L3**	**CO4**
	c.	Using modern mathematical tool write a program/code to find the largest eigen value of $A=\begin{bmatrix}1&1&3\\1&5&1\\3&1&1\end{bmatrix}$ by power method.	**05**	**L3**	**CO5**

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