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BMATM101

First Semester B.E./B.Tech. Degree Examination, Jan./Feb. 2023
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.	With usual notations prove that $\tan\phi = \dfrac{rd\theta}{dr}$.	6	L2	CO1
	b.	Find the pedal equation of $r^n = a^n \cos n\theta$	7	L2	CO1
	c.	Find the angle of intersection of the curves $r = a(1 + \cos\theta)$, $r = b(1 - \cos\theta)$	7	L2	CO1
		OR			
Q.2	a.	Derive the radius of curvature for the Cartesian curve.	7	L2	CO1
	b.	Find the angle between the polar curves $r = a\log\theta$, $r = \dfrac{a}{\log\theta}$	8	L2	CO1
	c.	Using modern mathematical tool write a program/code to plot sine and cosine curves.	5	L3	CO5
		Module – 2			
Q.3	a.	Expand $\sqrt{1 + \sin 2x}$ by Maclaurin's series upto the terms containing x^4.	6	L2	CO2
	b.	If $U = f(x - y, y - z, z - x)$, show that $\dfrac{\partial U}{\partial x} + \dfrac{\partial U}{\partial y} + \dfrac{\partial U}{\partial z} = 0$.	7	L2	CO2
	c.	Examine the function $f(x,y) = x^3 + 3xy^3 + 15x^2 - 15y^2 + 72x$ for extreme values.	7	L3	CO2
		OR			
Q.4	a.	Evaluate $\displaystyle\lim_{x \to 0}\left(\dfrac{a^x + b^x + c^x + d^x}{4}\right)^{\frac{1}{x}}$.	6	L2	CO2
	b.	If $U = x^2 + y^2 + z^2$, $V = xy + yz + zx$, $W = x + y + z$, find $\dfrac{\partial(U, V, W)}{\partial(x, y, z)}$.	7	L2	CO2
	c.	Using modern mathematical tool to write a program/code to evaluate $\displaystyle\lim_{x \to \infty}\left(1 + \dfrac{1}{x}\right)^x$	7	L3	CO5
		Module – 3			
Q.5	a.	Solve $\dfrac{dy}{dx} + \dfrac{y\cos x + \sin y + y}{\sin x + x\cos y + x} = 0$.	6	L2	CO3
	b.	If the air is maintained at 30ºC and the temperature of the body cools from 80ºC to 60ºC in 12 minutes, Find the temperature of the body after 24 minutes.	7	L3	CO3
	c.	Find the general and singular solutions of $xp^2 + xp - yp + 1 - y = 0$.	7	L2	CO3

<div align="center">OR</div>

Q.6	a.	Solve $\dfrac{dy}{dx} + x \sin 2y = x^3 \cos^2 y$.	6	L2	CO3
	b.	Show that the parabola $y^2 = 4a(x + a)$ is self orthogonal.	7	L3	CO3
	c.	Solve $xyp^2 - (x^2 + y^2)\,p + xy = 0$.	7	L2	CO3

<div align="center">Module – 4</div>

Q.7	a.	Solve $(D^4 - 4D^3 + 8D^2 - 8D + 4)\,y = 0$.	6	L2	CO3
	b.	Solve $(D^2 - 6D + 9)y = 6e^{3x} + 7e^{-2x} - \log 2$.	7	L2	CO3
	c.	Solve by variation of parameters $(D^2 + 1)\,y = \operatorname{Sec} x$.	7	L2	CO3

<div align="center">OR</div>

Q.8	a.	Solve $(D^2 - 4D + 13)\,y = \operatorname{Cos} 2x$.	6	L2	CO3
	b.	Solve $y'' + 3y' + 2y = 12x^2$.	7	L2	CO3
	c.	Solve $(x^2)y'' - xy' + y = \log x$.	7	L2	CO3

<div align="center">Module – 5</div>

Q.9	a.	Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 & 1 \\ 2 & 1 & -1 & 0 \\ 3 & 3 & 2 & 1 \\ 2 & 4 & 6 & 2 \end{bmatrix}$	6	L2	CO4
	b.	For what values λ and μ the system 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.	7	L2	CO4
	c.	Solve the system of equations using Gauss Seidel method by taking (0, 0, 0) as an initial conditions $10x + y + z = 12$, $x + 10y + z = 12$, $x + y + 10x = 12$.	7	L2	CO4

<div align="center">OR</div>

Q.10	a.	Using Gauss – Jordon method, solve $x + y + z = 11$, $3x - y + 2z = 12$, $2x + y - z = 3$.	7	L2	CO4
	b.	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].	8	L2	CO4
	c.	Using modern mathematical tool write a program/code to test the consistency of the equations $x + 2y - z = 1$, $2x + y + 4x = 2$, $3x + 3y + 4z = 1$.	5	L3	CO5

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