USN | | | | | | | | | | |

BMATM101

First Semester B.E./B.Tech. Degree Examination, Nov./Dec. 2023
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.	Find the angle between the curves $r(1 + \cos\theta) = a$ and $r(1 - \cos\theta) = b$.	06	L2	CO1
	b.	With usual notation prove that $\tan\theta = r\dfrac{d\theta}{dr}$.	07	L1	CO1
	c.	Find the radius of curvature at the point (3a/2, 3a/2) of the curve $x^3 + y^3 = 3axy$	07	L3	CO1
		OR			
Q.2	a.	Find the Pedal Equation of the curve $r^n = a(1 + \cos n\theta)$.	08	L2	CO1
	b.	Derive an expression for the radius of curvature in Cartesian form.	07	L1	CO1
	c.	Using modern mathematical tool write a programme to plot sine and cosine curve.	05	L3	CO5
		Module – 2			
Q.3	a.	Find the Maclaurin's series expansion of sec x upto the term containing x^4.	06	L2	CO2
	b.	If u = f(ax – by, by – cz, cz – ax), then show that $\dfrac{1}{a}\dfrac{\partial u}{\partial x} + \dfrac{1}{b}\dfrac{\partial u}{\partial y} + \dfrac{1}{c}\dfrac{\partial u}{\partial z} = 0$	07	L2	CO2
	c.	Examine the extreme values of the function $f(x, y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$	07	L2	CO2
		OR			
Q.4	a.	Evaluate $\displaystyle\lim_{x \to 0}\left(\dfrac{1^x + 2^x + 3^x}{3}\right)^{1/x}$	08	L2	CO2
	b.	If $u = x + 3y^2 - z^3$, $v = 4x^2yz$, $w = 2z^2 - xy$ find the value of $\dfrac{\partial(u, v, w)}{\partial(x, y, z)}$ at the point (1, –1, 0)	07	L2	CO2
	c.	Using modern mathematical tool write a programme to show that $U_{xx} + U_{yy} = 0$ where $u = e^x[x \cos y - y \sin y]$.	05	L2	CO5
		Module – 3			
Q.5	a.	Solve $x\dfrac{dy}{dx} + y = x^3y^6$	06	L2	CO3
	b.	Prove that the confocal and coaxial parabolas $y^2 = 4a(x + a)$ is self orthogonal.	07	L3	CO3
	c.	Solve $xyp^2 - (x^2 + y^2)p + xy = 0$	07	L2	CO3
		OR			
Q.6	a.	Solve $(4xy + 3y^2 - x)dx + x(x + 2y)dy = 0$	06	L2	CO3
	b.	A body in the 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.	07	L2	CO3
	c.	Solve the equation (px – y)(py – x) = 2p by reducing into Clairaut's form taking the substitutions $X = x^2$, $Y = y^2$.	07	L2	CO3

Module – 4

Q.7	a.	Solve $[4D^4 - 8D^3 - 7D^2 + 11D + 6] y = 0$	06	L2	CO4
	b.	Solve $(D^2 + 4)y = \sin 3x + \cos 2x$.	07	L2	CO4
	c.	Solve $(2x + 5)^2 \dfrac{d^2y}{dx^2} - 6(2x + 5)\dfrac{dy}{dx} + 8y = 6x$	07	L2	CO4

OR

Q.8	a.	Solve $y'' - 6y' + 9y = 8e^{-2x}$	06	L2	CO4
	b.	Solve $\dfrac{d^2y}{dx^2} + 4y = \tan 2x$ by the method of variation of parameters.	07	L2	CO4
	c.	Solve $x^2y'' + 5xy' + 4y = x^2$	07	L2	CO4

Module – 5

Q.9	a.	Find the rank of the matrix $$A = \begin{pmatrix} -1 & 2 & 3 & -2 \\ 2 & -5 & 1 & 2 \\ 3 & -8 & 5 & 2 \\ 5 & -12 & -1 & 6 \end{pmatrix}$$	06	L2	CO5
	b.	Using Gauss elimination method solve the system of equations $x + 2y + z = 3$, $2x + 3y + 2z = 5$, $3x + 5y + 5z = 2$.	07	L3	CO5
	c.	Solve the following system of equations by Gauss Seidel method. $10x + 2y + z = 9$, $2x + 20y - 2z = -44$, $-2x + 3y + 10z = 22$. Carry out 3 iterations.	07	L3	CO5

OR

Q.10	a.	For what value of λ and μ the system of equations $x + y + z = 6$, $x + 2y + 3z = 10$, $x + 2y + \lambda z = \mu$ has (i) no solution (ii) a unique solution (iii) infinite number of solutions.	08	L3	CO5
	b.	Find the largest eigen value and the corresponding eigen vector of the matrix, starting with an initial approximation $[1\ \ 1\ \ 0]^T$ $$\begin{pmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{pmatrix}$$ Carryout 4 iterations.	07	L3	CO5
	c.	Using modern mathematical tool write a programme to test the consistency of the equation $x + 2y - z = 0$, $2x + y + 4z = 2$, $3x + 3y + 4z = 1$.	05	L2	CO5

* * * * *