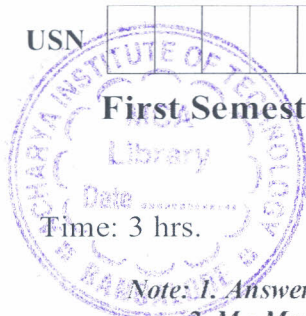




First Semester B.E./B.Tech. Degree Examination, June/July 2025

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. M : Marks , L: Bloom's level , C: Course outcomes.

3. VTU Mathematics formula Handbook is permitted.

Module – 1			M	L	C
Q.1	a.	Derive an expression for Angle between radius vector and tangent.	6	L2	CO1
	b.	Find the pedal equation for the curve $r^2 = a^2 \sec 2\theta$.	7	L2	CO1
	c.	Find the radius of curvature of the curve $x^3 + y^3 = 2a^3$ at the point (a, a).	7	L3	CO1
OR					
Q.2	a.	With usual notation prove that $\rho = \frac{(1 + y_1^2)^{3/2}}{y_2}$	7	L2	CO1
	b.	Prove that the pair of polar curves intersect orthogonally $r^n = a^n \cos n\theta$, $r^n = b^n \sin n\theta$.	8	L2	CO1
	c.	Using modern mathematical tool, write a programme code to plot sine and cosine curves.	5	L3	CO5
Module – 2					
Q.3	a.	Expand $\cos x$ by Maclaurin's series upto the containing x^4 .	6	L2	CO2
	b.	If $u = \tan^{-1} \left(\frac{y}{x} \right)$ where $x = e^t - e^{-t}$ and $y = e^t + e^{-t}$, find $\left(\frac{du}{dt} \right)$.	7	L2	CO2
	c.	Show that $f(x, y) = x^3 + y^3 - 3xy + 1$ is minimum at the point (1, 1).	7	L3	CO2
OR					
Q.4	a.	Evaluate $\lim_{x \rightarrow 0} \left(\frac{\sin x}{x} \right)^{1/x^2}$.	8	L2	CO2
	b.	If $U = x + y + z$, $V = y - z$, $W = z$, find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$.	7	L2	CO2
	c.	Using modern mathematical tool, write a program to prove $u_{xx} + u_{yy} = 0$. If $u = e^x [x \cos y - y \sin y]$.	5	L3	CO5

Module – 3				
Q.5	a.	Solve : $\frac{dy}{dx} + \frac{y}{x} = y^2 x$.	6	L2 CO3
	b.	Solve $(5x^4 + 3x^2y^2 - 2xy^3) dx + (2x^3y - 3x^2y^2 - 5y^4)dy = 0$.	7	L2 CO3
	c.	Solve $yp^2 + (x-y)p - x = 0$.	7	L2 CO3
OR				
Q.6	a.	Obtain the General and Singular solution of the equation $p = \log (px - y)$.	6	L2 CO3
	b.	Define Newton's law of cooling. 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.	Solve the equation $(px - y) (py+x) = 2p$ by reducing into Clairaut's form taking the substitution $X = x^2$, $Y = y^2$.	7	L2 CO3
Module – 4				
Q.7	a.	Solve : $y''' + 6y'' + 11y' + 6y = 0$.	6	L2 CO3
	b.	Solve : $y'' + 2y' + y = 2x + x^2$.	7	L2 CO3
	c.	Solve : $y'' + 4y = 4 \sec^2 2x$ by the method of variation of parameter.	7	L2 CO3
OR				
Q.8	a.	Solve : $(6 D^2 + 17D + 12) y = e^{-x}$.	6	L2 CO3
	b.	Solve : $x^2 y'' + xy' + 9y = \sin (3 \log x)$.	7	L2 CO3
	c.	Solve : $(1 + x)^2 y'' + (1 + x) y' + y = 2 \cos[\log (1 + x)]$.	7	L2 CO3
Module – 5				
Q.9	a.	Find the rank of the matrix $\begin{bmatrix} 0 & 2 & 3 & 4 \\ 2 & 3 & 5 & 4 \\ 4 & 8 & 13 & 12 \end{bmatrix}$	6	L2 CO4
	b.	Solve the system of equations $x + y + z = 9$; $x - 2y + 3z = 8$; $2x + y - z = 3$ by Gauss Elimination method.	7	L3 CO4
	c.	Solve the following system of equations by Gauss – Seidal method : $10x + y + z = 12$; $x + 10y + z = 12$; $x + y + 10z = 12$ for 4 Iterations.	7	L3 CO4
OR				

Q.10	a. Test for consistency and solve : $x - 4y + 7z = 14$, $3x + 8y - 2z = 13$; $7x - 8y + 26z = 5$.	7	L2	CO4
	b. Find the largest eigen value and corresponding eigen vector of matrix $\begin{pmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{pmatrix}$ by power method, by taking initial eigen vector $(1, 1, 1)^T$ carryout upto 5 Iteration.	8	L3	CO4
	c. Using modern mathematical tool write a programme to solve the system of equations $5x - y - z = -3$; $x - 5y + z = -9$; $2x + y - 4z = 15$ by Gauss Siedal method.	5	L3	CO5
