



First Semester B.E./B.Tech. Degree Supplementary Examination,
June/July 2024
Mathematics – I for CSE 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.	Show that the curves $r = a(1 + \sin\theta)$ and $r = b(1 - \sin\theta)$ intersect each other orthogonally.	7	L2	CO1
	c.	Find the radius of curvature at the point $\left(\frac{39}{2}, \frac{39}{2}\right)$ for the curve $x^3 + y^3 = 3axy$.	7	L3	CO1
OR					
Q.2	a.	With usual notations prove that $\rho = \frac{[1 + y_1^2]^{3/2}}{y_2}$	8	L2	CO1
	b.	Find the pedal equation of the curve : $r^n = a^n \cos n\theta$.	7	L1	CO1
	c.	Using modern mathematical tool, write a program/code to plot the curve $r = 2 \cos 2\theta $.	5	L1	CO5
Module – 2					
Q.3	a.	Obtain the Maclaurin's expansion of $\log(1 + e^x)$ upto the term containing x^4 .	6	L2	CO1
	b.	If $u = f[2x - 3y, 3y - 4z, 4z - 2x]$ then find the value of $\frac{1}{2} \frac{\partial u}{\partial x} + \frac{1}{3} \frac{\partial u}{\partial y} + \frac{1}{4} \frac{\partial u}{\partial z}$.	7	L1	CO1
	c.	Find the maximum and minimum value of the function, $f(x, y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$.	7	L1	CO1
OR					
Q.4	a.	Evaluate $\lim_{x \rightarrow 0} \left(\frac{a^x + b^x + c^x + d^x}{4} \right)^{\frac{1}{x}}$	7	L2	CO1

	b.	If $u = x^2 - y^2$, when $x = e^t \cos t$, $y = e^t \sin t$, show that $\frac{\partial u}{\partial t} = 2e^{2t}[\cos 2t - \sin 2t]$.	8	L2	CO1
	c.	Using modern mathematical tool write a program/code to show that $u_{xx} + u_{yy} = 0$, given $u = e^x[x \cos y - y \sin y]$.	5	L3	CO5
Module - 3					
Q.5	a.	Solve: $\frac{dy}{dx} + \frac{y}{x} = y^2 x$	6	L3	CO2
	b.	Find the orthogonal trajectories of $\frac{x^2}{a^2 + x} + \frac{y^2}{b^2 + x} = 1$ where λ is a parameter.	7	L1	CO2
	c.	Solve: $x^2 p^2 + xyp - 6y^2 = 0$.	7	L3	CO2
OR					
Q.6	a.	Solve: $(y^4 + 2y)dx + (xy^3 + 2y^4 - 4x)dy = 0$.	6	L2	CO2
	b.	Solve the differential equation $L \frac{di}{dt} + Ri = 200 \sin 300t$ when $L = 0.05$ and $R = 100$ and find the value of the current i at any time t , if initially there is no current in the circuit. What value does i approach after a long time.	7	L3	CO2
	c.	Find the general and singular solution of $(a^2 - x^2)p^2 + 2xyp + b^2 - y^2 = 0$	7	L2	CO2
Module - 4					
Q.7	a.	(i) Find the remainder when 41^{75} is divided by 3, (ii) Find the last digit in 7^{289} .	6	L2	CO3
	b.	Find the solution of the linear congruence $18x \equiv 30 \pmod{42}$.	7	L2	CO3
	c.	Using RSA algorithm find public key and private key with respect to $p = 3$, $q = 11$ and $m = 31$	7	L3	CO3
OR					
Q.8	a.	Show that $8^{30} - 1$ is divisible by 31 using Fermat to little theorem.	6	L2	CO3
	b.	Solve the system of linear congruence's using CRT $x \equiv 2 \pmod{3}$, $x \equiv 3 \pmod{5}$, $x \equiv 2 \pmod{7}$.	7	L3	CO3
	c.	(i) Find the remainder when $349 \times 74 \times 36$ is divided by 3. (ii) Find the roots of $x^2 + 2x - 3 \equiv 0 \pmod{5}$	7	L2	CO3
Module - 5					
Q.9	a.	Find the rank of the matrix $\begin{bmatrix} -2 & -1 & -3 & -1 \\ 1 & 2 & 3 & 1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 \end{bmatrix}$	6	L2	CO4

	b.	Test for consistency and solve $5x + 3y + 7z = 4$, $3x + 26y + 2z = 9$, $7x + 2y + 10z = 5$	7	L3	CO4
	c.	Find the largest Eigen value and the corresponding Eigen vector, $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ with initial vector $[1 \ 1 \ 1 \ 1 \ 1]^T$ carry out 5 iterations.	7	L1	CO4
OR					
Q.10	a.	Solve the system of equations by Gauss Seidal method $83x + 11y - 4z = 95$, $7x + 52y + 13z = 104$, $3x + 8y + 29z = 71$. Carry out three iterations.	8	L4	CO3
	b.	Solve the system of equations by using Gauss-Jordan method: $x + 2y + z = 8$ $2x + 3y + 4z = 20$, $4x + 3y + 2z = 16$	7	L3	CO4
	c.	Using modern mathematical tool, write a program/code to find the largest eigen value of, $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$	5	L3	CO5
