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First Semester B.E/B.Tech. Degree Examination, Dec.2023/Jan.2024
Mathematics – I for EEE Stream

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
1	a.	With usual notations prove that $\tan \phi = r \frac{d\theta}{dr}$.	6	L2	CO1
	b.	Find the angle of intersection for the pair of curve $r = a(1 + \sin \theta)$, $r = b(1 - \sin \theta)$.	7	L2	CO1
	c.	Find the radius of curvature of the curve $x^3 + y^3 = 3xy$ at $\left(\frac{3}{2}, \frac{3}{2}\right)$.	7	L2	CO1
OR					
2	a.	Prove that the pair of curves $r = a \sec^2\left(\frac{\theta}{2}\right)$, $r = b \operatorname{cosec}^2\left(\frac{\theta}{2}\right)$ intersect orthogonally.	8	L2	CO1
	b.	Find the Pedal equation of the curve $r^n = a^n \cos n\theta$.	7	L2	CO1
	c.	Using modern mathematical tool write a program/code to plot sine and cosine curves.	5	L3	CO5
Module – 2					
3	a.	Expand $\log(\sec x)$ up to the term containing x^6 using Maclaurin's series.	6	L2	CO1
	b.	If $u = \tan^{-1}\left(\frac{y}{x}\right)$ where $x = e^t - e^{-t}$ and $y = e^t + e^{-t}$. Find $\frac{du}{dt}$.	7	L2	CO1
	c.	If: $u = x + 3y^2 - z^3$ $v = 4x^2yz$ $w = 2z^2 - xy$ Find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$ at $(1, -1, 0)$.	7	L3	CO1

OR

4	a.	Evaluate : i) $\lim_{x \rightarrow 0} \left(\frac{a^x + b^x}{2} \right)^{\frac{1}{x}}$ ii) $\lim_{x \rightarrow 0} (\sin x)^{\tan x}$	7	L2	CO1
	b.	If $u=f(y-z, z-x, x-y)$ prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$.	8	L2	CO1
	c.	Using modern mathematical tool write a program/ code to evaluate : $\lim_{x \rightarrow \infty} \left(1 + \frac{1}{x} \right)^x$	5	L3	CO5

Module - 3

5	a.	Solve : $\frac{dy}{dx} + 2\frac{y}{x} = \frac{y^2 \log x}{x}$	6	L2	CO2
	b.	Find the orthogonal trajectories of the family of Asteroid $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$	7	L3	CO2
	c.	Solve : $p^3 + 2xp^2 - y^2p^2 - 2xy^2p = 0$	7	L2	CO2

OR

6	a.	Solve : $y(x+y+1)dx + x(x+3y+2)dy = 0$.	6	L2	CO2
	b.	Show that a DE for the current i in an electric circuit containing an inductance L and resistance R in series and acted by an electromotive force $E \sin \omega t$ satisfies the equation : $L \frac{di}{dt} + Ri = E \sin \omega t$. Find the value of the current at any time t , if initially there is no current in the circuit.	7	L3	CO2
	c.	Modify the equation into Clairaut's form. Hence find the general and singular solution of $xp^2 - py + kp + a = 0$.	7	L2	CO2

Module - 4

7	a.	Evaluate : $\int_{-1}^1 \int_0^{x+z} \int_{x-z}^{x+z} (x+y+z) dy dx dz$	6	L2	CO3
	b.	Evaluate by changing the order of integration : $\int_0^1 \int_0^{\sqrt{1-x^2}} y^2 dx dy$	7	L2	CO3
	c.	Prove that $\beta(m, n) = \frac{\Gamma(m) \cdot \Gamma(n)}{\Gamma(m+n)}$	7	L2	CO3

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OR

8	a.	Evaluate : $\int_0^a \int_0^{\sqrt{a^2-y^2}} y\sqrt{x^2+y^2} dx dy$ by changing into polar form.	6	L2	CO3
	b.	Find the area bounded between the parabolas $y^2 = 4ax$ and $x^2 = 4ay$ using double integration.	7	L3	CO3
	c.	Prove that $\int_0^{\frac{\pi}{2}} \sqrt{\sin \theta} d\theta \times \int_0^{\frac{\pi}{2}} \frac{d\theta}{\sqrt{\sin \theta}} = \pi$.	7	L2	CO3

Module - 5

9	a.	Find the Rank of the Matrix : $\begin{bmatrix} 1 & 0 & 2 & -2 \\ 2 & -1 & 0 & -1 \\ 1 & 0 & 2 & -1 \\ 4 & -1 & 3 & -1 \end{bmatrix}$	6	L2	CO4
	b.	Solve the system of equations by Gauss – Elimination method. $2x + y + z = 10$ $3x + 2y + 3z = 18$ $x + 4y + 9z = 16$.	7	L3	CO4
	c.	Using Gauss – Seidel iterative method to solve : $5x + 2y + z = 12$ $x + 4y + 2z = 15$ $x + 2y + 5z = 20$ Carryout 4 iterations, taking the initial approximation to the solution as (1, 0, 3).	7	L3	CO4

OR

10	a.	Find the Rank of the matrix : $\begin{bmatrix} 4 & 0 & 2 & 1 \\ 2 & 1 & 3 & 4 \\ 2 & 3 & 4 & 7 \\ 2 & 3 & 1 & 4 \end{bmatrix}$	7	L2	CO4
	b.	Solve by Gauss – Jordan method : $2x + y + 3z = 1$ $4x + 4y + 7z = 1$ $2x + 5y + 9z = 3$.	7	L3	CO4
	c.	Using modern mathematical tool write a program/code to test the consistency of the equations : $x + 2y - z = 1$ $2x + y + 4z = 2$ $3x + 3y + 4z = 1$.	6	L3	CO5
