Maharaja Education Trust (R), Mysuru

MAHARAJA INSTITUTE OF TECHNOLOGY MYSORE

An Autonomous Institute, affiliated Visvesvaraya Technological University, Belagavi

Belawadi, Srirangapatna Taluk, Mandya – 571 477

Approved by AICTE, New Delhi |Recognized by Govt. of Karnataka|

First Semester B.E Degree Examination, February/March 2024

Mathematics-1 for Computer Science and Engineering Stream

Duration: 3 hrs | Max. Marks: 100

Note: *1. Answer five full questions choosing one complete question from each module.*
2. Formula Hand Book is permitted
3. M: Marks, L: Bloom's level, C: Course outcomes.

Sl. No.	Questions	M	L	C
	Module 1			
1 a)	With usual notation prove that $\cot\phi = \frac{1}{r}\left(\frac{dr}{d\theta}\right)$	6	L2	CO1
b)	Find the angle of intersection between the two polar curves $r^m = a^m \cos m\theta$ and $r^m = b^m \sin m\theta$.	7	L1	CO1
c)	Find the radius of curvature for the Folium of De-Cartes $x^3 + y^3 = 3axy$ at the point $\left(\frac{3a}{2}, \frac{3a}{2}\right)$ on it.	7	L1	CO1
	OR			
2 a)	With usual notation prove that $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\theta}\right)^2$.	7	L2	CO1
b)	Find the pedal equation of the curve $r(1-\cos\theta) = 2a$.	7	L1	CO1
c)	Using modern mathematical tool, write a program/code to find radius of curvature of the curve $r = 4(1+\cos t)$ at the point $t = \frac{\pi}{2}$.	6	L3	CO5
	Module 2			
3 a)	Expand $\log(1+x)$ in powers of x up to the terms containing x^4 using Maclaurin's series.	6	L2	CO1
b)	If $Z = f(x+ay) + g(x-ay)$ then prove that $\frac{\partial^2 z}{\partial y^2} = a^2 \frac{\partial^2 z}{\partial x^2}$	7	L2	CO1
c)	Find the extreme values of the function $f(x,y) = x^3 + 3xy^2 - 3x^2 - 3y^2 + 4$	7	L1	CO1
	OR			
4 a)	Evaluate (i). $\lim\limits_{x\to 0}\left(\frac{\tan x}{x}\right)^{\frac{1}{x^2}}$ (ii). $\lim\limits_{x\to 1} x^{\frac{1}{1-x}}$	7	L3	CO1
b)	If $u = x + 3y^2 - z,\ v = 4x^2yz$ and $w = 2z^2 - xy$ then find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$ at the point $(1,-1,0)$	7	L1	CO1
c)	Using modern mathematical tool, write a program/code to evaluate $\lim\limits_{x\to\infty}\left(1+\frac{1}{x}\right)^x$	6	L3	CO5
	Module 3			
5 a)	Solve: $\frac{dy}{dx} - y\tan x = y^2 \sec x$	6	L3	CO2
b)	Find the orthogonal trajectories of the family of curve $r^n \sin n\theta = a^n$ where a is a parameter.	7	L1	CO2
c)	Find the solution of the equation $x^2(y-px) = yp^2$ by reducing into Clairaut's	7	L1	CO2

	form using the substitution as $X = x^2$ and $Y = y^2$			
	OR			
6 a)	Solve: $(x^4 - 2xy^2 + y^4)dx - (2x^2y - 4xy^3 + \sin y)dy = 0$	6	L3	CO2
b)	When a switch is closed in a circuit containing a battery E, a resistance R and an inductance L the current i build up at a rate given by $L\frac{di}{dt} + Ri = E$ Find i as a function of t. How long will it be before the current has reached one-half of its final value, if E = 6 volts, R = 100 ohms and L = 0.1 Henry	7	L1	CO2
c)	Solve: $xyp^2 - (x^2 + y^2)p + xy = 0$	7	L3	CO2
	Module 4			
7a)	i) Find the last digit in 7^{126} ii) Find the remainder when $64 \times 65 \times 66$ is divided by 67	6	L1	CO3
b)	Solve the linear congruence $11x \equiv 4(mod\ 25)$	7	L3	CO3
c)	Find the remainder when 5^{11} is divided by 7 using Fermat's Little theorem.	7	L1	CO3
	OR			
8 a)	Solve $x \equiv 3(mod\ 4)$, $x \equiv 2(mod\ 3)$ and $x \equiv 4(mod\ 5)$ Using Chinese Remainder theorem.	6	L3	CO3
b)	Solve the system of linear congruence $5x + 3y \equiv 2(mod\ 14)$ and $-3x + 4y \equiv 7(mod\ 14)$	7	L3	CO3
c)	Show that $4(29)! + 5!$ is divisible by 31 using Wilson's Theorem.	7	L2	CO3
	Module 5			
9 a)	Find the rank of the matrix $\begin{bmatrix} 1 & 3 & -1 & 2 \\ 0 & 11 & -5 & 3 \\ 2 & -5 & 3 & 1 \\ 4 & 1 & 1 & 5 \end{bmatrix}$	6	L1	CO4
b)	Investigate the values of λ and μ so that the equation $2x + 3y + 5z = 9$, $7x + 3y - 2z = 8$, $2x + 3y + \lambda z = \mu$ has (i) no-solution (ii) unique solution (iii) infinite solution	7	L3	CO4
c)	Using Rayleigh's power method, find the largest eigen value and the corresponding eigen vector of the matrix $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ by taking initial vector as $[1,1,1]^T$. Perform 6 iterations.	7	L3	CO4
	OR			
10a)	Solve the following system of equation by Gauss elimination method $x_1 - x_2 + x_3 = 6$, $2x_1 + 4x_2 + x_3 = 3$, $3x_1 + 2x_2 - 2x_3 = -2$	7	L3	CO4
b)	Solve the following system of equation by Gauss seidel method $27x + 6y - z = 85$, $6x + 15y + 2z = 72$, $x + y + 54z = 110$	7	L3	CO4
c)	Using modern mathematical tool, write a program/code to test the consistency of the equation $x_1 + 2x_2 - x_3 = 1, 2x_1 + x_2 + 4x_3 = 2$ and $3x_1 + 3x_2 + 4x_3 = 1$	6	L3	CO5

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