



Maharaja Education Trust (R), Mysuru
MAHARAJA INSTITUTE OF TECHNOLOGY MYSORE

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BMATS101

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	C	L
Module 1				
1 a)	With usual notation prove that $\tan \phi = r \frac{d\theta}{dr}$	6	CO1	L2
b)	Find the angle between the curves $r^2 \sin 2\theta = 4$ and $r^2 = 16 \sin 2\theta$	7	CO1	L2
c)	Show that the radius of curvature of the curve $x = a(\cos t + t \sin t)$ $y = a(\sin t - t \cos t)$ is at	7	CO1	L2
OR				
2 a)	Show that the angle of intersection of the curves $r = a \log \theta$ and $r = \frac{a}{\log \theta}$ is $\tan^{-1} \left[\frac{2e}{1-e^2} \right]$.	7	CO1	L2
b)	Find the pedal equation of the curve $r^m = a^m (\cos m\theta + \sin m\theta)$	7	CO1	L2
c)	Using modern mathematical tool, write a program/code to plot the curve $r = a(1 + \cos \theta)$ and $r = a(1 - \cos \theta)$.	6	CO5	L3
Module 2				
3 a)	Expand $\log(1 + \sin x)$ by Maclaurin's series up to the fourth degree term.	6	CO1	L2
b)	If $u = f\left(\frac{y-x}{xy}, \frac{z-x}{xz}\right)$, show that $x^2 \frac{\partial u}{\partial x} + y^2 \frac{\partial u}{\partial y} + z^2 \frac{\partial u}{\partial z} = 0$.	7	CO1	L2
c)	Find the extreme values of the function $x^3 + 3xy^2 - 3x^2 - 3y^2 + 4$.	7	CO1	L2
OR				
4 a)	Evaluate (i). $\lim_{x \rightarrow 0} (\cot x)^{\frac{1}{\log x}}$ (ii). $\lim_{x \rightarrow 0} \left(\frac{a^x + b^x + c^x + d^x}{4} \right)^{\frac{1}{x}}$	7	CO1	L3
b)	If $u = x^2 + y^2 + z^2$, $v = xy + yz + zx$, $w = x + y + z$, find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$.	7	CO1	L2
c)	Using modern mathematical tool, write a program/code to show that $xu_x + yu_y = 1$, if $u = \log \left(\frac{x^2 + y^2}{x + y} \right)$	6	CO5	L3
Module 3				
5 a)	Solve: $(8xy - 9y^2)dx + 2(x^2 - 3xy)dy = 0$	6	CO2	L2
b)	Find the orthogonal trajectories of the family $r = 2a(\cos \theta + \sin \theta)$	7	CO2	L2
c)	Solve: $4y^2 p^2 + 2pxy(3x + 1) + 3x^3 = 0$	7	CO2	L2
OR				
6 a)	Solve: $xy(1 + xy^2) \frac{dy}{dx} = 1$	6	CO2	L2

b)	Show that the family of parabola $x^2 = 4a(y + a)$ is self-orthogonal.	7	CO2	L2
c)	Find the general solution of the equation $e^{4x}(p-1) + e^{2y}p^2 = 0$ by reducing in to Clairut's form by taking the substitution $u = e^{2x}, v = e^{2y}$.	7	CO2	L1
Module 4				
7a)	(i) Find the remainder when 2^{1000} is divided by 13. (ii) Find the last digit of 7^{2013}	6	CO3	L2
b)	Solve the system of linear congruence $x \equiv 3(mod5), \quad x \equiv 1(mod7), \quad x \equiv 6(mod8)$ Using Chinese remainder theorem.	7	CO3	L2
c)	Find the general solution of linear Diophantine equation $123x + 57y = 531$	7	CO3	L2
OR				
8a)	(i) Find the remainder when $2(26)!$ is divided by 29. (ii) Find the remainder when 5^{11} is divided by 7 using Fermat's Little theorem.	6	CO3	L2
b)	Solve the system of linear congruence $3x + 4y \equiv 5(mod13), \quad 2x + 5y \equiv 7(mod13)$	7	CO3	L2
c)	(i) Solve $x^3 + 2x - 3 \equiv 0(mod9)$ (ii) Find the remainder when $347 \times 74 \times 36$ is divided by 3	7	CO3	L2
Module 5				
9 a)	Find the rank of the matrix $\begin{bmatrix} 1 & -2 & -1 & 3 \\ 2 & 5 & -4 & 7 \\ -1 & -2 & -1 & 2 \\ 3 & 3 & -5 & 10 \end{bmatrix}$	6	CO4	L2
b)	For what values of k the equations $x + y + z = 1, \quad x + 2y + 4z = k, \quad x + 4y + 10z = k^2$ have a solution. Solve completely.	7	CO4	L2
c)	Solve the system of equations by Gauss-Jordan method. $2x + y + 3z = 1, \quad 4x + 4y + 7z = 1, \quad 2x + 5y + 9z = 3$	7	CO4	L2
OR				
10a	Solve the system of equations $28x + 4y - z = 32, \quad 2x + 17y + 4z = 35, \quad x + 3y + 10z = 24$ by Gauss Seidel method. Perform five iterations.	7	CO4	L2
b)	Use Rayleigh's power method to find the largest Eigen value and corresponding Eigen vector of the matrix $\begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$ take $X_0 = \begin{bmatrix} 1 \\ 0.8 \\ -0.8 \end{bmatrix}$ Perform five iterations.	7	CO4	L3
c)	Using modern mathematical tool, write a program/code to test the consistency of the equations $x + 2y - z = 1, \quad 2x + y + 4z = 2, \quad 3x + 3y + 4z = 1$	6	CO5	L3
