Reg No.: _____ Name : _____

Jyothi Engineering College(Autonomous)

B. Tech Degree S1 (R) Examination, December 2025 (2025 Scheme)

25MAT101- MATHEMATICS FOR INFORMATION SCIENCE-1

Total Mark: 60 Total Time: 2 Hr 30min

CO MARK

PART A

(Answer All Questions. Each question carries 3 marks)

1. Find the points of inflection for $f(x) = \frac{x^3}{3} - \frac{x^2}{2} - 2x + \frac{1}{3}$ CO1 (3)

2. For what value of 'a' is the function $f(x) = \begin{cases} x^2 - 1 & , x < 3 \\ 2ax & , x \geq 3 \end{cases}$ is continuous for all x. CO1 (3)

3. Find $\frac{\partial z}{\partial x}$ in the equation yz- ln z = x+y. CO2 (3)

4. Show that $\lim_{(x,y)\to(0,0)} \frac{xy}{x^2+y^2}$ does not exist. CO2 (3)

5. Find the critical points of $f(x,y) = x^2 + xy + y^2$. CO3 (3)

6. Let $w = xy + z, x = s, y = t, z = s + t$. Find $\frac{\partial w}{\partial t}$. CO3 (3)

7. Apply the method of steepest descent to minimize the function $f(x,y) = x^2 - y$ starting from the point **(1,1)**. Choose $\alpha = 0.1$ and perform 2 iterations. CO4 (3)

8. Use the method of Lagrange Multiplier to find the maximum value of $f(x,y) = xy$ subject to the constraint $x^2 + y^2 = 9$. CO4 (3)

PART B

(Answer any one full question from each module, each question carries 9 marks)

9. a) Find $\frac{d^2y}{dx^2}$ if $2x^3 - 3y^2 = 8$ CO1 (5)

   b) Discuss the concavity of $f(x) = x^4 - 4x^3 + 6x^2$. CO1 (4)

OR

10. a) Find first and second derivatives of $\frac{1}{3s^2} - \frac{2}{s^3}$ CO1 (5)

    b) Show that the linear approximation of $f(x) = (1+x)^k$ at x=0 is $1 + kx$. CO1 (4)

11. a) Find all second order partial derivatives of the function $f(x,y) = \ln(x^2 + y^2)$. CO2 (5)

    b) Check the continuity of $f(x,y) = \begin{cases} \frac{x}{\sqrt{x^2+y^2}} & \text{if } (x,y) \neq (0,0) \\ 0 & \text{if } (x,y) = (0,0) \end{cases}$ at (0,0) . CO2 (4)

OR

12. a) Show that the function $f(x,y) = 2\tan^{-1}\frac{y}{x}$ satisfies Laplace equation. CO2 (5)

    b) Find the Domain and Range of the following functions

    a) $f(x,y) = \frac{x+y}{x-y}$

    b) $f(x,y) = \sqrt{y - x^2}$ CO2 (4)

13. a) If $u = f(\frac{x}{y}, \frac{y}{z}, \frac{z}{x})$, prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$ CO3 (5)

b) A company's profit is modelled by $P(x,y) = 50x + 60y - (x^2 + y^2)$ where x = units of product A, y = units of product B. Find the production levels (x, y) that maximize profit. CO3 (4)

OR

14. a) Find the absolute maximum and minimum values of $f(x,y) = 2 + 2x + 2y - x^2 - y^2$ on the triangular region in the first quadrant bounded by the lines x = 0, y = 0, y = 9 - x. CO3 (5)

b) Let $w = \log(x^2 + y^2 + z^2), x = u\cos v, y = u\sin v, z = e^u$ Find $\frac{\partial w}{\partial u}$. CO3 (4)

15. Apply steepest method to $f(x,y) = 2x^2 + y^2 - 4x + 4y$, starting from the point (0,0). Choose $\alpha = 0.01$. Perform 6 iterations. CO4 (9)

OR

16. A manufacturer produces two different models - X and Y of the same products. Model X makes a contribution of Rs 50 per unit and model Y, Rs 30 per unit, towards total profit. Raw materials r_1 and r_2 are required for production. At least 18 kg of r_1 and 12 kg of r_2 must be used daily. Also, at most 34 hours of labour are to be utilized. A quantity of 2 kg of r_1 is needed for model X and 1 kg of r_1 for model Y. For each of X and Y, 1 kg of r_2 is required. It takes 3 hours to manufacture model X and 2 hours to manufacturer model Y. How many units of each model should be produced in order to maximize the product? CO4 (9)

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