

Tribhuvan University  
Institute of Science and Technology  
2072

Bachelor Level / first-semester / Science

**Computer Science and Information Technology(MTH112)**

(Mathematics I (Calculus))

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Full marks: 80

Pass marks: 32

Time: 3 hours

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Attempt all questions.

**Group A (10×2=20)**

1. If  $f(x) = (x - 1) + x$ , then prove that  $f(x) \cdot f(1 - x) = 1$

2. Define critical point. Find the critical point of  $f(x) = x^2$ .

3. Evaluate:  $\lim_{n \rightarrow \infty} \frac{3 - 5n^6}{n^6 - 3}$ .

4. Find the equation of the parabola with vertex at the origin and directrix at  $y = 2$

5. Find the angle between the planes  $x - 2y - 2z = 5$  and  $5x - 2y - z = 0$

6. Evaluate  $\int_0^3 \int_0^2 (4 - y^2) dx dy$ .

7. Find  $\frac{dt}{dx}$  and  $\frac{dt}{dy}$  if  $f(x, y) = ye^2$ .

8. Find the equation for the tangent plane to the surfaces  $Z = f(x, y) = 9 - x^2 - y^2$  at the point (1, 2, 3).

9. Show that  $y = c_1 x e^{-2x} + c_2 e^{-2x}$  is the solution of  $y'' + y' - 2y = 0$ .

10. Solve  $\frac{d^2y}{dx^2} + \frac{dy}{dzx} = 0$ .

**Group B (5×4=20)**

11. Verify Rolle's theorem for  $f(x) = x^2$ ,  $x \in [-1, 1]$ .

12. Find the Taylor's series expression of  $f(x) = \cos \theta$  at  $x = 1$ .

13. Find the Cartesian equation of the polar equation  $r \cos\left(\theta - \frac{\pi}{3}\right) = 3$

14. Show that the function  $f(x, y) = \begin{cases} \frac{xy}{x^2 + y^2}, & (x, y) \neq (0, 0) \\ 0 & (x, y) = (0, 0) \end{cases}$  is continuous at every point except the origin.

15. Solve  $xz \frac{dz}{dx} + yz \frac{dz}{dy} = xy$

Group C (5×8=40)

16. Find the area bounded on right by the line  $y=x-2$  on the left by the parabola  $x=y^2$  and below by the x-axis

Or

What is an improper integral? Evaluate (a)  $\int_2^{\infty} \frac{dx}{\sqrt{x-1}}$  (b)  $\int_2^{\infty} \frac{dx}{(x-1)^2}$

17. Define curvature of a curve .find that the curvature of a helix  $\vec{R}(t) = (a \cos wt)\vec{i} + (a \sin wt)\vec{j} + (bt)\vec{k}$

18. Find the area enclosed by  $r^2 = 2a^2 \cos 2\theta$

19. Find the extreme values of  $Z = x^3 - y^3 - 2xy + 6$ .

OR

Find the extreme value of function  $F(x, y) = xy$  takes on the ellipse  $\frac{x^2}{8} + \frac{y^2}{2} = 1$

20. Define initial boundary values problems .Derive the heat equation or wave equation in one dimension .