

**Tribhuvan University**  
**Institute of Science and Technology**  
**2073**

Bachelor Level/First Year/First Semester/Science  
**Computer Science and Information Technology (MTH.112)**  
(Mathematics I)

**Full Marks : 80 | Pass Marks: 32 | Time: 3 hours.**

Candidates are required to give their answers in their own words as far as practicable.  
The figures in the margin indicate full marks.

**Attempt all questions.**

**Group A (10x2=20)**

1. If  $f(x) = \sin x$  and  $g(x) = -x/2$ . Find  $f(f(x))$  and  $g(f(x))$ .
2. Define critical point. Find the critical point of  $f(x) = 2x^2$ .
3. Evaluate  $\lim_{n \rightarrow \infty} \frac{a-b^4}{n^4+a}$ .
4. Find the equation of the parabola with vertex at the origin and directrix at  $x=7$ .
5. Find a vector parallel to the line of intersection of the planes  $3x + 6y - 2z = 5$ .
6. Evaluate  $\int_{-1}^0 \int_{-1}^1 (x + y + 1) dx dy$ .
7. Find  $\frac{dt}{dx}$  and  $\frac{dt}{dy}$  if  $f(x,y) = x^2 + y^2$
8. Evaluate  $\log_{(x,y) \rightarrow (0,1)} \frac{x-xy+k}{x^2y+5xy-y^3}$
9. Show that  $y = ax^2 + b$  is the solution of  $xy'' + y' = 0$ .
10. Solve  $\frac{d^2y}{dx^2} - y = 0$

**Group B (5x4=20)**

11. Verify Rolle's theorem for  $f(x) = x^3$ ,  $x \in [-3,3]$ .
12. Find the Taylor series expansion of the case at  $e^x$ , at  $x=0$ .
13. Find a Cartesian equivalent of the polar equation  $r \cos(\theta - \pi/3) = 3$ .
14. Evaluate it  $(x,y) \rightarrow (0,0) \frac{2y^2}{\sqrt{x^2+xy}}$
15. Obtain the general solution of  $(y-z) \frac{dz}{dx} + (x-y) \frac{dz}{dy} = z-x$ .

**Group C (5x8=40)**

16. Evaluate the integrals and determine whether they converge or diverge  
(a)  $\int_1^{\infty} \frac{dx}{x}$       (b)  $\int_1^{\infty} \frac{dx}{x^2}$

**OR**

Find the area bounded on the parabola  $y = 2 - x^2$  and the line  $y = -x$ .

17. Find the curvature of the helix  $\vec{R}(t) = (a \cos \omega t)\vec{i} + (a \sin \omega t)\vec{j} + (bt)\vec{k}$ ?
18. Find the volume enclosed between the surfaces  $z = x^2 + 3y^2$  and  $z = 8 - x^2 - y^2$
19. Find the extreme values of the function  $F(x,y) = xy - x^2 - y^2 - 2x - 2y + 4$

**OR**

Find the extreme values of  $f(x,y) = xy$  subject to  $g(x,y) = x^2 + y^2 - 10 = 0$ .

20. Define second order partial differential equation. Define initial boundary value problem.  
Derive the heat equation or wave equation in one dimension.