

Tribhuvan University  
Institute of Science and Technology  
2080  
☆

Bachelor Level / First Year/ First Semester/ Science  
**Computer Science and Information Technology (MTH112)**  
(Mathematics I)  
**(OLD COURSE)**

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.

Group A

(3 × 10 = 30).

Attempt **any THREE** questions:

1. (a) If  $f(x) = 3x^2 - x + 2$ , then find  $f(2)$ ,  $f(-2)$ ,  $f(a)$ ,  $f(-a)$  and  $f(0)$ . [5]  
(b) Find  $\lim_{x \rightarrow -2} \frac{x^3 + 2x^2 - 1}{5 - 3x}$  [5]
2. (a) Find the derivative of  $y = \frac{x^2 + x - 2}{x^3 + 6}$ . [5]  
(b) Estimate the area between the parabola  $y = x^2$  and the line  $y = x$ . [5]
3. (a) Verify the Mean Value Theorem for the function  $f(x) = 3x^2 + 2x + 5$   
 $x \in [-1, 1]$ . [4]  
(b) Define initial value problem. Solve the equation  $xy' + 2y = 3x$ ,  $y(1) = 2$ . [4]  
(c) Find the volume of a sphere of radius  $a$ . [2]
4. (a) Find the local maximum and minimum values and saddle points of  
 $f(x, y) = x^4 + y^4 - 4xy + 1$ . [5]  
(b) Find the curvature of the parabola  $y = x^2$  at the points  $(0, 0)$ ,  $(0, 1)$  and  $(2, 4)$ . [5]

Group B

(10 × 5 = 50).

Attempt **any TEN** questions:

5. Verify Rolle's theorem for  $f(x) = x^2 - 4$ ,  $x \in [-2, 2]$ . [5]
6. Find the Maclaurin series expansion of  $\sin x$  at  $x = 0$ . [5]
7. If  $f(x) = \sqrt{x-2}$  and  $g(x) = \sqrt{x}$ , find  $(f \circ g)(x)$  and  $(g \circ f)(x)$ . [5]
8. Show that the absolute value function  $f(x) = |x|$  is continuous everywhere. [5]
9. Find  $\int_0^{\frac{1}{2}} \frac{x}{\sqrt{1-4x^2}} dx$ . [5]
10. Sketch the curve  $y = x^3$ . [5]
11. Find the solution of  $y'' + 4y' + 4 = 0$ ,  $y(0) = 2$ ,  $y'(0) = 1$ . [5]
12. Test the series  $\sum_{n=1}^{\infty} \frac{n^2}{5n^2 + 4}$  diverges or converges. [5]

13. Define cross product of two vectors. If  $\vec{a} = \vec{i} + 2\vec{j} + 3\vec{k}$  and  $\vec{b} = 2\vec{i} + 3\vec{j} - 4\vec{k}$ , find  $\vec{a} \times \vec{b}$  and  $\vec{b} \times \vec{a}$ . [5]
14. Find the second partial derivatives of  $f(x, y) = x^3 + x^2y^3 - 2y^2$ . [5]
15. Find the length of the arc of the semi-cubical parabola  $y^2 = x^3$  between the points  $(1, 1)$  and  $(4, 8)$ . [5]