Tribhuvan University

Institute of Science and Technology

2081

Bachelor Level / First Year/ First Semester/ Science — Full Marks: 80

Computer Science and Information Technology (MTH 112) — Pass Marks: 32

(Mathematics I) — Time: 3 hours.

(OLD COURSE)

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

The figures in the margin indicate full marks.

Group A $(3 \times 10 = 30)$.

Attempt **any THREE** questions:

1. (a) If $f(x) = 3x^2 - 2x - 5$, then find $f(1)$, $f(2)$, $f(a)$, $f(-a)$ and f(0). [5]
   (b) Calculate: $\lim_{x \to 1} \frac{x^2 + x - 2}{x - 1}$. [5]

2. (a) Find the derivative of $y = \frac{\sqrt{x}}{x^2 - x}$. [5]
   (b) Estimate the area between the parabola $y^2 = x$ and the line $y = -x$. [5]

3. (a) Verify the Mean Value Theorem for the function $f(x) = x^2 - x$ for $x \in [-2, 2]$. [5]
   (b) Define initial value problem. Solve the equation $xy' - y = 4x$, $y(2) = 6$. [5]

4. (a) Find the local maximum and minimum values and saddle points of $f(x, y) = x^2 + y^2 - x^2y + 2$. [5]
   (b) Where is the function $f(x) = |x|$ differentiable? Discuss. [5]

Group B $(10 \times 5 = 50)$.

Attempt **any TEN** questions:

5. Verify Rolle's theorem for $f(x) = x^2 + 4$ for $x \in [-2, 2]$. [5]

6. Find the Maclaurin series expansion of e^x at $x = 0$. [5]

7. If $f(x) = \sqrt{2x + 1}$ and $g(x) = \sqrt[3]{x}$, find $(fog)(x)$ and $(gof)(x)$. [5]

8. Show that the function $f(x) = 1 + x^2$ is continuous everywhere. [5]

9. Evaluate: $\int_0^2 \frac{x \, dx}{\sqrt{1 + 2x^2}}$. [5]

10. Sketch the curve $y = 2x^2 + 1$. [5]

11. Find the solution of $y'' - 6y' - 7y = 0$. [5]

12. Test whether the series $\sum_{n=1}^{\infty} \frac{n^2}{3n^2 + 4}$ diverges or converges. [5]

13. Define cross product of two vectors. If $\vec{a} = \vec{i} + \vec{j} + 2\vec{k}$ and $\vec{b} = -\vec{i} + \vec{j} - 2\vec{k}$, find $\vec{a} \times \vec{b}$ and $\vec{b} \times \vec{a}$. [5]

14. Find the second partial derivatives f_{xx}, f_{xy} and f_{yy} of $f(x, y) = 2x^3 + \sqrt{x}\, y^2 - y$. [5]

15. Find the extreme values of $f(x, y) = y^2 - x^2$. [5]