Tribhuvan University
Institute of Science and Technology
2080
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Bachelor Level / First Year/ First Semester/ Science
Computer Science and Information Technology (MTH117)
(Mathematics I)
(NEW COURSE)

Full Marks: 60
Pass Marks: 24
Time: 3 hours.

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

Section A $(2 \times 10 = 20)$.

Attempt **any TWO** questions:

1. (a) If $\vec{a} = (4, 0, 3)$ and $\vec{b} = (-2, 1, 5)$, find $|\vec{a}|, 3\vec{b}, \vec{a} + \vec{b}$ and $2\vec{a} + 5\vec{b}$. [1+1+1+2]
   (b) Estimate the value of $\lim_{x \to 0} \frac{\sqrt{x^2+9} - 3}{x^2}$ [5]

2. (a) The area of the parabola $y = x^2$ from $(1, 1)$ to $(2, 4)$ is rotated about the y-axis. Find the area of the resulting surface . [5]
   (b) Find the solution of the equation $y^2 dy = x^2 dx$ that satisfies the initial condition y(0)= 2. [5]

3. (a) As dry air moves upward, it expands and cools. If the ground temperature is 20^0C and the temperature at height of $1\,km$ is 10^0C, express the temperature T(in ^0C) as a function of the height h (in kilometer), assuming that linear model is appropriate.
   (b) Draw a graph of the function in part (a). What does the slope represent?
   (c) What is the temperature at a height of $2.5\,km$? [5+3+2]

Section B $(8 \times 5 = 40)$.

Attempt **any EIGHT** questions:

4. Integrate $\int_0^1 x^2\sqrt{x^3+1}\,dx$. [5]

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

6. Find where the function $f(x) = 3x^4 - 4x^3 - 12x^2 + 5$ is increasing and where it is decreasing . [5]

7. Find y' if $x^3 + y^3 = 6xy$. [5]

8. Show that $y = x - \frac{1}{x}$ is a solution of the differential equation $xy' + y = 2x$. [5]

9. Sketch the graph and find the domain and range of the function $f(x) = 2x - 1$. [5]

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

11. If $f(x, y) = x^3 + x^2y^3 - 2y^2$, find $f_x(2, 1)$ and $f_y(2, 1)$. [5]

12. Show that the function $f(x) = x^2 + \sqrt{7 - x}$ is continuous at $x = 4$. [5]