

Tribhuvan University
Institute of Science and Technology
2073
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Bachelor Level / First Year/ First Semester/ Science
Computer Science and Information Technology (MTH. 104)
(Calculus and Analytical Geometry)

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 $g(f(x))$.

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

3. Evaluate $\lim_{n \rightarrow \infty} \frac{a - bn^4}{n^4 + a}$.

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 $3x + 6y - 2z = 7$ and $2x + y - 2z = 5$.

6. Evaluate $\int_{-1}^0 \int_{-1}^1 (x + y + 1) dx dy$.

7. Find $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$ if $f(x, y) = x^2 + y^2$.

8. Evaluate $\lim_{(x,y) \rightarrow (0,1)} \frac{x - xy + k}{x^2 y + 5xy - y^3}$.

9. Show that $y = ax^2 + b$ is the solution of $xy'' + y' = 0$.

10. Solve $\frac{d^2 y}{dx^2} - y = 0$.

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 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 $(y - z) \frac{\partial z}{\partial x} + (x - y) \frac{\partial z}{\partial y} = z - x$.Group C

(5x8=40)

16. Evaluate the integrals and determine whether they converge or diverge

$$(a) \int \frac{dx}{x} \quad (b) \int \frac{dx}{x^2}$$

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

$$z = x^2 + 3y^2 \text{ and } z = 8 - x^2 - y^2.$$

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.