K25U 3365

Reg. No. : ....

Name : ....

First Semester B.Sc. Degree (C.B.C.S.S. – O.B.E. – Supplementary) Examination, November 2025
(2019 to 2023 Admission)
CORE COURSE IN MATHEMATICS
1B01MAT : Set Theory, Differential Calculus and Numerical Methods

Time : 3 Hours | Max. Marks : 48

PART – A

Answer **any four** questions from this Part. **Each** question carries **one** mark. **(4×1=4)**

1. Let A = {1, 2, 3}, B = {x, y}. Let R be a relation defined by {(1, x), (2, x)}. Find the domain and range of R.

2. Find $\lim\limits_{x \to 0} \frac{1}{x}$.

3. Give an example of a function which is not continuous at x = 1.

4. Find all second order partial derivatives of the function f(x, y) = xy.

5. Check whether the given function $f(x, y) = x^2 - y^2$ is homogeneous or not.

PART – B

Answer **any eight** questions from this Part. **Each** question carries **two** marks.
(8×2=16)

6. Check whether the relation a divides b is partial relation on set of all integers.

7. Give an example of a relation on set of all real numbers, which is reflexive but not symmetric.

8. Let f : R → R, g : R → R defined by $f(x) = x^2$, $g(x) = 5x^2 + 6x + 1$, find f∘g and g∘f.

P.T.O.

9. Determine the maximum number of positive and negative roots and intervals of length one unit in which the real roots lie for the following equation $3x^2 - 2x^2 - x - 5 = 0$.

10. Suppose $\lim_{x \to c} f(x) = 5$ and $\lim_{x \to c} g(x) = -2$. Find $\lim_{x \to c} \frac{f(x) - g(x)}{g(x)}$.

11. Show that there is a root of the equation $x^3 - x - 1 = 0$ between 1 and 2.

12. At what points (x, y) in the plane are the function $f(x, y) = \sin(x + y)$ is continuous.

13. Find f_x and f_y as functions, if $f(x, y) = \frac{2y}{y + \cos x}$.

14. If $f(x, y, z) = x^2 + y^2 - 2z^2$, show that $\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2} = 0$.

15. Find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial x}$ at (0, 0, 0), if $x^3 + z^2 + ye^{xz} + z \cos y = 0$.

16. Find $\frac{dy}{dx}$ using implicit differentiation, if $y^2 - x^2 - \sin xy = 0$.

PART – C

Answer **any four** questions from this Part. **Each** question carries **four** marks.

(4×4=16)

17. Let R be a relation on P defined by the equation x + 3y = 12.
    i) Write R as set of ordered pairs.
    ii) Find the domain and Range of R.
    iii) Find the composition Relation $R \circ R$.

18. Using arithmetic modulo m, evaluate

    a) 9 + 13, b) 7 + 11, c) 4 – 9, d) 2 – 10

19. Derive the Newton's method for finding $\frac{1}{N}$, where N > 0. Hence, find $\frac{1}{17}$, using the initial approximation as 0.15. Do the iterations converge ?

20. If $y = \sin(\sin x)$, prove that $\frac{d^2y}{dx^2} + \tan x \frac{dy}{dx} + y \cos^2 x = 0$.

21. Use the Intermediate Value Theorem to prove that the equation $\sqrt{2x+5} = 4 - x^2$ has a solution.

22. State mixed partial theorem. Verify it for the function $w = \ln(2x + 3y)$.

23. Express $\frac{\partial w}{\partial r}$ and $\frac{\partial w}{\partial s}$ in terms for r and s if $w = x + 2y + z^2$, $x = \frac{r}{s}$, $y = r^2 + \ln s$, $z = 2r$.

PART – D

Answer **any two** questions from this Part. **Each** question carries **six** marks.

(2×6=12)

24. i) Consider the function $f : A \to B$, $g : B \to C$, then prove that if $g \circ f$ is on-to, then g is on-to.

ii) Show that $\log_b A^n = n \log_b A$.

25. Find the positive real roots of the equation $x^3 - 3x + 1 = 0$. Obtain these roots correct to three decimal places, using the method of false position.

26. If $y = e^{(a \sin^{-1} x)}$, prove that $(1 - x^2)y_{n+2} - 2(n + 1)xy_{n+1} - (n^2 + a^2)y_n = 0$.

27. Show that the function $f(x,y) = \frac{2x^2y}{x^2+y^2}$, has no limit as (x, y) approaches (0, 0).
