B.A./B.Sc./B.Com. (Theory) Examination 2026
Semester I (Under CCF-2022)
Centre: Rammohan College

IDC-1-Th: Mathematics in Daily Life

Full Marks: 50 **Time: 2 Hours**

Group-A: Answer any ONE question of the following. $1 \times 4 = 4$

1. Draw a Venn diagram to represent $(A \cup B) \cap C^c$ (where C^c is the complement of C) and explain the steps. Using an example of two disjoint sets A and B, verify that $n(A \cup B) = n(A) + n(B)$.

2. In a College, 40 students enrolled for Mathematics, 30 enrolled for Physics, and 20 enrolled for both subjects. If there are 60 students in total, using the formula

$$n(A \cup B) = n(A) + n(B) - n(A \cap B),$$

find how many students enrolled only for Mathematics, only for Physics, and neither of these two subjects.

Group-B: Attempt any FIVE questions of the following. Each question carries 4 marks. $5 \times 4 = 20$

3. Prove by induction that for all positive integers n, the sum of the first n natural numbers is given by the formula:

$$1 + 2 + 3 + \cdots + n = \frac{n(n+1)}{2}$$

4. Let a and b be two integers. Prove that if $a \cdot b = 1$, then either $a = b = 1$ or $a = b = -1$.

5. State the Euclid's Division Lemma. If $a = 75$ and $b = 24$, find the unique integers q and r such that $a = bq + r$ with $0 \leq r < b$.

6. Prove that the greatest common divisor of two positive integers m and n is equal to the gcd of n and the remainder r when m is divided by n, i.e., $\gcd(m, n) = \gcd(n, r)$.

7. Find all the prime divisors of 40!.

8. Let a and b be non-zero integers such that $a \mid b$ and $b \mid a$. Prove that $a = \pm b$.

9. Give the definitions of a prime number and the least common multiple (LCM) of two integers.

10. Prove that 197 is a prime number.

Group-C: Attempt any ONE of the following. Each question carries 7 marks. $1 \times 7 = 7$

11. (a) Convert the binary number 11011_2 to the decimal system. [2+3+2]

(b) Convert the decimal number 2024_{10} to the binary system.

(c) Convert the hexadecimal number $B7A_{16}$ to the decimal system.

12. (a) Show by using a truth table that $(p \leftrightarrow q) \equiv (p \rightarrow q) \wedge (q \rightarrow p)$. [4+3]

(b) Construct the truth table for the statement $(p \vee \sim q) \rightarrow (q \wedge p)$.

13. What is a contingency in logic? Give an example. Check whether the statement $[(\neg p \rightarrow q) \wedge (\neg q)] \rightarrow p$ is a tautology, a contradiction, or a contingency by using a truth table. [3+4]

Group-D: Attempt any <u>ONE</u> of the following. Each question carries 9 marks. $1 \times 9 = 9$

14. (a) Solve the following LPP graphically:

$$\text{Minimize } Z = 3x + 5y$$

subject to

$$2x + 3y \geq 12,$$
$$-x + y \leq 3,$$
$$x \leq 4, y \geq 3$$

(b) Define Objective function of an LPP. [7+2]

15. (a) (a) A dietician wants to mix two types of foods, I and II, in such a way that the vitamin content of the mixture contains at least 8 units of vitamin A and 10 units of vitamin C. Food I costs Rs. 60 per kg and Food II costs Rs. 80 per kg. Food I contains 2 units/kg of vitamin A and 3 units/kg of vitamin C. Food II contains 3 units/kg of vitamin A and 4 units/kg of vitamin C. Formulate this problem as a Linear Programming Problem to minimize the cost of the mixture.

(b) Define 'objective function' and 'non-negativity constraints' in an LPP. [6+3]

16. (a) Define strategy and saddle point of a game. [3+6]

(b) Solve the following game whose payoff matrix is given by:

	I	II	III	IV
A_1	5	3	1	20
A_2	5	5	4	6
A_3	-4	-2	0	-5

Group-E: Attempt any <u>TWO</u> of the following. Each question carries 5 marks. $2 \times 5 = 10$

17. A sum of Rs. 5,000 is invested at a simple interest rate of 8% per annum. In how many years will this amount become Rs. 7,000?

18. Find the compound interest on Rs. 10,000 for 2 years at 8% per annum, compounded half-yearly.

19. A sum of Rs. 2,500 is divided into two parts. The first part is invested at 6% simple interest per annum and the second part at 4% simple interest per annum. If the annual interest from both investments is equal, find the interest accumulated from each part.

20. Calculate the income tax payable for a person whose taxable income is Rs. 12,00,000 under both the old and new tax regimes. (Assume the following tax slabs for calculation purposes:)

Old Regime: Up to Rs. 2.5L: Nil; 2.5L-5L: 5%; 5L-10L: 20%; Above 10L: 30%.

New Regime: Up to Rs. 3L: Nil; 3L-6L: 5%; 6L-9L: 10%; 9L-12L: 15%; Above 12L: 20%. (Assume standard deduction is already factored into taxable income).

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