IDC-1: Mathematics in Daily Life
Full marks: 60 (3 Credits=2 Credits Theory + 1 Credit Tutorial)

Group A: Basics of Set Theory

- Concept of sets, subsets and set operations (Union, Intersection, Complementation, Subtraction); Statements of basic laws of set algebra.
- Venn diagrams, Arrow diagram and conversion from one to other. Statement of the formula $(A \cup B) = (A) + (B) - n(A \cap B)$ and its application in daily life. Problem solving by using set theoretic method.

Group B: Combinatorial Problem Solving Ability

- Simple problems on permutations and combinations with special emphasize on finding number of diagonals of a polygon, number of ways to do a tusk / chain of tusks, number of functions from a finite set to a finite set, number of subsets of a set with certain constrains, arrangements and selections of people, digits, numbers, alphabets, teams etc., circular arrangements etc.
- Simple problems on Pigeonhole principle and Inclusion-Exclusion principle.

Group C: Understanding Integers

- Statement and simple problems on First Principle of Mathematical Induction. Statement of Division algorithm; G.C.D. of two positive integers, Expression of G. C. D. of two integers x, y in the form $px + qy$ (p, q are integers), Euclidean Algorithm without proof.
- Representation of real numbers in different bases (decimal, binary, ternary, octal etc.)
- Linear Diophantine equation in two variables: Statement of condition on the existence of integral solution, General / particular solution, Simple real life applications.
- Prime Integers. Some elementary properties of prime integers (only statement), Fundamental theorem of Arithmetic (only statement), Algorithm for Primality test.
- Congruence of Integers: Meaning of $a \equiv b \pmod{m}$, Statements of elementary properties of congruence; If $a \equiv b \pmod{m}$ then for any integer c, $(a + c) \equiv (b + c) \pmod{m}$, $(a - c) \equiv (b - c) \pmod{m}$, $ac \equiv bc \pmod{m}$, $a^n \equiv b^n \pmod{m}$ for natural numbers n;

- Application of congruence of integers: Divisibility tests by 2, 3, 4, 5, 7, 9, 11, 13 (Statements of relevant results and problems only), Check Digits in International Standard Book Number (ISBN), Universal Product Code (UPC), VISA and MASTER card (Statements of relevant results and Problems only), Formation of Round Robin Tournament Table using congruence of integers (Technique and Problems only).

Group D: Mathematical logic

- Proposition, propositional variables and propositional Logic;
- Logical Connectives: NOT (Negation), OR (Disjunction), AND (Conjunction), Exclusive OR(XOR), IMPLICATION(If p then q) and BI-IMPLICATION (If and only if) and their Truth Tables; Truth value of a proposition, Truth tables of expressions involving more than one logical connective;
- Tautology, logical consequence, logical equivalence, contradiction;

Group E: Basics of Operations Research

- Idea of Linear Programming Problems: Objective function, decision variables, constraints.
- Formulation of daily life problems as an LPP (e.g. Carpenter problem, preparation of mixtures of chemicals, diet problems etc.);
- Solution of an LPP by graphical method (only bounded region).
- Transportation and Assignment Problems.
- Definition of Game, Examples from daily life Two person zero sum game, Strategy, Payoff, Saddle point, Solution of a game problem with saddle point (only elementary problems).

Group F: Financial Mathematics

- Time value of money:- Simple interest and Compound interest (Fundamental Formulae); Interest payable monthly, quarterly, annually; (Only problems).
- Present Value and APR; Mortgage Repayments; Annuities; Investing; Personal Finance.
- Ordinary Simple Annuities – Accumulated value and Discounted Value of an ordinary simple annuity – Idea of repayment of loans, Simple problems. (No formula derivation).
- Problems on Dividend calculation and Calculation of income tax on taxable income (old and new regime).

Group G: Algebraic, Transcendental and Differential Equations

- What they are ? How they arise ?
- Formation of algebraic and transcendental equations from real life problems and their solutions.
- First-Order Ordinary Differential Equations; Second-Order Ordinary Differential Equations with Constant Coefficients.
- Linked Systems (Only Problems).

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[2] David M. Burton; Elementary Number Theory, Universal Book Stall, 1989

[3] Kenneth H. Rosen; Elementary Number Theory and its Applications, Addison-Wesley Publishing Company, 1984

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[5] E. G. Goodaire and M. M. Parmenter; Discrete Mathematics with Graph Theory, Prentice Hall, 2nd edition, 2001

[6] Elliott Mendelson; Introduction to Mathematical Logic; Chapman & Hall; London,1997

[7] M. Chakraborty; Lecture note; A journey through the logic wonderland, IIEST Shibpur, 2016

[8] Paul R. Thie and G. E. Keough; An Introduction To Linear Programming and Game Theory; John Wiley & Sons, INC., Third Edition, 2008

[9] Richard Bronson and Govindasami Naadimuthu, Schaum's Outline of Operations Research; McGraw Hill, 1997

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