

MCA  
(SEM. I) THEORY EXAMINATION 2022-23  
DISCRETE MATHEMATICS

Time: 3 Hours

Total Marks: 100

**Note:** Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief.

2 x 10 = 20

- (a) State the Distributive and Associative laws of set theory.
- (b) Write down the properties of Equivalence Relation.
- (c) Define the Hasse diagram with example.
- (d) What do you mean by Normal Form in Boolean algebra?
- (e) Define the term Proposition.
- (f) Negate the statement “*He is poor and laborious*”
- (g) Define Monoid with example.
- (h) Define the Commutative Ring with unity.
- (i) Solve the recurrence relation:  $a_n - 3a_{n-1} + 2a_{n-2} = 0$ .
- (j) Write down the properties of Generating function.

SECTION B

2. Attempt any *three* of the following:

10x3=30

- (a) If  $X = \{1,2,3\}$ ,  $Y = \{p, q\}$  and  $Z = \{a, b\}$  and the functions  $f$  and  $g$  are define as  
 $f : X \rightarrow Y$  be  $f = \{(1, p), (2, p), (3, q)\}$ ,  
 $g : Y \rightarrow Z$  be  $g = \{(p, q), (q, b)\}$  then find  $f \circ g$  and  $g \circ f$ .
- (b) Let  $L$  be the set of all factor of 12 and let ‘/’ be the divisibility relation on  $L$ .  
Then show that  $(L, ‘/’)$  is a lattice.
- (c) Show that:  $(p \leftrightarrow q) \wedge (q \leftrightarrow r) \rightarrow (p \leftrightarrow r)$  is a Tautology.
- (d) What do mean by Order of an element in a group?  
Find the order of each element of the multiplicative group  $G = \{1, -1, i, -i\}$ .
- (e) Solve the recurrence  $a_{n+2} - 4a_{n+1} + 4a_n = 2^n$

SECTION C

3. Attempt any *one* part of the following:

10x1=10

- (a) Define the function and explain the difference between function and relation with example
- (b) For any set  $A$  and  $B$ , Prove that :  $P(A \cap B) = P(A) \cap P(B)$ .

4. Attempt any *one* part of the following: 10x1=10

- (a) Define Modular Lattice. Also Prove that: Every Distributive lattice is Modular.
- (b) Solve using K-map:  $F(A, B, C, D) = \sum(0,1,2,3,4,5,6,7,8,9,11)$

5. Attempt any *one* part of the following: 10x1=10

- (a) Show that  $s$  is a valid conclusion from the premises:  
 $p \rightarrow q, p \rightarrow r, \sim (q \wedge r) \text{ and } \vee p.$
- (b) If  $K(x) : x \text{ is student}, M(x) : x \text{ is clever}, N(x) : x \text{ is successful}.$   
Express the following using quantifiers:
  - (i) There exists a student
  - (ii) Some students are clever
  - (iii) Some students are not successful.

6. Attempt any *one* part of the following: 10x1=10

- (a) Define the permutation group. If  $A = \{1, 2, 3, 4, 5\}$  then find:  
 $(1\ 3)\ 0\ (2\ 4\ 5)\ 0\ (2\ 3).$
- (b) Show that  $G = \{0,1,2,3,4\}$  is a cyclic group under addition modulo 5.

7. Attempt any *one* part of the following: 10x1=10

- (a) Determine the numeric function corresponding to the following Generating function:  
 $A(Z) = \frac{7Z^2}{(1-2Z)(1+3Z)}$
- (b) Prove by mathematical induction that  $n^3 + 2n$  is divisible by 3 for each positive integer  $n$ .