

Roll No.

Total Pages : 3

BT-4/J-22

44151

DISCRETE MATHEMATICS

Paper-PC-CS-202A

Time : Three Hours]

[Maximum Marks : 75

Note : Attempt five questions in all, selecting at least *one* question from each unit.

UNIT-I

1. (a) Using mathematical induction, prove that $n^3 + 2n$ is divisible by 3.
(b) Prove that $(A \cup B)' = A' \cap B'$.
2. (a) Construct the truth table for the following statements :
(i) $\neg(p \wedge q) \wedge (\neg r)$.
(ii) $\neg(p \wedge \neg q) \vee (r)$.
(b) If the set A is finite and contains n elements, prove that the power set $P(A)$ of the set A contains 2^n elements.

UNIT-II

3. (a) Consider relation
 $R = \{(a, b) \mid \text{length of string } a = \text{length of string } b\}$
on the set of strings of English letters. Prove that R is an equivalence relation.

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- (b) Show that the inclusion relation \subseteq is a partial ordering relation on the power set of a set.
4. (a) Given $A = \{1, 2, 3\}$, $B = \{a, b\}$ and $C = \{l, m, n\}$. Find each of the following sets
- (i) $A \times B \times C$.
 - (ii) $A \times C$.
 - (iii) $B \times C \times A$.
- (b) Define Lattice. Prove that D_{36} the set of divisors of 36 ordered by divisibility forms a lattice.

UNIT-III

5. (a) Prove that the function $f: \mathbb{N} \rightarrow \mathbb{N}$ defined as
- $$f(n) = \begin{cases} n+1, & n \text{ is odd} \\ n-1, & n \text{ is even} \end{cases}$$
- is inverse of itself.
- (b) Solve : $a_n + a_{n-1} = 3n2^n$, $a_0 = 0$, using Generating function method.
6. (a) Let $f: \mathbb{Z} \rightarrow \mathbb{Z}$ be defined by $f[x] = 3x^3 - x$. Is this function
- (i) One-to-one?
 - (ii) Onto?
- (b) There are 280 people in the party. Without knowing anybody's birthday, what is the largest value of n for which we can prove that at least n people must have been born in the same month?

UNIT-IV

7. (a) Prove that the identity element in a group is unique.
- (b) Let G be a group and $a \in G$. Prove that the cyclic subgroup H of G generated by a is a normal subgroup of $N(a) = \{x \in G : xa = ax\}$.

8. (a) Let P be a subgroup of a group G and let

$$Q = \{x \in G : xP = Px\}.$$

Is Q a subgroup of G ?

- (b) Let $f: (R, +) \rightarrow (R_+, \times)$ is defined as $f(x) = e^x$ for all x in R , where $R \rightarrow$ set of real numbers and $R_+ \rightarrow$ set of positive real numbers. Prove that f is a homomorphism. Is f an isomorphism?
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