# G-1/173/22

Roll No. .....

## I Semester Examination, January 2022

## M.Sc.

### INFORMATION TECHNOLOGY

Paper III

(Mathematical Foundations of Computer Science)

Time : 3 Hours ] [ Max. Marks : 100

**Note :** *All questions are compulsory. Question Paper comprises of 3 Sections. Section A is objective type/multiple choice questions with no internal choice. Section B is short answer type with internal choice. Section C is long answer type with internal choice.*

**SECTION A** **1 × 10 = 10**

**(Objective Type/Multiple Choice Questions)**

*Choose the correct answer :*

**1.** If $x \in N$ and $x$ is prime, then $x$ is ..... set.

(a) Infinite set (b) Finite set

(c) Empty set (d) Not a set

P.T.O.



**2.** Which of the following is De Morgan's law ?

(a) $P \wedge (Q \vee R) \equiv (P \wedge Q) \vee (P \wedge R)$

(b) $\sim(P \wedge R) \equiv \sim P \vee \sim R, \sim (P \vee R) \equiv \sim P \wedge \sim R$

(c) $P \vee \sim P \equiv$ True, $P \wedge \sim P \equiv$ False

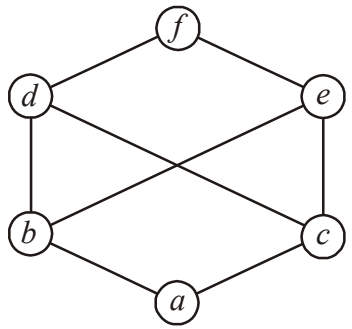
(d) None of the above

**3.** $\neg (A \vee q) \wedge (A \wedge q)$ is a :

(a) Tautology (b) Contingency

(c) Contradiction (d) None of the mentioned

**4.** The graph given below is an example of :




(a) non-lattice poset (b) bounded lattice

(c) semilattice (d) partial lattice

**5.** Every poset that is a complete semilattice must always be a :

(a) sublattice (b) complete lattice

(c) partial lattice (d) free lattice

**6.** Intersection of subgroups is a :

(a) group (b) subgroup

(c) cyclic group (d) semigroup

**7.** The tree elements are called :

(a) vertices (b) nodes

(c) pointes (d) edges

**8.** In a ..... the vertex set and the edge set are finite sets.

(a) finite graph (b) connected graph

(c) infinite graph (d) bipartite graph

**9.** Breadth First Search traversal of a binary tree finds its applications :

(a) Cloud computing

(b) Weighted graph

(c) Euler path

(d) Peer to peer networks

**10.** For very spanning tree with $n$ vertices and $n$ edges what is the least number of different Spanning trees can be formed ?

(a) 2 (b) 3

(c) 4 (d) 5





**SECTION B** **6×5=30**

**(Short Answer Type Questions)**

**Note :** *All the five questions are compulsory.*

**Unit-I**

**1.** Find a set of largest possible size that is a subset of both {1, 2, 3, 4, 5} and {2, 4, 6, 8, 10}.

*Or*

Let A $\{x \in N : 4 \leq x < 12\}$ and B $\{x \in N : x \text{ is even}\}$. (a) Find $A \cap B$. (b) Find $A \backslash B$.

**Unit-II**

**2.** Prove that the statements $\neg(P \rightarrow Q)$ and $P \wedge \neg Q$ are logically equivalent without using truth tables.

*Or*

Define Boolean Algebra. Explain Switching Circuits.

**Unit-III**

**3.** What are the properties of a Group ? Show that the set G = {1} forms a group with respect to multiplication.

*Or*

Consider the function $f : Z \to Z$ given by :

$$f(n) = \begin{cases} n+1 & \text{if } n \text{ is even} \\ n-3 & \text{if } n \text{ is odd.} \end{cases}$$

(a) If $f$ injective ? Prove your answer

(b) If $f$ surjective ? Prove your answer

**Unit-IV**

**4.** Suppose you have a graph with $v$ vertices and $e$ edges that satisfies $v = e + 1$. Must the graph be a tree ? Prove your answer.

*Or*

Prove Euler's formula using induction on the number of edges in the graph.

**Unit-V**

**5.** Explain Binary Tree Traversal with the help of appropriate examples.

*Or*

Describe different types of trees and write the Properties of Tree.

**SECTION C** **12×5=60**

**(Long Answer Type Questions)**

**Note :** *All the five questions are compulsory.*





**Unit-I**

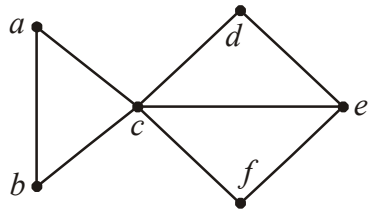
**1.** What is De Morgan's Law ? Describe in detail De Morgan's law Cardinality.

*Or*

What is recursive function ? Explain Algebra of Proposition and propositional Functions.

**Unit-II**

**2.** Find all spanning trees of the gaph below. How many different spanning trees are there ? How many different spanning trees are there up to isomorphism (that is, if you grouped all the spanning trees by which are isomorphic, how many groups would you have) ?




*Or*

???

**Unit-III**

**3.** If R is a ring such that $a^2 = a \forall a \in R$ prove that $a + a = 0 \forall a \in R$. i.e., each element of R is its own additive inverse.

*Or*

What are Polynomials ? Explain Polynomials Roots and its Applications.

**Unit-IV**

**4.** Describe in detail Dijkastra's Algorithm with suitable example.

*Or*

What is Simple Graph ? Explain Graph and its types.

**Unit-V**

**5.** How many lattice paths start at (3, 3) and :

(a) ends at (10, 10) ?

(b) end at (10, 10) and pass through (5, 7) ?

(c) end at (10, 10) and avoid (5, 7) ?

*Or*

Explain, why the coefficient of $x^5y^3$ the same as the coefficient of $x^3y^5$ in the expansion of $(x + y)^8$ ?

★ ★ ★ ★ ★ ★ c ★ ★ ★ ★ ★