Exam. Code : 206701

Subject Code : 3667

M.Sc. Computer Science Ist Semester

MCS-104 DISCRETE STRUCTURES

Time Allowed—3 Hours] [Maximum Marks—100

Note :—Attempt **five** questions in all, taking at least **one** from each Section. All questions carry equal marks.

SECTION—A

1. (a) Let $f : X \to Y$ is a function. What does it mean to say that f has an inverse function ? Give a necessary and sufficient condition for f to have an inverse function.

   (b) Let $A = \{a, b, c, d, e\}$, $g = \{e, f, g, h\}$ and $C = \{a, c, h, e\}$ be the three sets. Prove that

   $$|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |B \cap C| - |A \cap C| + |A \cap B \cap C|$$

   where $|A|$ represents cardinality of set A.

2. For two positive integers, we write $m < n$ if the sum of the (distinct) prime factors of the first is less than or equal to the product of the (distinct) prime factors of the second. For instance, $75 < 14$, because $3 + 5 \leq 2 \times 7$.

   (a) Is this relation reflexive ? Explain.

   (b) Is this relation anti-symmetric ? Explain.

   (c) Is this relation transitive ? Explain.

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SECTION—B

3. (a) Define complete binary tree. What is the total number of nodes in a binary tree of height h ?

   (b) State the criteria to detect the planarity of a connected graph and give an example also.

4. (a) What are the steps involved in deriving a minimum spanning tree using Kruskal's algorithm.

   (b) "The cost of minimum spanning tree is unique, but the minimum spanning tree may not be unique". Justify the comment.

SECTION—C

5. Four playing cards Club A, Heart J, Spade Q and Diamond K are arranged in a row.

   (a) List all the possible permutations.

   (b) How many different permutations are there ?

6. Solve the recurrence relation :

   $$a_n - 7a_{n-1} + 26a_{n-2} - 24a_{n-3} = 0 \text{ for } n \geq 2.$$

SECTION—D

7. (a) What is the characteristic of a ring ? What makes a ring commutative and/or a ring with unity ?

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(b) What are integral domains and fields ? Can you think of a ring that isn't an integral domain or an integral domain that isn't a field ?

8. What are logic circuit (LC) and switching functions (SF) in Boolean algebra ? Explain the application of Boolean algebra in LC and SF, by taking appropriate examples.