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B.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2012.

Second Semester

Computer Science — Allied

Paper II — MATHEMATICAL FOUNDATIONS FOR
COMPUTER SCIENCE — I

(For those who joined in July 2008 and afterwards)

Time : Three hours

Maximum : 75 marks

PART A — ($10 \times 1 = 10$ marks)

Answer ALL questions.

Choose the correct answer.

1. The number of elements in a set A is called the _____ of A.

(a) Identify
(b) Cardinality
(c) Equality
(d) None

2. A relation which is reflexive, symmetric and transitive is called an _____.

(a) Equivalence (b) Antisymmetric
(c) Irreflexive (d) None

3. The other name for one-one function is _____.

(a) Surjective (b) Bijective
(c) Injective (d) Identity

4. Let $f: X \rightarrow Y$ be a function. If $A \subseteq X, B \subseteq Y$ and f is one-one, then _____.

(a) $f^1(f(A)) \subseteq A$ (b) $A \subseteq f^1(f(A))$
(c) $f(f^1(A)) \subseteq A$ (d) $A \subseteq f(f^1(A))$

5. The statement which do not contain any connectives are called _____ statements.

(a) Atomic (b) Molecular
(c) Composite (d) Compound

6. $p \rightarrow q \Leftrightarrow$

(a) $p \vee q$ (b) $p \vee \neg q$
(c) $\neg p \vee q$ (d) $\neg p \wedge q$

7. The degree of every vertex in a complete graph of n vertices is _____.

- (a) n (b) $n - 1$
(c) 2 (d) 3

8. If the initial and the terminal vertices of a path are the same, then the path is called a _____.

- (a) cycle (b) loop
(c) regular (d) none

9. A tree is a connected _____ graph.

- (a) Cyclic (b) Acyclic
(c) Euler (d) Hamiltonian

10. A disconnected graph consists of two or more connected graphs called _____.

- (a) trees (b) components
(c) cycles (d) none

PART B — ($5 \times 5 = 25$ marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) For any finite sets A and B prove that $|A \cup B| = |A| + |B| - |A \cap B|$.

Or

(b) Among middle aged men who read Tamil daily, 72% read Dhinakaran and 86% read Dhina Thanthi. Find the percentage of middle-aged men who read both.

12. (a) Are f and g both necessarily onto, if $g \circ f$ is onto?

Or

(b) Let $f: \{1, 3, 4\} \rightarrow \{1, 2, 5\}$ and $g: \{1, 2, 5\} \rightarrow \{1, 3\}$ be given by $f = \{(1, 2), (3, 5), (4, 1)\}$ and $g = \{(1, 3), (2, 3), (5, 1)\}$. Write down $g \circ f$ and $f \circ g$.

13. (a) Construct the truth table for the formula $(P \rightarrow Q) \leftrightarrow (\neg P \vee Q)$.

Or

(b) State and prove the De-Morgan's Laws in logic using truth table.

14. (a) Prove that the number of vertices of odd degree in a graph is always even.

Or

- (b) Define degree of a vertex and show that the sum of degrees of the vertices in a graph is twice the number of edges.

15. (a) (i) Write notes on connected and disconnected graphs.
(ii) If a graph has exactly two vertices of odd degree, then prove that there must be a path joining these two vertices.

Or

- (b) Define Euler graphs and Eulerian graphs. List the properties of Eulerian graphs.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) For any three sets A, B, C prove that

- (i) $A \Delta B = (A \cup B) - (A \cap B)$
(ii) $A \cap (B \Delta C) = (A \cap B) \Delta (A \cap C)$
(iii) $A \cap B = \emptyset$ iff $A \Delta B = A \cup B$.

Or

- (b) State and prove De Morgan's laws.

17. (a) Prove that a function $f: X \rightarrow Y$ is a bijection if there exists a unique function $g: Y \rightarrow X$ such that $g \circ f = i_x$ and $f \circ g = i_y$.

Or

- (b) Let $f: R \rightarrow R$ given by $f(x) = x^2 - 3$. Find f^{-1} .

18. (a) Construct the truth table for the formula $(P \rightarrow (Q \rightarrow R)) \rightarrow ((P \rightarrow Q) \rightarrow (P \rightarrow R))$.

Or

- (b) Obtain the principal disjunctive and conjunctive normal form for the formula, $(\neg P \vee \neg Q) \rightarrow (P \leftrightarrow \neg Q)$.

19. (a) Prove that the number of edges among all n vertex graphs with no triangles is $\lfloor n^2/4 \rfloor$. ($\lfloor a \rfloor$ denotes the greatest integer not exceeding the real number).

Or

- (b) Let $G_1(n_1, e_1)$ and $G_2(n_2, e_2)$ be two disjoint graphs. Then prove that

- (i) $G_1 \cup G_2$ is a $(n_1 + n_2, e_1 + e_2)$ graph
(ii) $G_1 + G_2$ is a $(n_1 + n_2, e_1 + e_2 + n_1 n_2)$ graph and
(iii) $G_1 * G_2$ is a $(n_1 n_2, n_1 e_2 + n_2 e_1)$ graph.

20. (a) Prove that a simple graph with n vertices and k components can have at most $(n-k)(n-k+1)/2$ edges.

Or

- (b) Show that a graph G is connected iff for any partition of V into disjoint subsets V_1 and V_2 there is an edge of G joining a vertex of V_1 to a vertex of V_2 .
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