

SAMPLE QUESTION

(TH.): MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

PG Sem.: 1st, Sub: MCA, Paper: MCA-1.1

1. Define Propositional logic and its applications. Discuss different operators used in propositional logic with suitable examples and diagrams.
2. Define Predicate and Quantifier through proper example. Let $Q(x, y)$ denotes the statement “ $x = y + 3$.” What are the truth values of the propositions $Q(1, 2)$ and $Q(3, 0)$?
3. Find the *contrapositive*, the *converse*, and the *inverse* of the following conditional statement.
“If it is raining, then the home team wins”.
4. What is logical equivalence in propositional logic? Show that $\neg(p \rightarrow q)$ and $p \wedge \neg q$ are logically equivalent by developing a series of logical equivalences without using truth table.
5. Define De Morgan’s laws. Use De Morgan’s laws to find the *negation* of each of the following statements.
 - i. Kwame will take a job in industry or go to graduate school.
 - ii. Ram knows Java and calculus.
 - iii. Rita will move to Oregon or Washington.
6. Write down the steps for proof by mathematical induction. Use mathematical induction to show that following formula for all nonnegative integers “ n ”.

$$1 + 2 + 2^2 + \dots + 2^n = 2^{n+1} - 1.$$

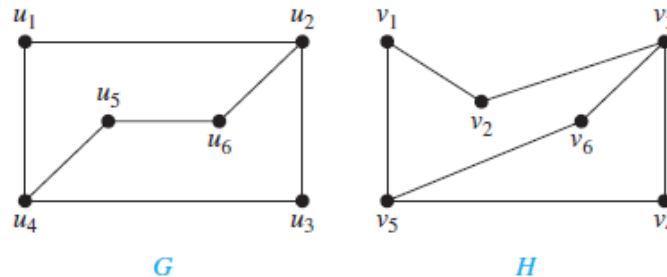
7. Define Function. Briefly discuss each of the following functions with suitable examples and diagrams.
 - i. one-to-one
 - ii. onto
 - iii. one-to-one correspondence
8. Briefly calculate the number of Reflexive, Symmetric and Antisymmetric relations possible on a set with “ n ” elements.
9. Define inverse function. Let f be the function from $\{a, b, c\}$ to $\{1, 2, 3\}$ such that $f(a) = 2, f(b) = 3$, and $f(c) = 1$. Is f invertible, and if it is, what is its inverse?
10. Define Relation. Discuss different closure of Relation through proper examples.
11. What is the difference between partial and total orderings? Show that the greater than or equal to relation (\geq) is a partial ordering on the set of integers.
12. Write short notes on the followings:
 - i. Different methods to represent a set with examples
 - ii. Draw Venn diagrams for different set operations
13. Define Logic Gates. Briefly discuss different Logic Gates used in computer or electronic devices with suitable examples and diagrams.
14. What is Boolean function? Find the possible values of the following Boolean function.
$$F(a, b, c) = a.b + \bar{c}$$
15. Define functional completeness. Can we find a smaller set of functionally complete operators? Justify.
16. Write down different Boolean identities in Boolean algebra. Prove the both cases of absorption law without using truth table.
17. Define duality principle in Boolean algebra. Find the dual of following Boolean function.

$$(x + \bar{y}).y + 1$$

18. What is logic circuit minimization? Simplify the following Boolean function using K -map.

$$F(A, B, C, D) = \sum (0, 1, 2, 5, 7, 8, 9, 10, 11, 13, 15)$$

19. A particular brand of shirt comes in 12 colors, has a male version and a female version, and comes in three sizes for each sex. How many different types of this shirt are made?
20. Define Pigeonhole Principle. There are 30 students in a class, then at least, how many have last names that begin with the same letter?
21. Differentiate between the permutation and combination. How many ways are there for four men and five women to stand in a line so that
 - i. all men stand together?
 - ii. all women stand together?
22. State about the principle of inclusion-exclusion. How many positive integers less than 1000 are divisible by neither 7 nor 11?
23. The name of a variable in the C programming language is a string that can contain uppercase letters, lowercase letters, digits, or underscores. Further, the first character in the string must be a letter, either uppercase or lowercase, or an underscore. If the name of a variable is determined by its first eight characters, how many different variables can be named in C? [Note: the name of a variable names are *case sensitive* and may contain fewer than eight characters.]
24. How many ways are there to select three pieces of fruit from a bowl containing apples, oranges, and pears if the order in which the pieces are selected does not matter, only the type of fruit and not the individual piece matters, and there are at least three pieces of each type of fruit in the bowl?
25. What is the necessary and sufficient condition to find an Euler circuit and Euler path in a simple connected undirected graph? Justify your answer through proper examples.
26. Define graph isomorphism and how is it determined? Determine whether the following graphs G and H are isomorphic or not? Justify your answer.



27. Write shortly on the following terminologies associated with graph with suitable examples and diagrams.
 Multigraph; Degree of vertex; Bridge v/s Articulation Point; Bipartite Graphs; Connected Component
28. Define Graph. Discuss different ways to represent a graph with suitable examples and diagrams.
29. Define planar graph. Are K_5 , Q_3 and $K_{3,3}$ planar? Justify through diagram.
30. Write short notes on the followings with examples.
 - i. Hamilton Paths and Circuits
 - ii. Graph Coloring

END