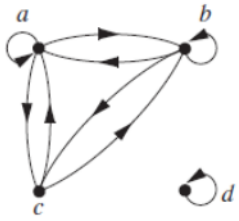
Indian Institute of Engineering Science and Technology, Shibpur
B.Tech. (CST) 3rd Semester Mid-Semester Examination, December 2020
Subject: Discrete Structures (CS - 2101)

Full marks: 30 **Time: 45 minutes**

Answer *all* Questions

1. Write the *converse* and *inverse* of the conditional statement "If Howard can swim across the lake, then Howard can swim to the island." [2]
2. A compound proposition that is always _____ is called a contradiction, and the one which is neither a tautology nor a contradiction is called a _____. [2]
3. The statement, "Every comedian is funny" where $C(x)$ is "x is a comedian" and $F(x)$ is "x is funny" and the domain consists of all people can be expressed by quantifiers as: [2]
(a) $\exists x(C(x) \wedge F(x))$ (b) $\forall x(C(x) \wedge F(x))$ (c) $\exists x(C(x) \rightarrow F(x))$ (d) $\forall x(C(x) \rightarrow F(x))$
4. Express the statements "Every computer science student needs a course in discrete mathematics" and "There is a student in this class who has taken at least one course in computer science" using predicates and quantifiers. [2 + 2]
5. Use rules of inference to show that the hypotheses "Andy works hard," "If Andy works hard, then he is a dull boy," and "If Andy is a dull boy, then he will not get the job" imply the conclusion "Andy will not get the job." [3]
6. A function is defined by mapping $f: A \rightarrow B$ such that A contains m elements and B contains n elements and $m \leq n$. Find the number of one-to-one functions. [2]
7. Are the following statements *True* or *False*? [2]
   a) An equivalence relation has reflexive, anti-symmetric, and transitive properties.
   b) A partially ordered relation has reflexive, symmetric, and transitive properties.
8. Suppose the relation on a set R is represented as $M_R = \begin{bmatrix} 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \end{bmatrix}$. Determine if this relation is *reflexive, irreflexive, symmetric, anti-symmetric, and transitive* (give reasons). Use Boolean multiplication of zero-one matrix wherever necessary. [5]
9. Determine which of the four properties (*reflexive, symmetric, antisymmetric, and transitive*) are present in the following binary relation represented by the directed graph (give reasons). [4]



10. Draw the Hasse diagram for the "less than or equal to" relation on {0, 2, 5, 10, 11, 15}. Find the maximal, minimal, greatest, and least elements in the diagram. [2 + ($1/2$*4)]