

Midterm: CSE173 DISCRETE MATHEMATICS

North South University

March 25, 2019

Name: _____

Student ID: _____

Deduction due to misconduct:

Total Marks:

Instructions:

1. It is a close notes, close books exam.
2. You have \geq **70 minutes** to complete the examination.
3. You may use a calculator.
4. Please sign the below Honor Code statement.

In recognition of and in the spirit of the North South University code of conduct, I certify that I will neither give nor receive unpermitted aid on this examination.

Signature: _____

1 Question 1: 20 Points

(a) When do you use Mathematical Induction process to prove a statement?

(b) Use Mathematical Induction to prove that $\forall n$, where n is a positive integer, $6^n - 1$ is divisible by 5.

2 Question 2: 22 Points

Perhaps, all of us must have listened to a lot of short stories about Bhoot/Ghost in our childhood. Let us consider that the below statements about Bhoot/Ghost were passed on to us by our grandparents:

If Bhoot is our imagination, then it is immortal. But if it is not imagination, then it is mortal and animal. If the Bhoot is either immortal or animal, then it is carnivorous. A Bhoot is ferocious if it is carnivorous.

Given these statements, use propositional logic, rule of inferences etc. to answer the below questions:

- (a) Write down the premises made about a Bhoot in the above statements.

(b) Prove if a Bhoot/Ghost is an imagination. Is a Bhoot ferocious? Is it carnivorous? [Please label all the necessary steps.]

3 Question 3: 20 Points

Represent the followings (a to c) using propositional or predicate logic:

(a) *A necessary condition for something around you to be called as crow is that it should be a black colored bird which eats garbage.*

(b) *Each black colored bird is a crow.*

(c) Given that $M(x)$: x is a teacher like MSK1, $P(x, y)$: x bores y .
Every teacher like MSK1 (as you see in CSE173 class) bores some of his students.

(d) Use series of logical equivalences to show that $\neg(p \vee (\neg p \wedge q)) \equiv \neg p \wedge \neg q$. Please label all the laws you use.

4 Question 4: 20 Points

Write down brief (we repeat, brief) answers to the following questions:

(a) *State what it means for an argument to be valid in predicate logic. Give an example.*

(b) *What do you mean by the term resolvent. Explain with an arbitrary example.*

(c) *Simplify the expression $(a \wedge b) \rightarrow (a \vee b)$ into the lowest possible form.*

(d) Transform the expression $(a \rightarrow b) \rightarrow c$ into Conjunctive Normal Form (CNF).

5 Question 5: 14 Points

Use Truth Table to identify if the statement $(p \rightarrow q) \wedge (q \rightarrow r)$ is a tautology/contradiction/contingency.

6 Question 6: 8 Points

(a) *If x is a positive integer and $x^2 \leq 3$, then $x = 1$.* Is it True or False? Explain

(b) Write down two of your shortcomings as a student.