Midterm Exam I (March 10, 2021, 08:30 am - 09:55 am)
CSE 215: Foundations of Computer Science
State University of New York at Stony Brook, Spring 2021
Instructor: Prof. Pramod Ganapathi

Total points = 45. Total questions = 8. Total pages = 2.
Instructions:
- Please write your full name and SBU student ID on the answer sheet.

Problem 1. [5 points]

Construct a truth table for the following statement form: $(p \wedge (q \vee r)) \rightarrow (p \wedge r)$.

Problem 2. [5 points]

Check the logical equivalence of $((p \wedge q) \rightarrow r)$ and $((p \rightarrow r) \vee (q \rightarrow r))$.

Problem 3. [10 points]

Give negations of the following statements. Reasoning is not required.

(a) [1 point] $p \wedge q$

(b) [1 point] $p \vee q$

(c) [1 point] $p \oplus q$

(d) [1 point] $p \rightarrow q$

(e) [1 point] $p \leftrightarrow q$

(f) [1 point] $\forall x, \forall y$ such that $p(x, y)$

(g) [1 point] $\forall x, \exists y$ such that $p(x, y)$

(h) [1 point] $\exists x, \forall y$ such that $p(x, y)$

(i) [1 point] $\exists x, \exists y$ such that $p(x, y)$

(j) [1 point] $\exists x, \forall y, \exists z$ such that $p(x, y, z)$

Problem 4. [5 points]

Determine if the following deduction rule is valid:
$p \rightarrow q$
$q \rightarrow r$
———-
$\therefore p \rightarrow r$

Problem 5. [5 points]

Determine if the following deduction rule is valid:
$p \rightarrow (q \vee r)$
$\sim (p \rightarrow q)$
———-
$\therefore r$

Problem 6. [5 points]

Prove or disprove the following statement. For all integers, if a is odd, then a^4 is odd.

Problem 7. [5 points]

Prove or disprove the following statement. The difference of two perfect squares is not a prime number. Here is the reasoning for the claim: $a^2 - b^2 = (a + b)(a - b)$, which is a composite number.

Problem 8. [5 points]

Prove by contradiction that there are no integers x and y such that $x^2 = 4y + 2$. (Hint: For this problem, you can assume without giving proof that if x^2 is even, then x is even.)