## CSE 311: Foundations of Computing I

## Section 2: Equivalences and Predicate Logic

## 1. Equivalences

Prove that each of the following pairs of propositional formulae are equivalent using propositional equivalences.
(a) $p \leftrightarrow q \quad(p \wedge q) \vee(\neg p \wedge \neg q)$
(b) $\neg p \rightarrow(q \rightarrow r) \quad q \rightarrow(p \vee r)$

## 2. Non-equivalence

Prove that the following pairs of propositional formulae are not equivalent by finding inputs they differ on.
(a) $p \rightarrow q$

$$
q \rightarrow p
$$

(b) $p \rightarrow(q \wedge r) \quad(p \rightarrow q) \wedge r$

## 3. Boolean Algebra

For each of the following parts, write the logical expression using boolean algebra operators. Then, simplify it using axioms and theorems of boolean algebra.
(a) $\neg p \vee(\neg q \vee(p \wedge q))$
(b) $\neg(p \vee(q \wedge p))$

## 4. Canonical Forms

Consider the boolean functions $F(A, B, C)$ and $G(A, B, C)$ specified by the following truth table:

| $A$ | $B$ | $C$ | $F(A, B, C)$ | $G(A, B, C)$ |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 1 | 1 | 1 | 0 |
| 1 | 1 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 |

(a) Write the DNF and CNF expressions for $F(A, B, C)$.
(b) Write the DNF and CNF expressions for $G(A, B, C)$.

