Quiz Section 2: Circuits and Predicate Logic

Task 1 – Equivalences

Prove that each of the following pairs of propositional formulas are equivalent using the specified method(s).

a) $p \to \neg p \wedge \neg p \to p$ vs. F

Use cozy at the following url (tinyurl.com/CSE311S2) to complete the problem online.

b) $\neg p \to (q \to r)$ vs. $q \to (p \vee r)$ using **(i)** truth tables and **(ii)** propositional equivalences.

Use cozy at the following url (tinyurl.com/CSE311S2b) to complete the problem online.

Task 2 – Non-equivalence

Prove that the following pairs of propositional formulae are not equivalent using a truth table and specifying an input they differ on.

a) $p \to r$ vs. $r \to p$

b) $a \to (b \wedge c)$ vs. $(a \to b) \wedge c$

Task 3 – More Circuits

Let Q be defined by $Q(p, q) = (\neg p) \oplus q$. Using only NOT, OR and Q gates, draw a circuit that represents the logical expression $(a \wedge b) \oplus c$.

Task 4 – 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) $\neg(p \vee (q \wedge p))$

Task 5 – 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 in boolean algebra for $G(A, B, C)$.

c) Simplify your CNF form for $G(A, B, C)$.

Task 6 – Translate to English

Translate these system specifications into English where $F(p)$ is "Printer p is out of service", $B(p)$ is "Printer p is busy", $L(j)$ is "Print job j is lost," and $Q(j)$ is "Print job j is queued". Let the domain be all printers and all print jobs.

a) $\exists p\,(F(p) \wedge B(p)) \rightarrow \exists j\; L(j)$

b) $(\forall j\; B(j)) \rightarrow (\exists p\, Q(p))$

c) $\exists j\;(Q(j) \wedge L(j)) \rightarrow \exists p\, F(p)$

d) $(\forall p\, B(p) \wedge \forall j\; Q(j)) \rightarrow \exists j\; L(j)$