ECS 20 **Homework #1, Propositional Calculus (44 points)** **Winter 2012**

Due: January 19th by 4:00pm

From text (13 points) : 4.6 – 4.9, 4.20 – 4.28 (1 points each)

1. (6 points)
   a. Write a truth table for $\neg(p \wedge q) \vee (p \vee q)$ using Method 1 (slowly grow parts of the expression and then combine)
   b. Write a truth table for $p \wedge (\neg q \rightarrow r)$ using Method 2 (separate columns for each variable and operator)

2. (5 points) Let s = "Jane played Skyrim too long", e = "Jane was blurry eyed", and w = "Jane did well on the exam." Write the following statements in symbolic form using the indicated letters and only the operators $\neg$, $\wedge$, $\vee$. You cannot use "$\rightarrow$" in your final statement, but you may use it in intermediate steps.
   a. Jane played Skyrim too long, was blurry eyed, and did poorly on the exam.
   b. Jane did not play Skyrim too long, was clear eyed, and did well on the exam.
   c. Jane was neither blurry eyed, nor did she play Skyrim, but she did not do well on the exam.
   d. If Jane played Skyrim too long, then Jane was blurry eyed and did not do well on the exam.
   e. Jane did well on the exam if and only if she was either clear eyed or didn't play Skyrim too long.

3. (5 points) Given the following information about a computer program, find the mistake in the program by providing a proof using the laws of logical equivalence and the rules of inference. Provide a reason for each step in your proof.

   There is an undeclared variable or there is a syntax error in the first five lines.
   If there is a syntax error in the first five lines, then there is a missing semicolon or a variable name is misspelled.
   There is not a missing semicolon.
   There is not a misspelled variable name.

4. (5 points) Use the laws of logical equivalence and the rules of inference to deduce the conclusion from the premises. Give a reason for each step. Assume all variables are proposition variables.

   $\neg p \vee q \rightarrow r$
   $s \vee \neg q$
   $\neg t$
   $p \rightarrow t$
   $\underline{\neg p \wedge r \rightarrow \neg s}$
   $\therefore \neg q$

5. (5 points) Use the rules of inference to show that the following argument is true.

   $\forall x(P(x) \vee Q(x))$
   $\forall x(\neg Q(x) \vee S(x))$
   $\forall x(R(x) \rightarrow \neg S(x))$
   $\exists x \neg P(x)$
   $\therefore \exists x \neg R(x)$

6. (5 points) Show your work as you use propositional calculus and the laws of equivalence to simplify the following digital logic circuit to use at most three logic gates, and then draw your new circuit.