CPSC 121 TUTORIAL - PROPOSITIONAL LOGIC

Problem 1. Show the following logical equivalences using the known logical equivalences. Explicitly indicate the name of every known logical equivalence that you have used.

(1) $\sim(\sim(p \vee q \vee p) \wedge p) \equiv T$
(2) $p \vee q \equiv \sim(\sim p \wedge ((\sim q \wedge \sim p) \vee (\sim q \wedge p)))$
(3) $(\sim p \vee s) \wedge (p \rightarrow (s \rightarrow \sim p)) \equiv \sim p$
(4) $(p \vee q) \equiv (\sim q \rightarrow p) \vee \sim(\sim p \wedge \sim q) \vee ((p \wedge \sim p) \wedge (q \vee \sim q))$

Problem 2. For each proposition below, indicate whether it is (1) a tautology, (2) a contradiction, or (3) neither a tautology nor a contradiction.

(1) $p \rightarrow (q \rightarrow \sim p)$
(2) $(\sim(p \oplus q)) \leftrightarrow (\sim q \oplus p)$
(3) $((p \leftrightarrow q) \leftrightarrow r) \rightarrow (p \vee q \vee r)$
(4) $\sim(\sim(p \rightarrow q) \vee (p \wedge q)) \wedge p$

Problem 3. Given the truth table below, using a Karnaugh-map, design a circuit to implement the function using as few gates as possible.

p	q	r	f
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Problem 4. Given the truth table below, using a Karnaugh-map, design a circuit to implement the function using as few gates as possible.

p	q	r	s	f
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1