

EE1001 Foundations of Digital Techniques

Assignment 2

Due: Sep 19 (before lecture begins)

1. Let p = “stocks are increasing” and q = “interest rates are steady.” Write the following statements in symbolic form using p , q , and the symbols $\sim$, $\vee$, and $\wedge$.
 - a) Stocks are increasing but interest rates are steady.
 - b) Neither are stocks increasing nor are interest rates steady.
2. Write truth tables for the following statement forms:
 - a) $\sim p \wedge q$
 - b) $p \wedge (\sim q \vee r)$
3. Use a truth table to determine whether $p \wedge (q \vee r)$ and $(p \wedge q) \vee (p \wedge r)$ are logically equivalent.
4. Use De Morgan’s laws to write the negations for the following statements:
 - a) The train is late or my watch is lost.
 - b) $-2 < x < 7$.
5. Use a truth table to determine if $(p \wedge \sim q) \wedge (\sim p \vee q)$ is a tautology or a contradiction.
6. Use Theorem 2.1 in the lecture notes to verify the logical equivalences below. Supply a reason for each step.
 - a) $\sim(p \vee \sim q) \vee (\sim p \wedge \sim q) \equiv \sim p$
 - b) $(p \wedge (\sim(\sim p \vee q))) \vee (p \wedge q) \equiv p$

7.

- a) Without using truth table, show that $p \rightarrow (q \vee r) \equiv (p \wedge \sim q) \rightarrow r$.
- b) Use the logical equivalence established in (a) to rewrite the following statement in another way. (Assume that n represents a positive integer.)
"If n is prime, then n is odd or n is 2."

8. Rewrite the statement "A necessary condition for a computer program to run correctly is that it has no syntax errors." in if-then form. Is having no syntax errors a sufficient condition for a computer program to run correctly? Why?

9. "If compound X is boiling, then its temperature is at least 150 °C." Assuming that this statement is true, which of the following must also be true?

- i. If the temperature of compound X is at least 150 °C, then compound X is boiling.
- ii. If the temperature of compound X is less than 150 °C, then compound X is not boiling.
- iii. Compound X will boil only if its temperature is at least 150 °C.
- iv. If compound X is not boiling, then its temperature is less than 150 °C.
- v. A necessary condition for compound X to boil is that its temperature be at least 150 °C.
- vi. A sufficient condition for compound X to boil is that its temperature be at least 150 °C.

10. Without using truth tables, show the following:

- a) $p \vee (p \wedge q) \equiv p$
- b) $((p \rightarrow q) \wedge p) \rightarrow q$ is a tautology