1 Introduction

The purpose of this assignment is to get a better understanding of universal gates and sequential circuits. The assignment focuses on the analysis of sequential circuits and using timing diagrams to depict the behavior of the different types of latches and flip flops that we have learnt so far.

2 Universal Gates

Check if the set of gates or functions in the following list are universal. Justify your answer. Assume constants 0 and 1 are available as inputs.

1. \{XOR, NOR\}
2. \{AND, NOT\}
3. \{XOR\}
4. \{f(a, b)\}, where \(f(a, b) = a + b'\).
5. \{f(a, b, c)\}, where \(f(a, b, c) = (a + b)(a + c)\).
6. \{f(a, b, c)\}, where \(f(a, b, c) = ab + ac + a'c'\).

3 Other types of gates

Given XOR and OR gates, prove or disprove the following equalities using Boolean Algebra.

1. \(a \oplus (b + c) = (a \oplus b) + (a \oplus c)\).
2. \(a + b \oplus c = (a + b) \oplus (a + c)\).

4 Latch

1. Exercise 3.7 in Harris
2. Exercise 3.8 in Harris
5  Timing Diagrams

1. Exercise 3.3 in Harris
2. Exercise 3.5 in Harris
3. Exercise 3.4 in Harris
4. Exercise 3.6 in Harris