

# ENGIN112 - Introduction to Electrical and Computer Engineering

## Homework 10

**Due 11 December 2009 at 1:25 p.m. (before class starts)**

Please write down the course and homework number, and your name on all sheets. Answer the problems in the order they were listed in the assignment. Show all your work.

Solve the following problems.

1. Compute the delay and the maximum frequency of a 4-bit ripple carry adder circuit built from a full adder circuit shown in Figure 4.10. Assume that all inputs ( $A[3:0], B[3:0], C_0$ ) as well as all outputs ( $S[3:0], C_4$ ) are latched by a D flipflop (DFF). In your calculations and use the following timing parameters: delay of an AND or OR gate = 2 ns; delay of an XOR gate = 3 ns; delay of an inverter = 1.5 ns; Clk-to-Q propagation time of a DFF = 1 ns; DFF setup time = 1 ns and hold time = 1 ns. Clearly indicate the critical path of the circuit.
2. 7.1
3. 7.6
4. 7.9
5. 7.20
6. 7.21
7. 7.28