

# Homework#4 for ECE 254 / CPS 225

Due in class on Monday, November 21

All homework must be done in groups of two or individually

## 1 Modeling and Evaluation

1.1) [10 points] Assume that MTTF of component A ( $MTTF_A$ ) is 1 year,  $MTTF_B=2$ , and  $MTTF_C=3$ . Assume that the system fails if any of the components fail. What is the MTTF of the system?

1.2) [10] Draw a discrete time Markov chain that represents a TMR system with two spares (beyond the three modules in the TMR system). Assume that the voter is fault-free and that no repair is possible. State all of your assumptions, including error probability (transient and permanent error probabilities).

1.3) [10] Draw a stochastic Petri net that represents a system with TMR processors, a hard failure rate of  $\lambda$  and a repair rate of  $\mu$ . Assume the voter is fault-free. You do not have to consider transient errors. State any assumptions you make.

## 2 Testing

2.1) [10] Give an example of fault equivalence in a simple combinational circuit (the circuit must be more than just one gate).

2.2) [10] For the circuit in Figure 1, create a test for the fault X stuck-at-1. If no test exists for this fault, explain why not.

2.3) [10] For the sequential circuit in Figure 2, draw two time frames of the equivalent combinational circuit.

2.4) [15] For the sequential circuit in Figure 2, devise a test vector sequence that detects Y stuck-at-0. Assume that both flip-flops are initially holding zeros. What is the minimum number of cycles that a test vector sequence requires to test for this fault?

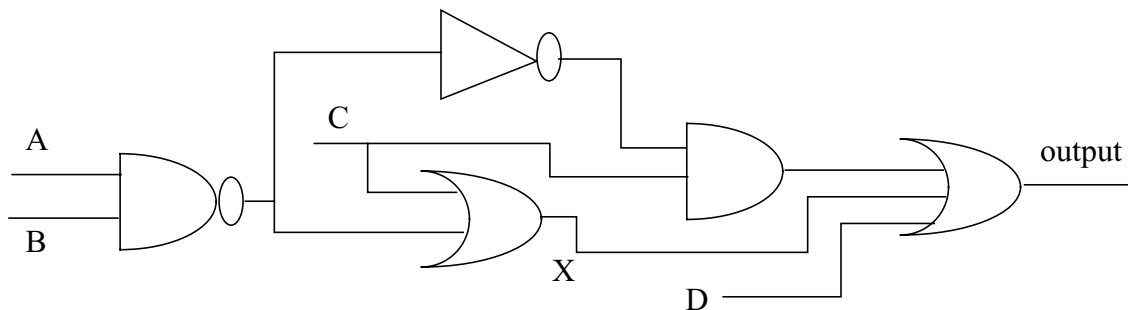
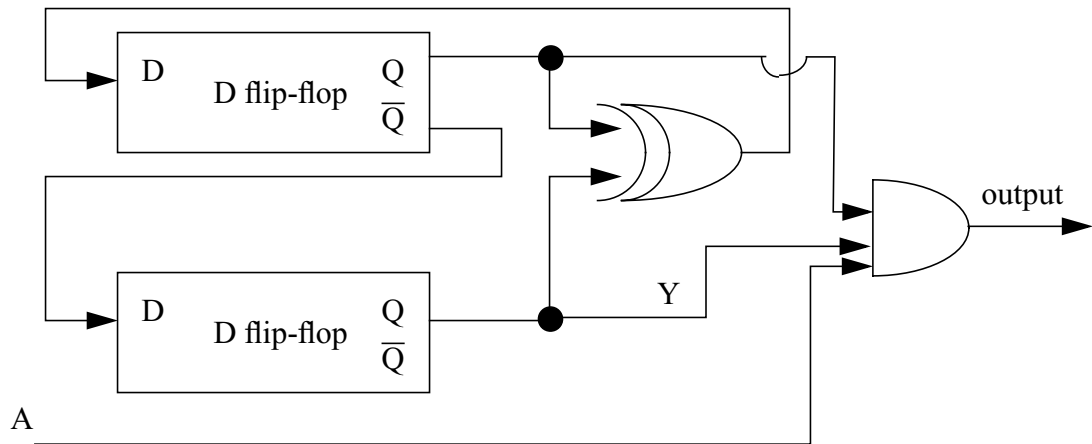


FIGURE 1. Combinational Circuit for Exercise 2.2



**FIGURE 2. Sequential Circuit for Exercises 2.3 and 2.4**