

1. Examples handout questions 8, 9, 10, 11, 13
2. Consider the following circuit:
$$F(A, B, C, D) = ABD + \overline{BCD} + \overline{AC}$$
 - (a) Are there any static-0 hazards in the circuit? If so, what input transitions could potentially produce a hazard?
 - (b) Are there any static-1 hazards in the circuit? If so, what input transitions could potentially produce a hazard?
 - (c) Give an alternative circuit with the same output as F that does not have any hazards.
3. You have been asked to design a 2-input multiplexor with an *Enable* input in addition to the select line. When *Enable* is high, the multiplexor acts like an ordinary 2:1 multiplexor. When *Enable* goes low, the output should be 0, regardless of the values on the input lines.
 - (a) Implement the above multiplexor using combinational logic in sum-of-products form.
 - (b) Implement the above multiplexor using an ordinary 2:1 multiplexor and one other logic gate.
 - (c) Implement a 4:1 multiplexor with an *Enable* input using several 2:1 multiplexors with *Enable* inputs. You are free to permanently connect inputs to logic high and low in your implementation.
4. Using a 1-of-8 decoder and OR gates create a circuit that takes a 3-bit number $A_2A_1A_0$ and outputs the number of 1's in the input as a 2-bit number Z_1Z_0 .
5. It is possible to build a flip-flop using a flip-flop of a different type. For instance, it is possible to create an J-K flip-flop using a D flip-flop and surrounding it with some additional logic.

Observe that the J-K flip-flop's state after a clock cycle, Q' , depends on the inputs J , K , and the current output Q . If building a J-K flip-flop using a D flip-flop, the next-state value must be present on the input of the D flip-flop (ready for the D flip-flop to latch it for the next cycle).

 - (a) Design a circuit using combinational logic that takes J , K , and Q as inputs and outputs Q' .

- (b) Hook up your circuit to the D flip-flop, along with any other logic elements to create a block that exposes the same inputs and outputs as a J-K flip-flop.
- (c) Create a D flip-flop using a T flip-flop.