

## ***ELEC 4200 Homework Assignment - Logic Circuit Design Review***

**Due: Tuesday, January 15**

1. Four light-emitting diodes (LEDs) are designated as LED0, LED1, LED2, and LED3. These LEDs are illuminated by applying a voltage to them corresponding to "logic 1", and darkened by applying a voltage to them corresponding to logic 0.

A computer generates a 4-bit number  $A = a_3a_2a_1a_0$ .

Design and sketch a digital logic circuit that will illuminate LED0 when  $A=0100$ , LED1 when  $A=0101$ , LED2 when  $A=0110$ , and LED3 when  $A=0111$ . For any other value of  $A$ , the LEDs should all be dark. You may use logic gates and/or decoders for your circuit. Clearly show all wires, and label all LEDs and signal lines.

2. Design a synchronous sequential circuit with two inputs,  $A$  and  $B$ , one output,  $Z$ , and a clock input,  $CLK$ . The circuit is to change states only on the rising edge of the clock. The circuit is to be designed as a Mealy model, and is to behave as follows.
  1. On reset,  $Z=0$ .
  2. Whenever  $Z=0$ ,  $Z$  changes to 1 if and only if, while  $A=1$ , the values of  $B$  at two consecutive clock transitions are 0-1 (in that order).  $Z$  should change as soon as  $B$  becomes 1 in the second clock period.
  3. Whenever  $Z=1$ ,  $Z$  changes back to 0 if and only if, while  $B=0$ , the values of  $A$  at two consecutive clock transitions are 0-1.  $Z$  should change as soon as  $A$  becomes 1 in the second clock period.

(HINT: This should require four states.)

Show all steps of the design process, beginning with a state diagram and showing how circuit equations are derived from it. Implement the design two ways, one using D flip flops and one using JK flip flops, sketching the schematic diagram of each solution.

3. Discuss (in detail) how you would test the circuit of problem 2, i.e. what input sequences would you apply to the circuit to verify its behavior?