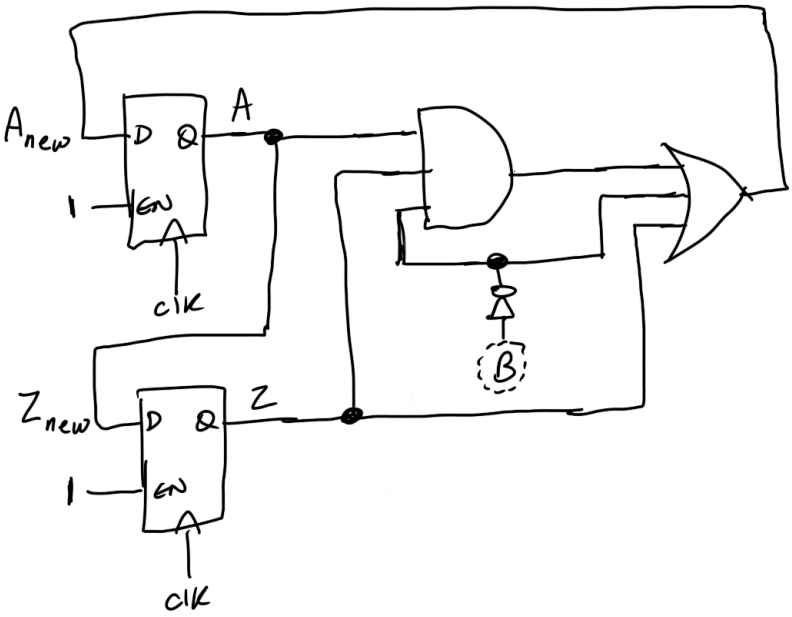
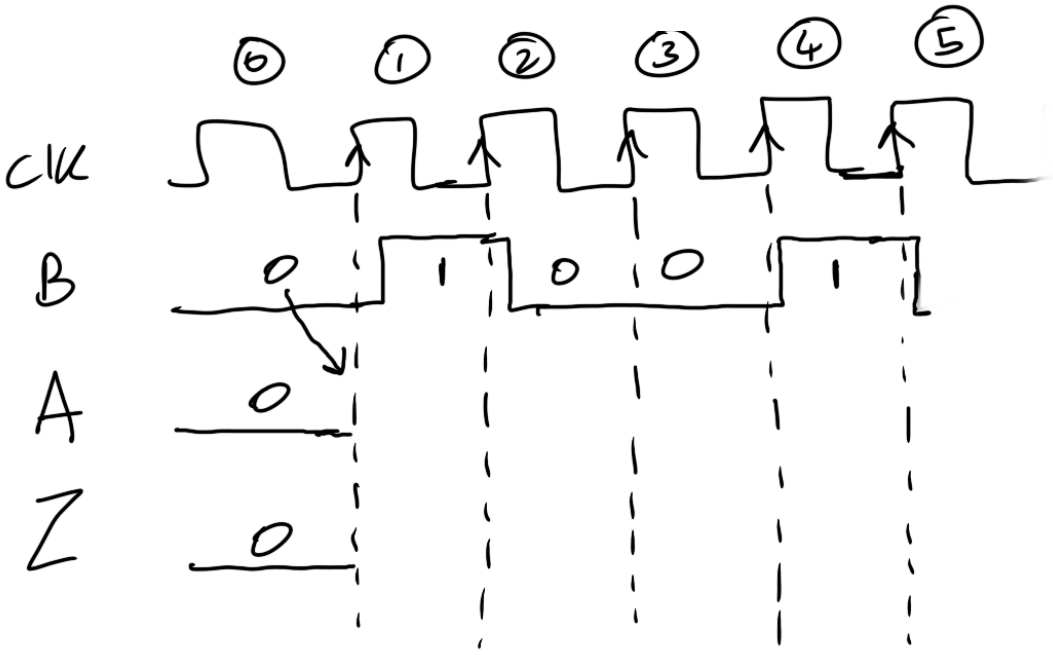
CMSC313 Mid-term Make-up Exam **Name:**

Closed book/notes. No electronics. (3 pages)
A lot of hints are provided below, no additional hints will be provided. If you have to make any additional assumptions, please list them out and continue solving the problem, showing work.

1. 25 points
Complete the timing diagram for the following circuit. Fill in the values for registers A and Z for clock cycles 1 to 5. Label values as 0 or 1 for both A and Z for each of the 5 clock cycles. The values for A and Z would be dependent on control parameter labelled as B as shown in the block diagram below.
Hint: For values of A and Z for cycle 1, find A_{new} and Z_{new} values in cycle 0. A_{new} is based on A, B and Z. Remember that A gets the value of A_{new} at the rising edge of clock going from cycle 0 to cycle 1.





2. Create a Finite State Machine to handle the following requirements. There is an input A that is 0 or 1. The output Z should be set to 1 if A goes through a sequence of 1->0->1. So if A is 1 in cycle 1, 0 in cycle 2, 1 in cycle 3, Z should go to 1 for cycle 3. And if A goes to 0 in cycle 4 and A goes to 1 in cycle 5, Z should go to 1 for cycle 5 as well because cycle 3,4,5 have a sequence of 1->0->1.
The design can use either Mealy or Moore state machine.
Hint: Start with the default/reset state called InitZero and assume that A was always 0 before. Create transition diagram showing what the new state should be in the next cycle for all values of inputs (A=0,1).

a. Transition Diagram (20 points).
b. Assign binary values to each state (5 points). Hint: If there are 1~2 states in the transition diagram, 1 bit of state is needed. If there are 3~4 states, 2 bits of state are needed, etc.
c. Truth Table (20 points)
d. Equations (for new value of state bit(s) and output) (20 points). Use any approach to show simplified equations. Show all work.
e. Block diagram, showing registers for each of the state bit(s) and combinational logic for the D inputs of the state bit(s) and the combinational logic for Z output. (10 points)

Bonus (10 points):
Simplify A_{new} equation.

Bonus (5 points):
Describe how A and Z are related.