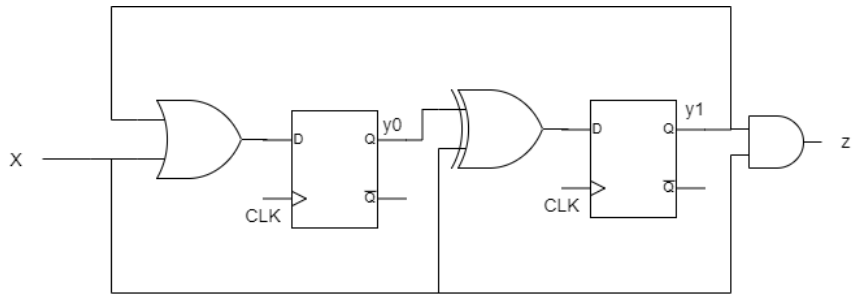
COMPUTER ARCHITECTURE UNIT 1 - 11/01/2022 (A)

Exercise 1 (4+2 points): Analyze the circuit in figure (up to the minimal automaton). Then, provide the temporal diagram of the circuit with the input sequence 110010.



Exercise 2 (7 points): Design a sequential circuit with one input x and two outputs z1 and z0. Output z1 must be 1 if the last three input bits exactly contain two 1s, while z0 must be 1 if the last two bits are equal. Use an SR FF for the MSB and T FFs for the remaining bits.

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Example:  x   0101110010000011
          z1  0001101000000001
          z0  0000110100111101
```

Exercise 3 (3 points): By using Boolean algebra, prove that:

$$(\bar{a} \oplus b) + \overline{\overline{(ac + \bar{b})}(a + bc)} = \bar{a} + b + c$$

Exercise 4 (4 points): Interconnect 4 registers R1…R4 through a bus so that:

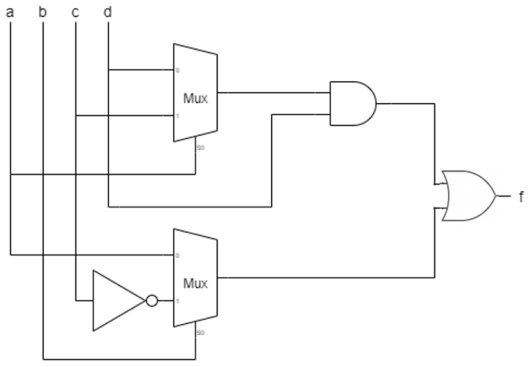
- If R1 is even, then the content of R2 goes into R3 and R4
- otherwise, the content of R3 goes into R1 and R2.

Movements are enabled only if the maximum between R1 and R2 is multiple of 4.

Exercise 5 (4 points): Given X = < 0 ; 10000 ; 0010000000 > and Y = < 1 ; 01111 ; 0100000000 > in IEEE half-precision format, calculate X+Y and represent the result both in IEEE half-precision and in decimal notation.

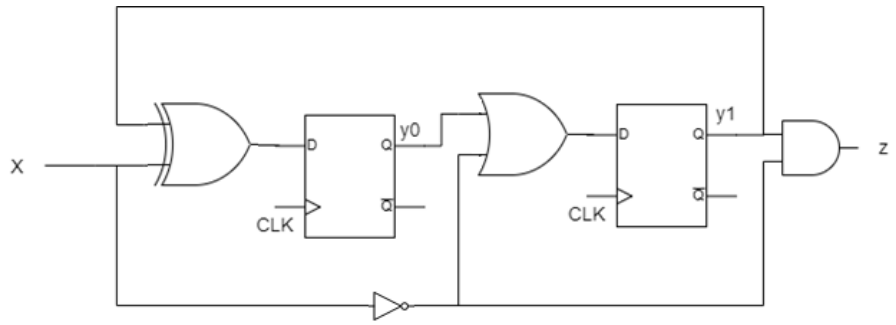
Exercise 6 (2+1+1+2 points)

- Consider the circuit in figure and write down the BE of function f
- Write the truth table for f
- Write the minimal POS expression for f
- Write f in ALLNOR form.



COMPUTER ARCHITECTURE UNIT 1 - 11/01/2022 (B)

Exercise 1 (4+2 points): Analyze the circuit in figure (up to the minimal automaton). Then, provide the temporal diagram of the circuit with the input sequence 100110.



Exercise 2 (7 points): Design a sequential circuit with one input x and two outputs z1 and z0. Output z1 must be 1 if the last three input bits represent an odd negative number, while z0 must be 1 if the last two bits are different. Use an SR FF for the MSB and T FFs for the remaining bits.

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Example:  x   011110010000011
          z1  000110000000000
          z0  010001011000010
```

Exercise 3 (3 points): By using Boolean algebra, prove that:

$$\overline{\overline{(ab + c)}(a + bc)} + (a \oplus \bar{c}) = \bar{a} + b + c$$

Exercise 4 (4 points): Interconnect 4 registers R1…R4 through a bus so that:

- If R1 is odd, then the content of R3 goes into R2 and R4
- otherwise, the content of R2 goes into R1 and R3.

Movements are enabled only if the minimum between R1 and R2 is not multiple of 4.

Exercise 5 (4 points): Given X = < 1 ; 10001 ; 0100000000 > e Y = < 0 ; 10000 ; 1100000000 > in IEEE half-precision format, calculate X+Y and represent the result both in IEEE half-precision and in decimal notation.

Exercise 6 (2+1+1+2 points)

- Consider the circuit in figure and write down the BE of function f
- Write the truth table for f
- Write the minimal POS expression for f
- Write f in ALLNOR form.