EE3230 VLSI Design, Fall 2021
Homework #3
Due Date : 2021/11/30

Note

1. Do the simulation and analysis with cic018.l.
2. Power supply (VDD) = 1.8V.
3. Use .tran 0.01p XX for simulation

Part Ⅰ (42%)

1. Design a SR latch as shown in Fig. 1. Assume CLK=100MHz with tr=tf=10ps, duty cycle=50%. (7%)
2. Simulate and find the setup time of this latch. (7%)
   Note1：For a positive latch, setup time and hold time of this latch are defined as Fig. 2.
   Note2：Give S=!R for question 2., 3., 4. and 5.
3. Same as above, simulate and find the hold time of this latch. (7%)
4. Simulate the S to Q delay tpsq and R to QB delay tprqb. (7%)
5. Sweep Vdd and find the operation voltage of this latch.
6. Complete the layout of this design. The layout should measure the area. (8%)
   Note：Area of the layout is the area of the minimum single rectangle that can cover all circuits.
7. Run the post-layout simulation (post-sim) and compare it with pre-simulation(2., 3., 4. and 5.) (pre-sim) (7%)

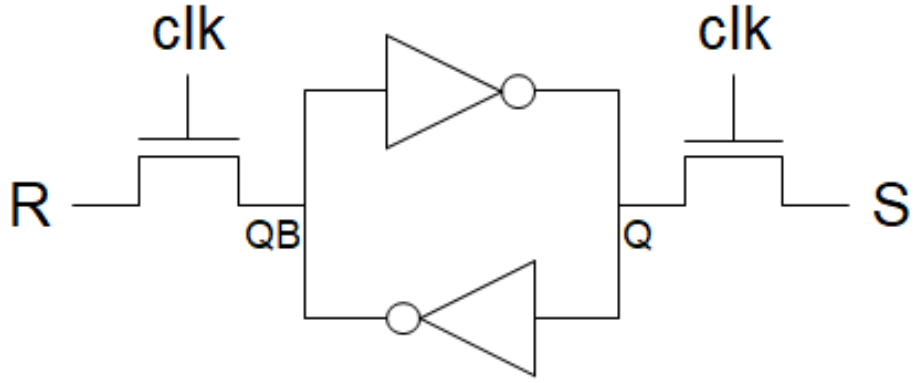

Fig. 1.

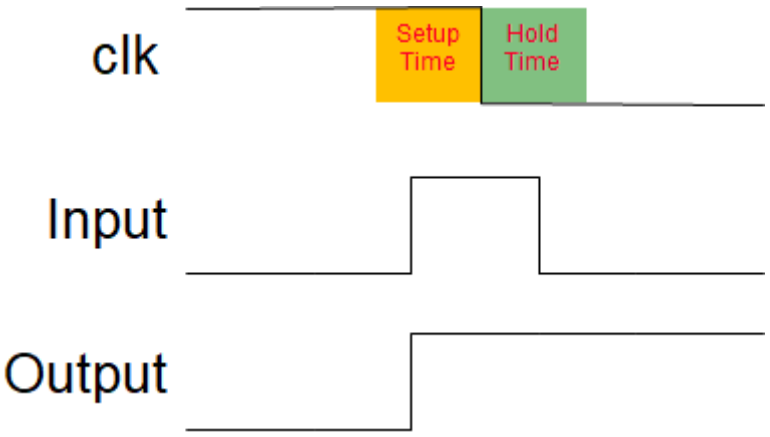

Fig. 2.

Part Ⅱ (43%)

1. Design a master-slave positive-edge-triggered D flip-flop as shown in Fig. 3. Assume CLK(C)=100MHz with tr=tf=10ps, duty cycle=50%. (7%)
2. Simulate and find the setup time of this flip-flop. (7%)
3. Simulate and find the hold time of this flip-flop. (7%)
4. Simulate the clock to Q delay tpcq. (7%)
5. Complete the layout of this design. The layout should measure the area. (7%)
   Note：Area of the layout is the area of the minimum single rectangle that can cover all circuits.
6. Run the post-layout simulation (post-sim) and compare it with pre simulation (2., 3. and 5.) (pre-sim) (7%)

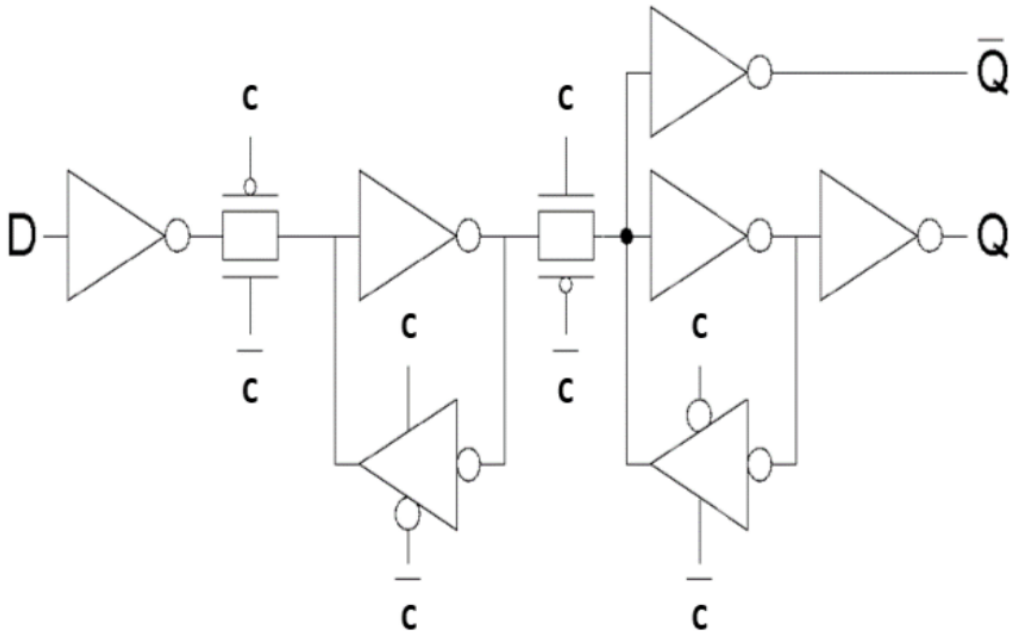

Fig. 3.

Part Ⅲ (15%)

Comment and Compare between Latch in Part Ⅰ and DFF in Part Ⅱ. (at least three comparisons) (each for 5%))

Submission

1. Report (HW3_StudentID_NAME.pdf)
    a. Picture of schematic
    b. Picture of waveform with cursor values
    c. Picture of area of the layout with markers
    d. Your comment
2. Hspice code file (.sp)
3. Netlist files (.spi)
4. Gds files (.gds)