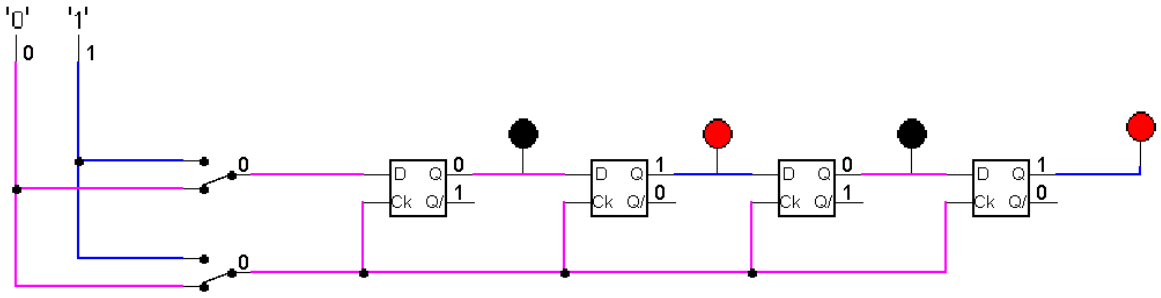
Instruction:

Complete all questions in **2 hours.**

1. Construct 4 bit Serial In parallel Out shift register using D- flip flop. Explain the Working mechanism of the circuit taking Serial input 1010. Also draw the timing diagram according to the given input.

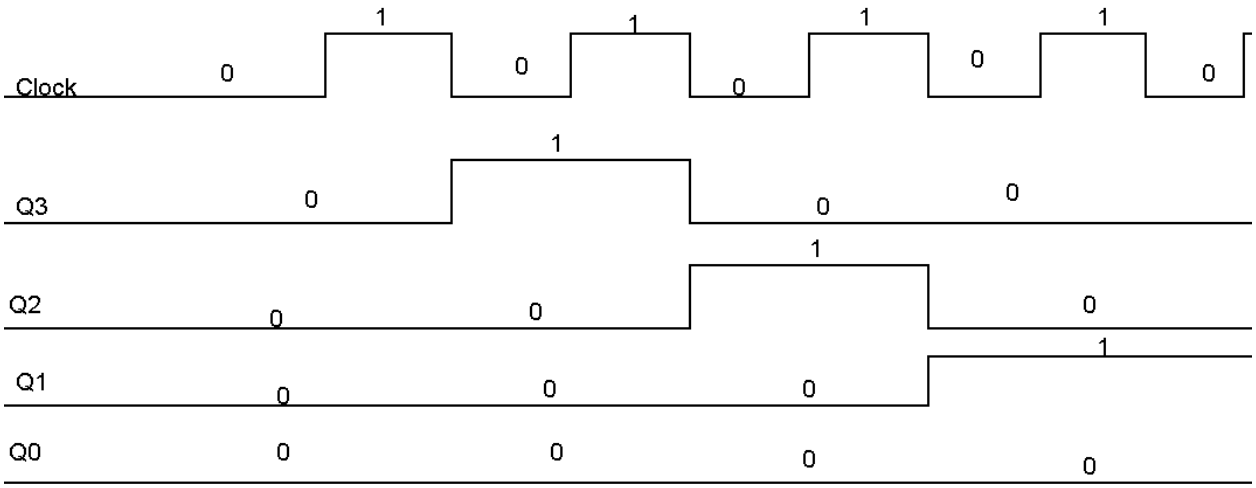


Prepared by Apeksha

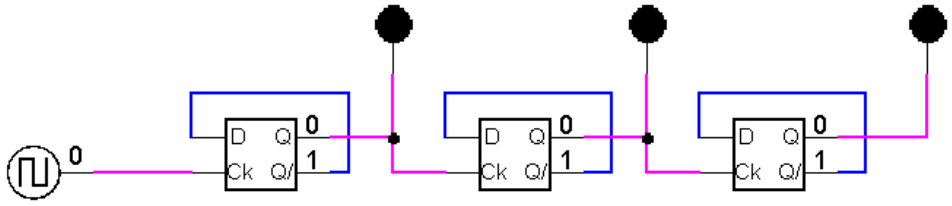
The above circuit is a 4 bit Serial In Parallel Out(SIPO) shift register. It is made by constructing D- flip flops in a line. In the beginning, the clock is in its initial state and all the outputs are zero. Then, 0 is passed. The output will not change. After that when 1 is passed in the second rising edge of the clock, the output in the first D flip flop will change to 1 and the output of other flip flops will remain unchanged. And similarly when 0 input is passed in the third rising edge of clock then again the output of first D flip flop will be zero but as the first flip flop has its stored memory so the output of the second flip flop will be changed to 1. This process will continue.

Clock	Input	Q3	Q2	Q1	Q0
↓	Initially	0	0	0	0
↑	0	0	0	0	0
↑	1	1	0	0	0
↑	0	0	1	0	0
↑	1	0	0	1	0

Time diagram:



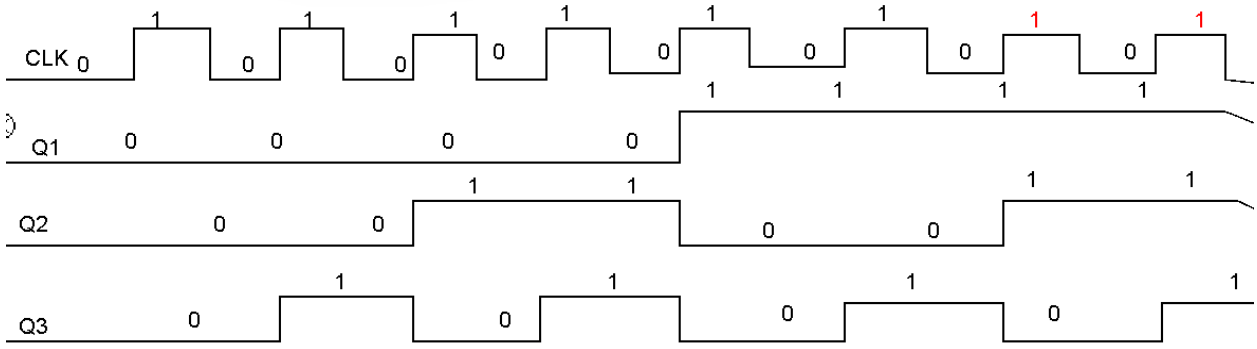
2. Design a 3 bit counter using Toggle D flip flop and draw the timing diagram.



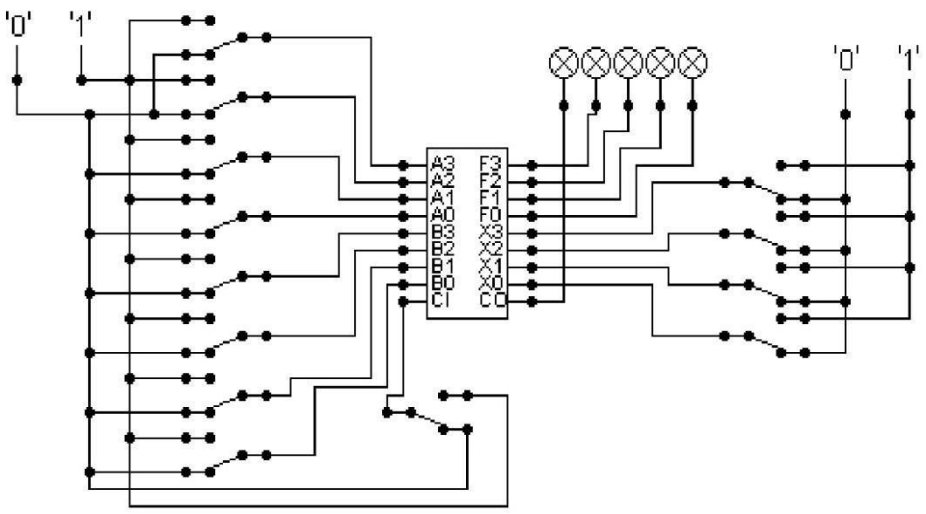
Prepared by Apeksha

Time Diagram:

clock	Q1	Q2	Q3
↑	0	0	0
↑	0	0	1
↑	0	1	0
↑	0	1	1
↑	1	0	0
↑	1	0	1
↑	1	1	0
↑	1	1	1



3. Load alu.cct file from the logsim folder. The circuit should look like this



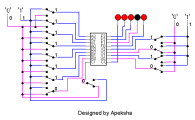
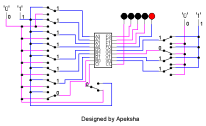
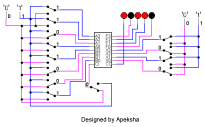
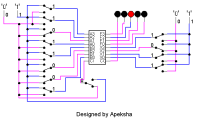
The circuit behaves like a simple arithmetic logic unit. The inputs A0-A3 represent a 4 bit binary number. Inputs B0-B3 represent another binary number. A0 and B0 are the least significant bits respectively. The following table details the functions supported by the chip. All other control lines = 0.

Function	Add	Subtract
X3-X0	1010	1011

i) Use A= 15 and B = 7

ii) Use A = 13 and B = 9

Write the corresponding result of the operations.

Function	Inputs	Results	Logsim Image
Add	A= 15 B= 7	0110	
Subtract	A= 15 B= 7	1000	
Add	A=13 B=9	0110	
Subtract	A=13 B=9	0100	

Thank you.