MULTIMEDIA UNIVERSITY

PDS0101 Introduction to Digital Systems
Tutorial 10

Tutorial outcomes

By the end of today's tutorial, you should be able to

- identify data movement patterns in shift registers
- explain the serial in/out, serial in/parallel out and parallel in/serial out register operations
- setup a ring counter and/or Johnson counter using shift registers

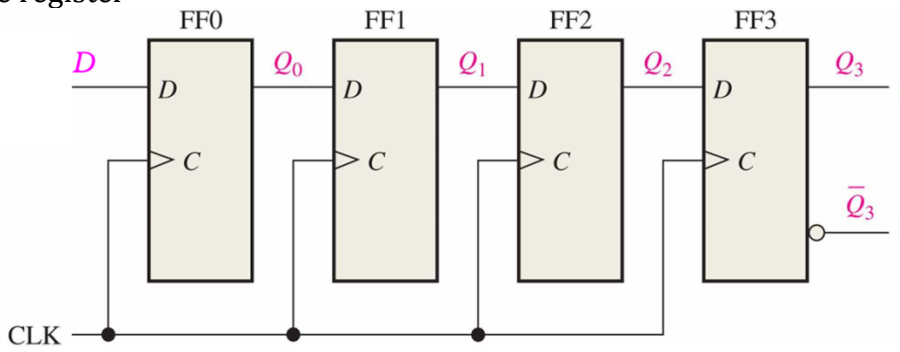
Theory based questions

1. Draw the logic circuit diagram for a 3-bit serial in/serial out shift register – what FFs do you use?

2. Revise the circuit from (1) to create a 3-bit serial in/parallel out shift register

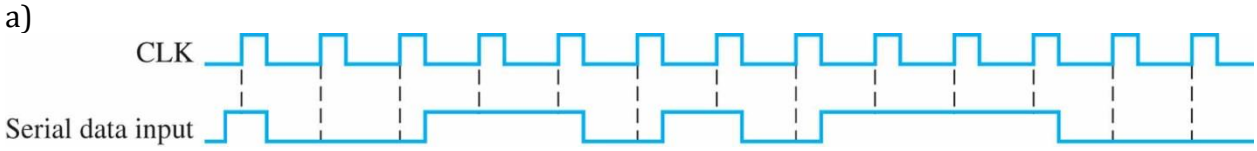
3. The sequence 1011 is applied to the input line of a 4-bit serial shift register. If the register is initially cleared, what is the state of the register after 3 clock pulses?

4. Identify the shift register shown in the diagram below. Then identify which is the input and output for the register

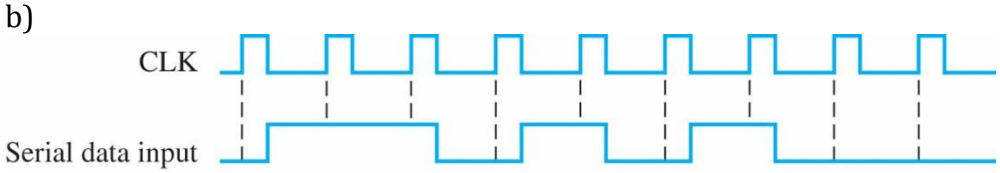


5. Using the register above in (4), determine the state of each flip-flop and show the Q waveforms in with the data inputs and clock timing diagrams shown below. The register has all 1's in each FF when it begins.

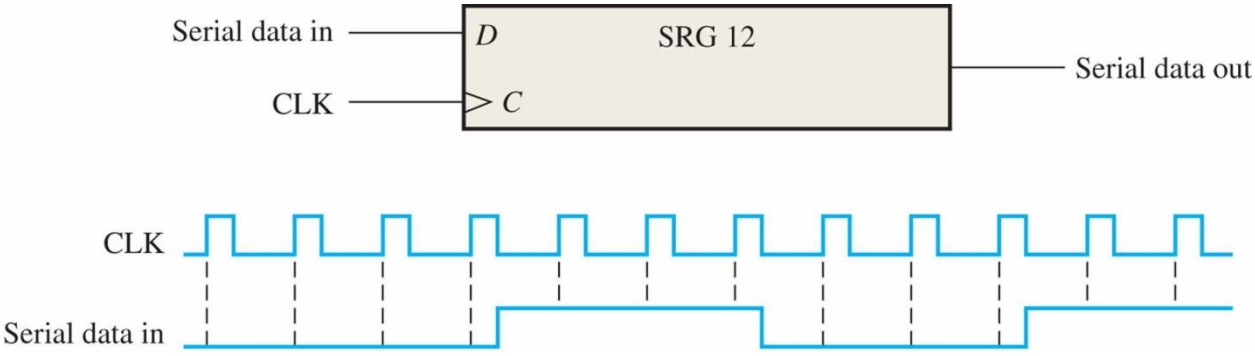
a)



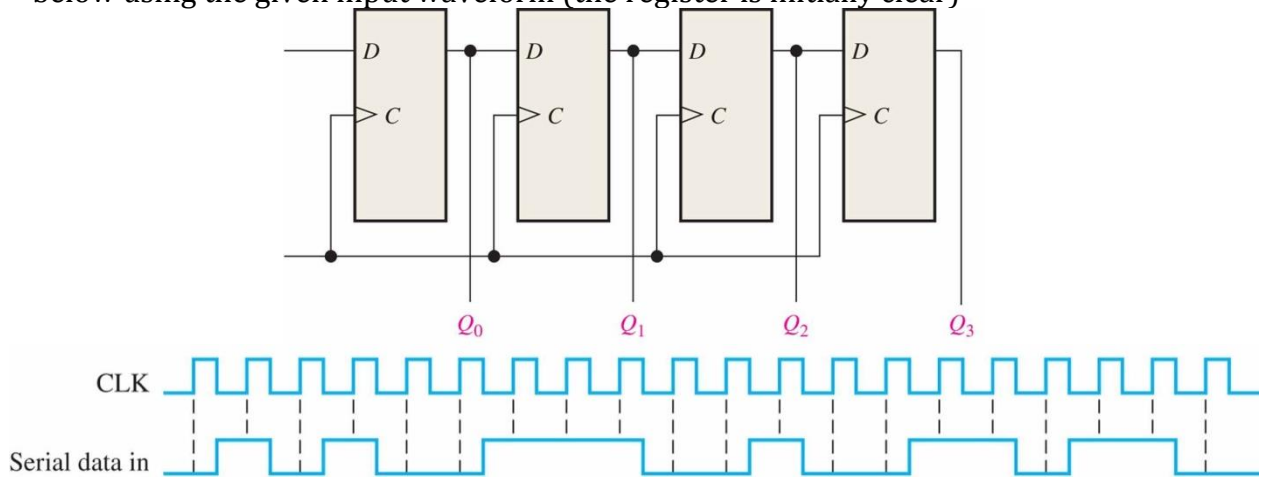
b)



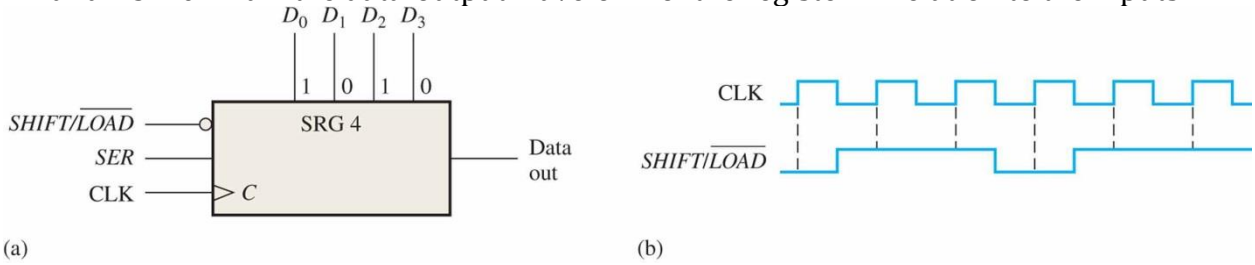
6. What is the state of the register below after each clock pulse if it starts in the 101001111000 state?



7. Identify and show the timing diagram including the parallel outputs for the shift register below using the given input waveform (the register is initially clear)



8. The parallel in/serial out register below has the SHIFT/LOAD and CLK inputs as shown in the timing diagram below. The parallel data inputs are constant at D0 = 1, D1 = 0, D2 = 1 and D3 = 0. Draw the data-output waveform of the register in relation to the inputs



9. Determine the number of flip-flops required to implement each of the following in a Johnson counter configuration
   a. modulus-6
   b. modulus-10
   c. modulus-14
   d. modulus-16

10. Draw the logic diagram for a modulus-18 Johnson counter using J-K flip-flops and show the timing sequence of its flip-flops in tabular form. How would the sequence change if it were a ring counter instead?