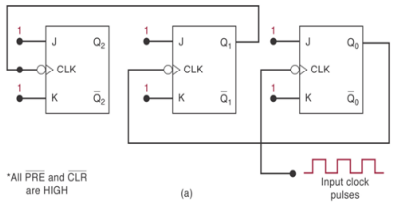
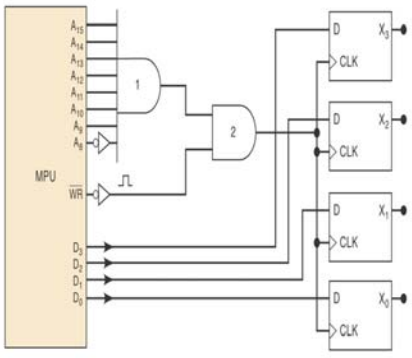
Example 5 - 14

- If the circuit of 3-bit counter is changed to have 6 FFs:
  - Determine the counter's MOD number
    - MOD number = $2^6 = 64$
  - Determine the Frequency of the last FFs (Q5) when the input frequency is 1 MHz
    - f = 1MHZ/64 = 15.625 kHz
  - What is the range of counting states for this counter?
    - 000000 to 111111 (0 to 63), number of states = 64
  - Assume a starting state (000000). What will be the counter's state after 129 pulses?
    - Counter will be back to its starting state every 64 pulses. So the 129th Pulse will bring the counter to state (000001)



Example 5 - 15

- What address code must MPU generate in order for the data to be transferred into X?
  - $(A_{15}..A_8) = (11111110)$
- Assume that X3-X0 = 0110, A15-A8 = 11111111, D3-D0 = 1011. What will be the contents of X after WR* pulse occurs?
  - Since $A_8 = 1$, X register will not be addressed and the content will not change (0110)

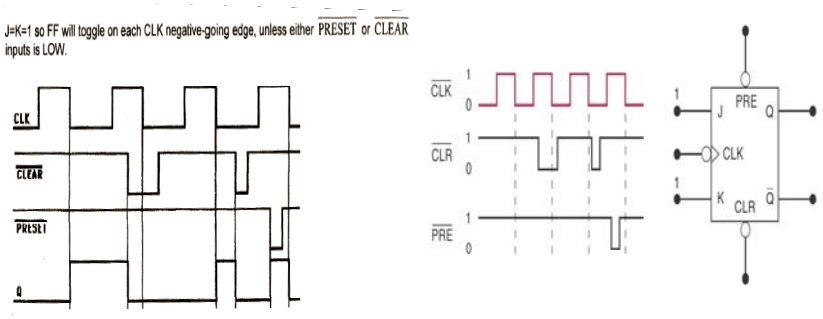


Midterm II Review - Topics

- **Digital Arithmetic (Chapter 6)**
  - Binary addition, signed numbers representation, 2's complement, Subtraction in 2's complement, overflow
  - Multiplication/Division of binary numbers
  - Arithmetic circuits (ALU), parallel binary adder, Design of a Full Adder
  - ALU integrated circuits (74382)
- **Flip-Flops & Related Devices (Chapter 5)**
  - NAND/NOR Latch
  - Clocked FF (SC, JK, D)
  - FFs timing consideration
    - Setup/hold time.
  - FFs Application
  - Parallel/Serial Data Transfer
  - Frequency Divider/Counting
    - Asynchronous counter
      - MOD number
      - State Transition Diagram

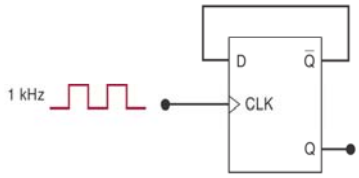
Problem - 1

- Determine the Q waveform for the J-K FF. Assume that Q = 0 initially. (Hint: the asynchronous inputs override all other inputs) :



Problem 2

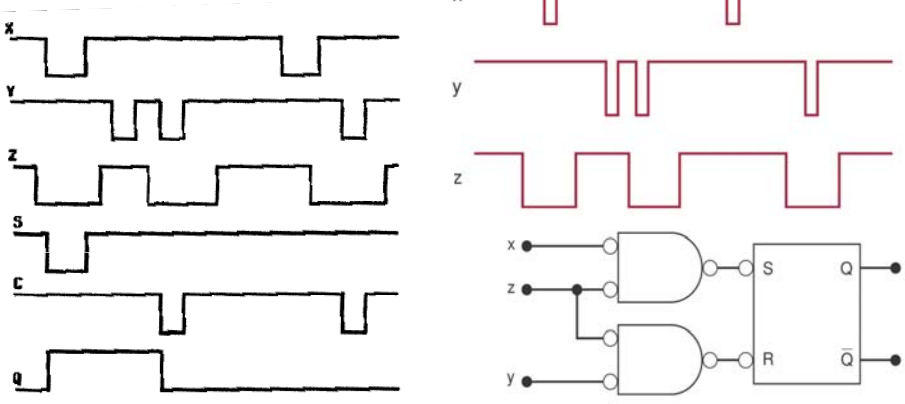
- An edge-triggered D flip-flop can be made to operate in the toggle mode by connecting it as shown.
  - Assume that Q = 0 initially, determine the Q waveform
  - Change the circuit so that Q is connected back to D, then determine the Q waveform.



  - If Q initially = 0, then Q is ½ frequency of the clock, 500 Hz
  - If Q is connected to D, then Q will not change as clock applied.

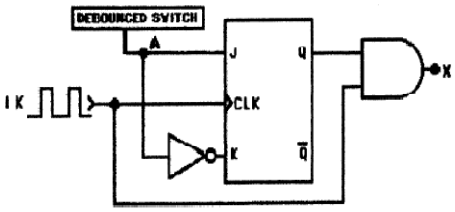
Problem 3

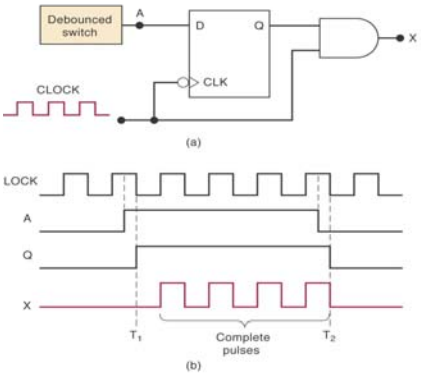
- Assume Q = 0 initially, determine the Q waveform.



Problem 4

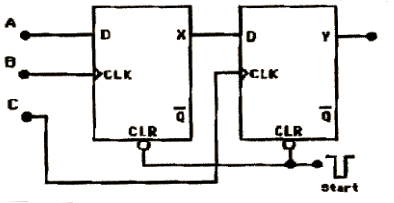
- Modify the circuit to use a JK FF instead.

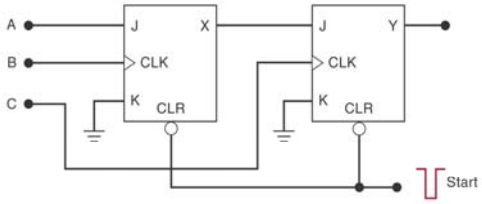




Problem - 5

- The following circuit has inputs A, B, and C all initially LOW. Output Y is supposed to go HIGH only when A, B, and C go HIGH in a certain sequence.
  - Determine the sequence that will make Y go HIGH.
  - Explain why the start pulse is needed.
  - Modify the circuit to use D FFs.





  - Y will go High if C goes high while X is High. X can go High only if B goes High while A is High, the correct sequence A, B, C.
  - The Start pulse is used to clear the FF X, Y before applying the ABC signals.