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1. The contents of a four-bit register is initially 0110. The register is shifted six times to the right with the serial input being 1011100. What is the content of the register after each shift?

2. The serial adder of Fig. 6.6 uses two four-bit registers. Register A holds the binary number 0101 and register B holds 0111. The carry flip-flop is initially reset to 0. List the binary values in register A and the carry flip-flop after each shift.

3. A flip-flops has a 3 ns delay from the time the clock edge occurs to the time the output is complemented. What is the maximum delay in a 10-bit binary ripple counter that uses these flip-flops? What is the maximum frequency at which the counter can operate reliably?

4. Using D flip-flops, design a counter with the following repeated binary sequence: 0, 1, 2, 4, 6.

5. (Verilog) You will be asked to design a "zero-detector" system. Zero-detector takes a bit sequence as input, and will output 1 if two or more consecutive *zeros* are detected in the input sequence. Denote the input signal by x and output by y.

   (a) Draw a state table.

   (b) Based on the state table, derive the logic for the next state. That is, express the next state as a function of present state and x. You should obtain the minimal expression, i.e., use K-map method if applicable.

   (c) Derive the output as a function of state variables.

   (d) Draw a state diagram.

   (e) Implement the verilog code for zero-detector. In the attached file "hw6.v", you can fill in the module "one_detector". Do not change anything else.

   (f) Run GTKWave and view waveform. You need to capture waveforms for the following signals from `main` module:
     - `CLOCK`
     - `p_state[1:0]`
     - `t_reset`
     - `x_in`

   Print out the captured waveform using the following instruction
     - When you run GTKWave, go to menu and select "View"→"Use Black and White"
     - Go to menu "File"→"Grab to File". This captures the waveform window.
     - Save the capture, and print it out. Your captured printout should show the signal waveforms ranging from time 0 to at least time 150 sec.