Digital Logic Problem Set #8

Revision: August 5, 2025

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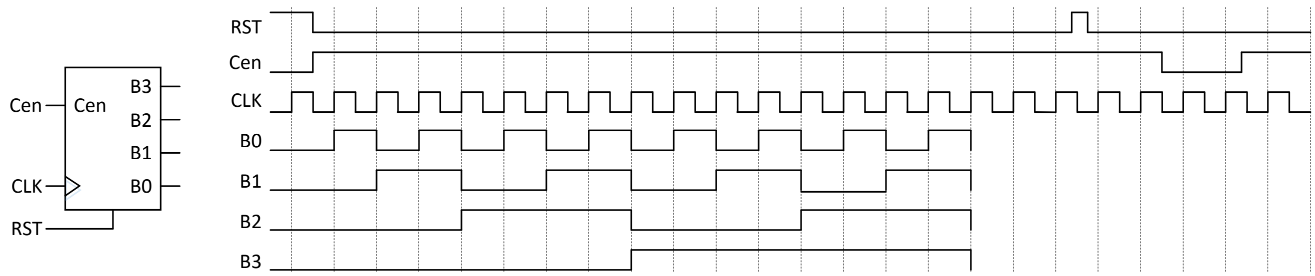
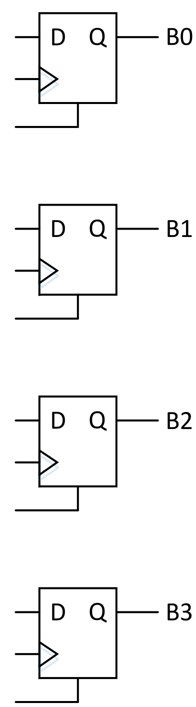
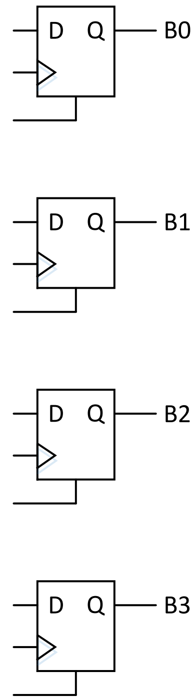
1. (12 points) Complete the timing diagram below to illustrate the behavior of the counter.



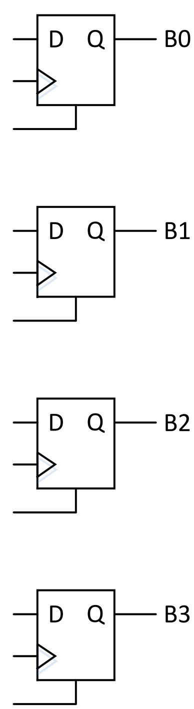
2. (12 points) Complete the circuit sketch for a four-bit synchronous binary counter by adding the required next-state logic gates in front of the flip-flops. (Hint: you can possibly sketch a circuit directly by observing that each more significant bit changes state when all the previous bits are a '1', or you can create K-maps and loop out minimum circuits… watch for XOR's)!



3. (8 points) Complete the circuit sketch for a four-bit asynchronous binary counter by adding the required logic gates.



4. (8 points) Complete the circuit sketch for a four-bit Johnson (or "ring") counter by adding the required logic gates.



5. (12 points) For the following questions, write "A" (for a synchronous binary counter), "B" (for an asynchronous binary counter), or "C" (for a Johnson or Ring counter) after the question to indicate which counters have the property or characteristic described.

Creates 2^N binary numbers from N flip-flops _______________

Creates 2xN binary numbers from N flip-flops _______________

Suffers from output bit skew in higher order bits _______________

Can be limited in operating frequency by next-state logic delays _______________

Outputs can be used as clocks for other circuit blocks _______________

Generates numbers in a natural counting sequence (i.e., 0, 1, 2, 3, etc.) _______________