

## Computer Engineering Oral Screening Exam: Fall 2004

### Level 0:

1. What is the difference between a latch and a flip-flop?
2. Assume that I can implement a Boolean function in a way that uses more than 2 levels of logic. What might be the advantage of such an implementation over one that uses only 2 levels of logic? What is the disadvantage?
3. What is a tri-state buffer? Why is it useful?

### Level 1:

Build a counter that can count from 0 to 15 and then wraps around. Use only D flip-flops as memory elements. The counter must be able to perform both serial and parallel load. Draw the schematic for this counter. Clearly label inputs and outputs.

### Level 2:

Given four n-bit registers R0, R1, R2 and R3, build the datapath and control of a dedicated circuit that implements the mean (i.e. average) of the four numbers stored in the registers. (Assume that Data is loaded to these registers and the registers contents remain constant until the computation of the mean is completed.) In your implementation, use intermediate-level building blocks such as adders, muxes, shifters, counters, encoders and decoders.

(Proceed in the way that you find the most productive. However, one possible strategy is to (1) state the algorithm you plan to use, (2) draw the ASM chart, (3) draw the datapath, (4) explain how control works.)