ES 4 exam 2 study guide

The second exam will be comprehensive in that the material in the second half of the course builds on the material from the first half, but all of the questions will involve the second-half material. For example, you might have to use a K-map to design a state machine, but we won't ask you to do a K-map from a given truth table.

Latches and flip-flops

- Given a circuit containing a D latch or a D flip-flop, draw a timing diagram to illustrate how and when the output changes.
- Write VHDL code to create D flip-flops, and explain how the lines of VHDL work to describe a flip-flop.
- Identify the behavior that results from various VHDL sensitivity lists, and draw a timing diagram illustrating that behavior.
- Explain why we often prefer flip-flops over latches.

Basic sequential circuits

- Sketch the general structure of a sequential circuit.
- Draw a schematic for a binary counter, shift register, one-hot counter, and LFSR.
- Given a short snippet of VHDL code, draw the circuit that will be created
- Write VHDL code to describe counters, shift registers, and other sequential circuits (similar to the VHDLweb problems)

State machines

- Explain what a state machine is in terms someone just beginning this course could understand
- Explain the difference between a Mealy and Moore state machine
- Given an English description of a system, do the following for both Moore and Mealy implementations:
  - Draw the state diagram
  - Determine how many bits of state are necessary, and choose state encodings
  - Write truth tables and logic equations for the state transitions and outputs
  - Draw the complete logic circuit diagram for the FSM

Timing sequential logic

- Define setup time and hold time, and annotate them on a timing diagram
- Given a sequential circuit and a table of gate/flip-flop delays, draw a timing diagram and calculate the maximum frequency at which the circuit could run.
- Given a circuit, explain how temporal and spatial parallelism could be applied to increase the overall throughput.

Memory

- Describe how a memory is organized in terms of bits, bytes, words, addresses, etc.
- Sketch a block diagram for a RAM or ROM, showing the widths of the input and output ports as appropriate.