# Introduction to Digital Design ECE 215
## Summer 2004 Test 3

1. What is the difference between serial and parallel transfer of an $n$-bit work? (4 points)

2. Explain how to convert serial data to parallel. What kind of register is needed? (4 points)

3. The content of a 4-bit shift register is intially 1101. The register is shifted right six times with the serial input being 101101. What is the content of the register after the final shift? (4 points)

4. Design a four bit shift register with parallel load using $D$ flip-flops (or express the design in Verilog). There are two control signals for the following operations: (10 points)

   | $S_1$ | $S_0$ | Register operation |
   |-------|-------|--------------------|
   | 0 | 0 | No change |
   | 0 | 1 | shift left (new bit enters from right) |
   | 1 | x | Load parallel data |

5. Design a decimal counter using $D$ flip-flops (or express the design in Verilog) (10 points)

6. Write a state diagram for a counter that steps through the sequence 1, 2, 3, 5, 7. (4 points)

7. Draw a block diagram of a memory unit. (6 points)

8. How many bytes are required for a memory with $k = 10$ address bits, and 16 bits per word? (4 points)

9. What is the difference between SRAM and DRAM in the way information is stored and in the way the memory is used. (4 points)

10. What is the difference between volatile and non-volatile memory? (4 points)

11. Can ROM be volatile? (2 point)

12. Explain the four basic types of ROM with respect to programming or reprogramming the memory. (8 points)

13. How is ROM used as a programmable logic device? (4 points)

14. What is the differerence between error correction and error detection?. (4 points)

15. What circuit elements are in a sequential programmable logical device (PLD) that are not found in a combinational PLD? (4 points)

16. How many gates in our Altera FLEX chip? (a) 700, (b) 7,000, (c) 70,000, (d) 700,000. (2 points)

17. What is the difference between a critical race and a non-critical race condition? (3 points)

18. Why do mechanical switches "bounce"? Give examples of circuts where the bounce matters and circuit where bounce does not matter. (5 points)

19. An asynchronous sequential circuit has two internal states and one output. The excitation and output functions are

$$
\begin{aligned}
Y_1 &= x_1 x_2 + x_1 y_2' + x_2' y_1 \\
Y_2 &= x_2 + x_1 y_1' y_2 + x_1' y_1 \\
z &= x_2 + y_2
\end{aligned}
$$

(a) Draw the logic diagram of the circuit (4 points)

(b) Derive the transition table and output map. (6 points)

20. Circle the stable states in the following transition diagram. (4 points)

$$x_1 x_2$$

| $y_1 y_2$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 00 | 10 | 00 | 01 |
| 01 | 11 | 10 | 01 | 11 |
| 11 | 00 | 11 | 10 | 11 |
| 10 | 00 | 10 | 11 | 10 |