Introduction to Digital Design ECE 215
Summer 2005 Test 3

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

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

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

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

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

6. Can ROM be volatile? (2 point)

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

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

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

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

11. Define the following terms (3 points each)

    (a) Hamming code

    (b) datapath

    (c) clock skew

    (d) synchronizer

    (e) macrocell

12. What are the three components of a digital system represented at the *register transfer level* (RTL)? (3 points)

13. List and give an example in RTL of the four types of operations most often encountered in digital systems. (8 points)

14. Draw the portion of an ASM chart starting from an initial state. There are two control signals x and y. If $xy = 10$, register R is incremented by one and control goes to a second state. If $xy = 01$, register R is cleared to zero and control goes from the initial state to a third state. Otherwise, control stays in the intial state. (5 points)

15. What may go wrong if you design an asynchonous system with two synchronizers? (4 points)

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

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

$$\begin{aligned} Y_1 &= x_1x_2 + x_1y_2' + x_2'y_1 \\ Y_2 &= x_2 + x_1y_1'y_2 + x_1'y_1 \\ z &= x_2 + y_2 \end{aligned}$$

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

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

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

y_1y_2 \ x_1x_2	00	01	11	10
00	00	10	11	01
01	11	00	10	01
11	00	11	01	11
10	00	10	00	10

19. Is the circuit corresponding to the above transition diagram stable or unstable? If it is unstable, identify the unstable cycle(s). (4 points)