Due: Tuesday, December 7, 2003

1. (10 points) Question A.13, page 494, Murdocca & Heuring
2. (10 points) Question A.29, page 497, Murdocca & Heuring
3. (10 points) Question B.10, page 542, Murdocca & Heuring
4. (10 points) Question B.11, page 542, Murdocca & Heuring
5. (60 points) This problem asks you to take the steps involved in the design process of a finite state machine. You will design a finite state machine that has a one bit input x and a one bit output z. The machine must output 1 for every input sequence ending in the string 0010 or 100. The output should be 0 in all other cases.

   [Adapted from *Contemporary Logic Design*, Randy H. Katz, Benjamin/Cummings Publishing, 1994.]

   (a) (10 points) In the space provided on the next page, draw the minimum state-transition diagram for the finite state machine described above. You must use the state-minimization algorithm described in class to show that the finite state machine has the minimum number of states. (*Hint:* You should have fewer than 8 states in your machine.)

   (b) (5 points) Use the state assignment heuristics described in class and pick *two* different state assignments for your finite state machine. *Note:* the bit pattern for the initial state must be 000.

   (c) (40 points) For each of the two state assignments:

      i. Fill in the truth tables with values for D flip-flops, for the output bit and for J-K flip-flops.

      ii. Use the Karnaugh maps provided to minimize the formulas for each column of the truth table.

      iii. Count the number of gates needed for each implementation.

   (d) (5 points) Should you use your first or second state assignment? D flip-flops or J-K flip-flops?

   Note: Keep a copy of your work for the last question. You will need it for DigSim Assignment 3.

CMSC 313 Homework 5 **Name: ________________________________**

Minimized State Transition Diagram (show work)

State Assignment:

	Assignment #1	Assignment#2
A	000	000
B		
C		
D		
E		
F		
unused		
unused		

ASSIGNMENT #1

Excitation Table for J-K Flip-Flops

Q	Q'	J	K
0	0	0	*d*
0	1	1	*d*
1	0	*d*	1
1	1	*d*	0

Truth Table:

	s2	s1	s0	x	s2'	s1'	s0'	z	j2	k2	j1	k1	j0	k0
0	0	0	0	0										
1	0	0	0	1										
2	0	0	1	0										
3	0	0	1	1										
4	0	1	0	0										
5	0	1	0	1										
6	0	1	1	0										
7	0	1	1	1										
8	1	0	0	0										
9	1	0	0	1										
10	1	0	1	0										
11	1	0	1	1										
12	1	1	0	0										
13	1	1	0	1										
14	1	1	1	0										
15	1	1	1	1										

Assignment #1: Karnaugh Maps for D Flip-Flops and the output

				s2	s2	
	s0 x \ s2 s1	00	01	11	10	
	00	0	4	12	8	
	01	1	5	13	9	x
s0	11	3	7	15	11	x
s0	10	2	6	14	10	
			s1	s1		

s2' =

# of gates =

				s2	s2	
	s0 x \ s2 s1	00	01	11	10	
	00	0	4	12	8	
	01	1	5	13	9	x
s0	11	3	7	15	11	x
s0	10	2	6	14	10	
			s1	s1		

s1' =

# of gates =

				s2	s2	
	s0 x \ s2 s1	00	01	11	10	
	00	0	4	12	8	
	01	1	5	13	9	x
s0	11	3	7	15	11	x
s0	10	2	6	14	10	
			s1	s1		

s0' =

# of gates =

				s2	s2	
	s0 x \ s2 s1	00	01	11	10	
	00	0	4	12	8	
	01	1	5	13	9	x
s0	11	3	7	15	11	x
s0	10	2	6	14	10	
			s1	s1		

z =

# of gates =

Total # of gates for D flip-flops (don't count z) =

Assignment #1: Karnaugh Maps for J-K Flip-Flops

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

j2 =

# of gates =

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

k2 =

# of gates =

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

j1 =

# of gates =

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

k1 =

# of gates =

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

j0 =

# of gates =

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

k0 =

# of gates =

Total # of gates for J-K flip-flops (don't count z) =

ASSIGNMENT #2

Excitation Table for J-K Flip-Flops

Q	Q'	J	K
0	0	0	*d*
0	1	1	*d*
1	0	*d*	1
1	1	*d*	0

Truth Table:

	s2	s1	s0	x	s2'	s1'	s0'	z	j2	k2	j1	k1	j0	k0
0	0	0	0	0										
1	0	0	0	1										
2	0	0	1	0										
3	0	0	1	1										
4	0	1	0	0										
5	0	1	0	1										
6	0	1	1	0										
7	0	1	1	1										
8	1	0	0	0										
9	1	0	0	1										
10	1	0	1	0										
11	1	0	1	1										
12	1	1	0	0										
13	1	1	0	1										
14	1	1	1	0										
15	1	1	1	1										

Assignment #2: Karnaugh Maps for D Flip-Flops and the output

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

s2’ =

# of gates =

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

s1’ =

# of gates =

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

s0’ =

# of gates =

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

z =

# of gates =

Total # of gates for D flip-flops (don’t count z) =

Assignment #2: Karnaugh Maps for J-K Flip-Flops

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

j2 =

\# of gates =

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

k2 =

\# of gates =

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

j1 =

\# of gates =

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

k1 =

\# of gates =

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

j0 =

\# of gates =

s0 x \ s2 s1	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

k0 =

\# of gates =

Total # of gates for J-K flip-flops (don't count z) =