Final Exam -- Open Book Section

14 December, 1994

The entire exam is to be turned in at 5:45 PM. Work the closed book section first and turn it in before you consult your books and notes to work on the open book section.

Name: _____

Problem 1. (15 points)

The state table for a sequential circuit with two state variables, *A* and *B*, one output *x*, and one output *z*, is shown in the five leftmost columns of the following table. Fill in the four righmost columns of the table with the appropriate inputs for two JK flip-flops implementing these state transitions

present state		input	next state		output	flip-flop inputs			
A	*B*	*x*	*A*	*B*	*z*	J_A	K_A	J_B	K_B
0	0	0	0	0	0				
0	0	1	0	1	0				
0	1	0	1	0	0				
0	1	1	0	1	0				
1	0	0	0	0	0				
1	0	1	1	1	0				
1	1	0	1	0	0				
1	1	1	0	1	1				

Now, derive minimal sum-of-product implementations for K_A and J_B, two of the inputs to the *A* and *B* flip-flops. Be sure to show how you derived your answers.

K_A =

J_B =

Next, draw the state diagram (*cf.*, Figure 1-27, p. 33) for the sequential circuit's state table in the space below.

Problem 2. (10 points)

Show the hardware needed to implement the following RTL statements for eight-bit registers R1 and R2 and control inputs *r*, *s*, and *t*.

r : R1 ← R1 + R2

r s : R2 ← 0

t': R1 ← R2, R2 ← R1

You may use eight-bit registers, multiplexers, adders, and the usual selection of logic gates in your solution.

Problem 3. (10 points)

Assuming the following values for eight bit registers R1 and R2

R1 = 11101100

R2 = 00011101

What are the values of the following expressions

R1 - R2

R1 ∧ R2

ashr R1 ashr is arithmetic right shift

cshl R1 cshl is circular left shift

Problem 4. (5 points)

How would you set the control inputs of the bus system shown in Figure 5-4 on page 130 of the textbook to execute the following RTL statement?

DR ← DR + 1, PC ← AC

Problem 5. (5 points)

What *sequence* of microinstructions as described in Table 7-1, page 224, will place the contents of the DR register into the PC register.

Problem 6. (10 points)

Show how to compute the following Pascal statements

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N := N + 1 ;
FACT := N + FACT ;
```

using the assembly language of the textbook.

Problem 7. (5 points)

In the bus system shown in Figure 5-4 on page 130 of the textbook, the PC register has three control inputs, LD, INR, and CLR. Derive Boolean equations for minimal sum-of-products circuits to control *two* of the three register inputs. You choose the two. Choose wisely.