

Department of Electrical and Computer Engineering  
The University of Texas at Austin

EE 360N, Fall, 2002

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Exam 1, October 9, 2002

Name: \_\_\_\_\_

TA Name: \_\_\_\_\_

Problem 1 (9 points): \_\_\_\_\_

Problem 2 (9 points): \_\_\_\_\_

Problem 3 (12 points): \_\_\_\_\_

Problem 4 (20 points): \_\_\_\_\_

Problem 5 (15 points): \_\_\_\_\_

Problem 6 (15 points): \_\_\_\_\_

Problem 7 (20 points): \_\_\_\_\_

Total (100 points): \_\_\_\_\_

Note: Please be sure that your answers to all questions (and all supporting work that is required) are contained in the space provided.

Note: Please be sure your name is recorded on every sheet of the exam. Recall, 5 points will be deducted from the final grade for each page on which your name does not appear.

**GOOD LUCK!**

Name: \_\_\_\_\_

Question 1 (9 pts)

a) The LC-2 adds the two 2's complement numbers 0101010101010101 and 0011100111001111, producing 1000111100100100. Is there a problem here. If yes, what is the problem? If no, why not?

b) We wish to execute a single LC-2 instruction that will subtract the decimal number 20 from Register 1 and put the result into Register 2.

Can we do it? If yes, do it:

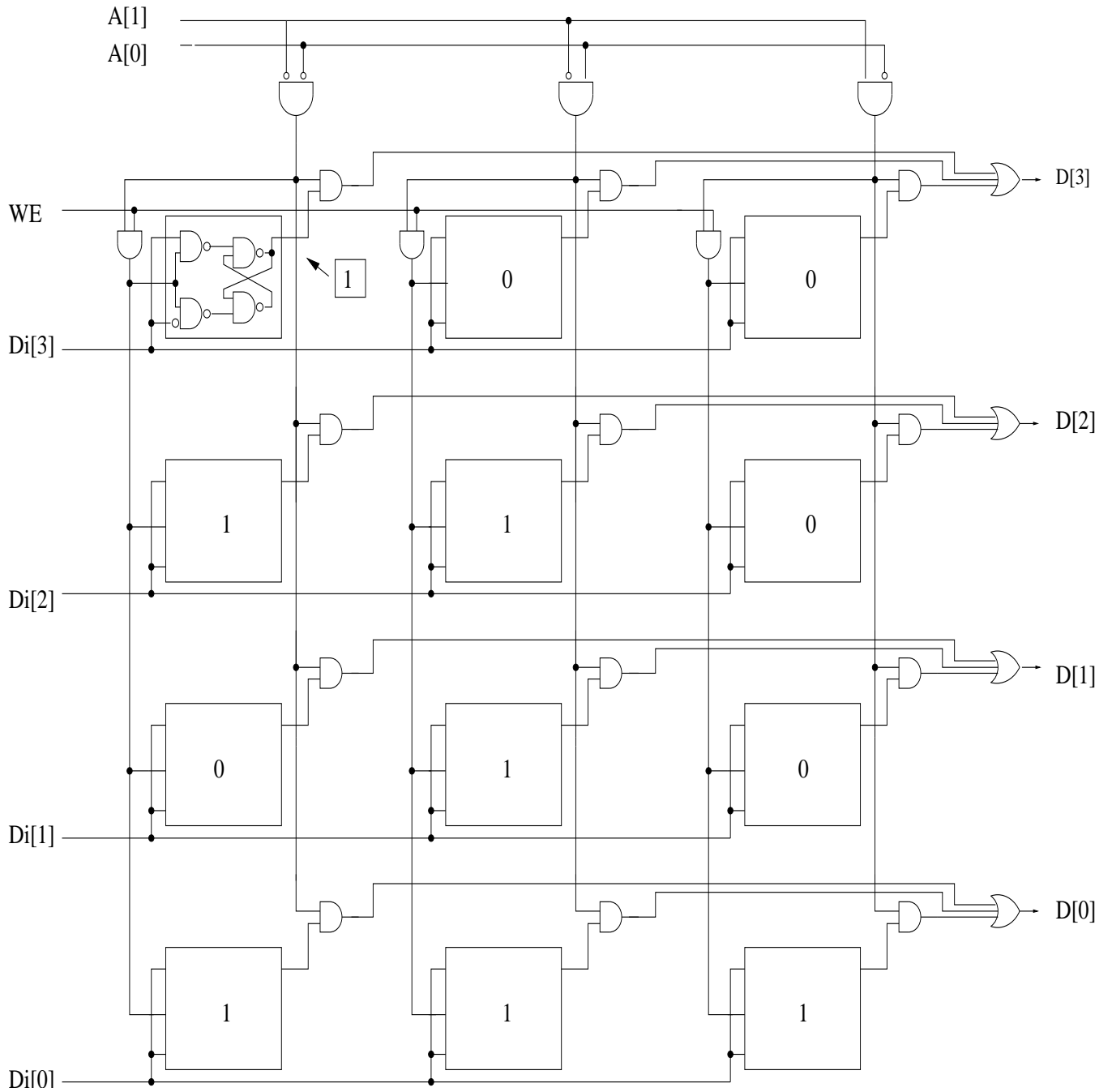


If not, explain why not.

c) A combinational logic circuit has two inputs. The values of those two inputs during the past ten cycles were 01, 10, 11, 01, 10, 11, 01, 10, 11, and 01. The values of these two inputs during the current cycle are 10. Explain the effect on the current output due to the values of the inputs during the previous ten cycles.

Name: \_\_\_\_\_

Question 2 (9 pts)



For the memory shown above:

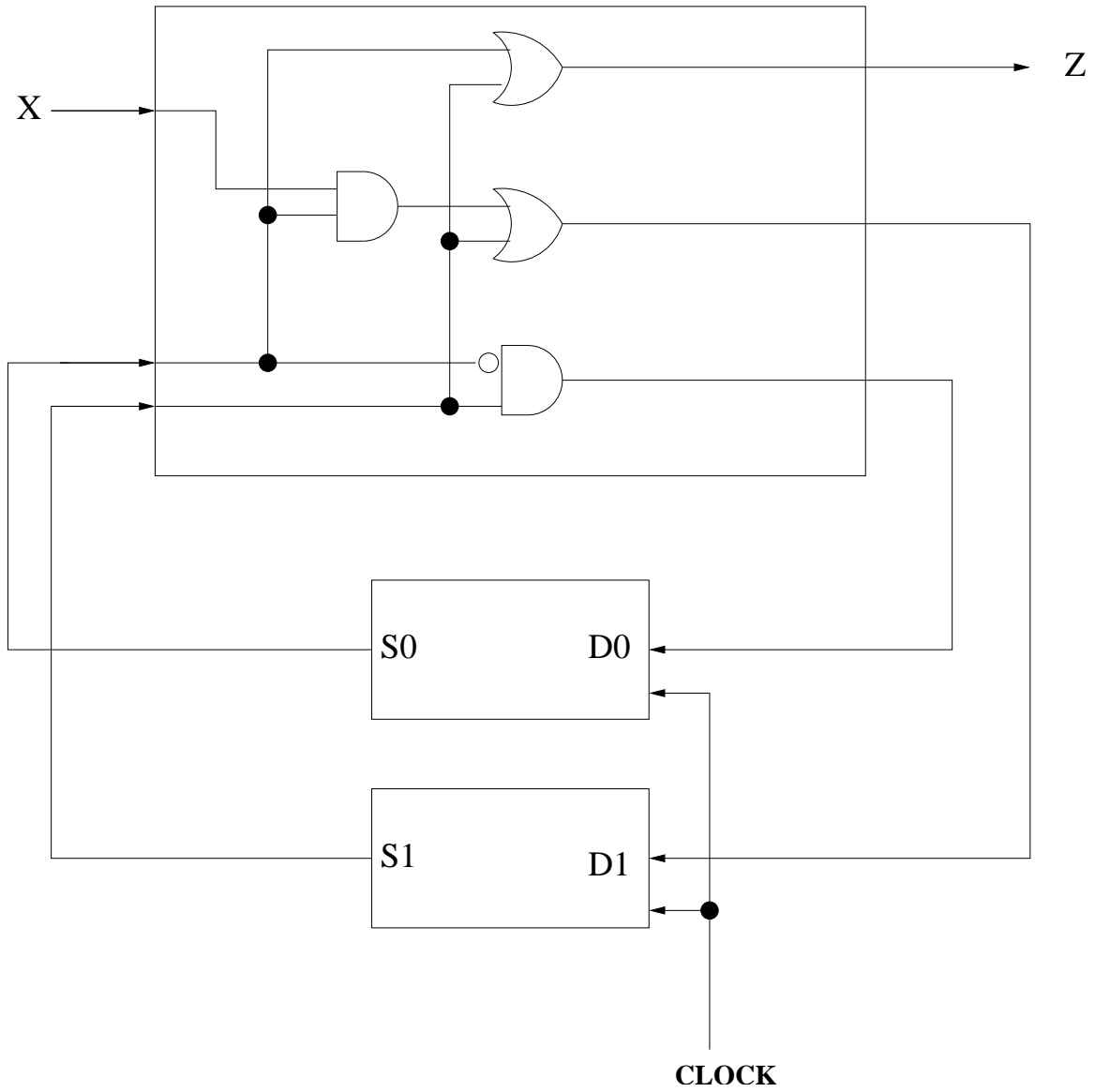
- a) What is the address space? \_\_\_\_\_
- b) What is the addressability? \_\_\_\_\_
- c) What is the data at address 2? \_\_\_\_\_



Name: \_\_\_\_\_

Question 4 (20 pts)

Shown below is an implementation of a Finite State Machine with an input X and output Z. Parts (a) and (b) are on the next page



Name: \_\_\_\_\_

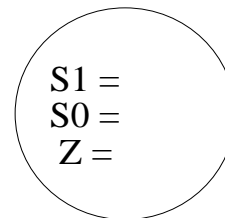
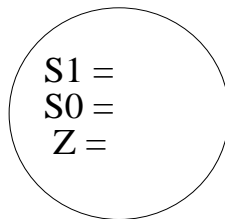
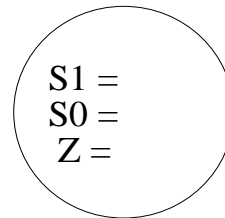
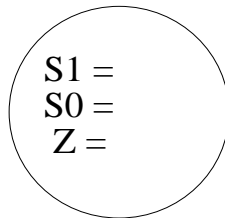
a) Complete the rest of the following table

S1, S0 specifies the present state

D1, D0 specifies the next state

S1	S0	X	D1	D0	Z
0	0	0			
0	0	1			
0	1	0			
0	1	1	1	0	1
1	0	0			
1	0	1			
1	1	0			
1	1	1			

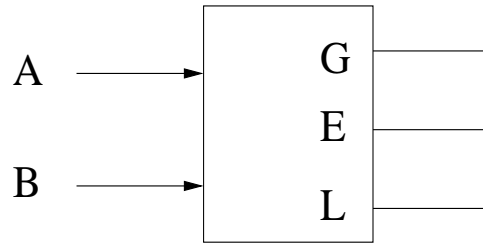
b) Complete the state diagram using the truth table from part (a)



Name: \_\_\_\_\_

Question 5 (15 pts)

A Comparator circuit has two 1 bit inputs A and B and three 1 bit outputs G (greater), E (Equal) and L (less than)



G is 1 if  $A > B$   
0 otherwise

E is 1 if  $A = B$   
0 otherwise

L is 1 if  $A < B$   
0 otherwise

a) Draw the truth table for a 1 bit comparator

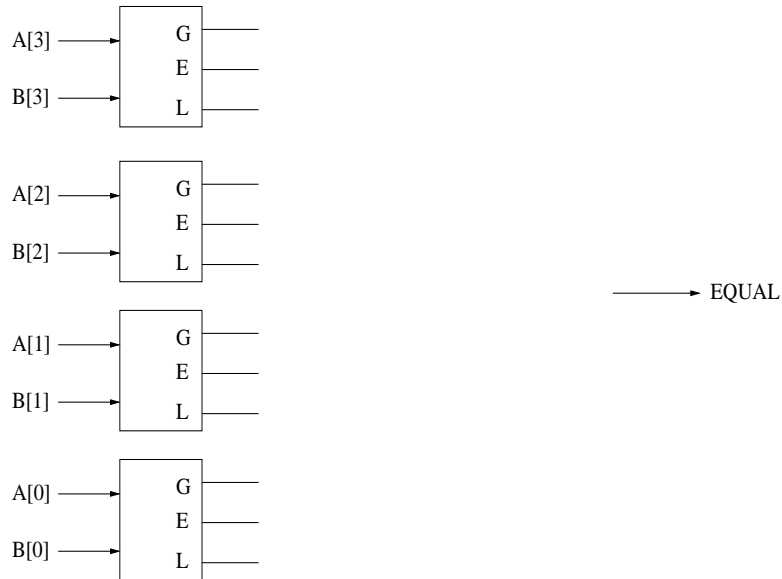
A	B	G	E	L
0	0			
0	1			
1	0			
1	1			

b) Implement G, E and L using AND, OR and NOT gates



Name: \_\_\_\_\_

c) Using the 1 bit comparator as a basic building block, construct a Four-bit Equality checker, such that output  
EQUAL is 1 if  $A[3:0] = B[3:0]$   
0 otherwise



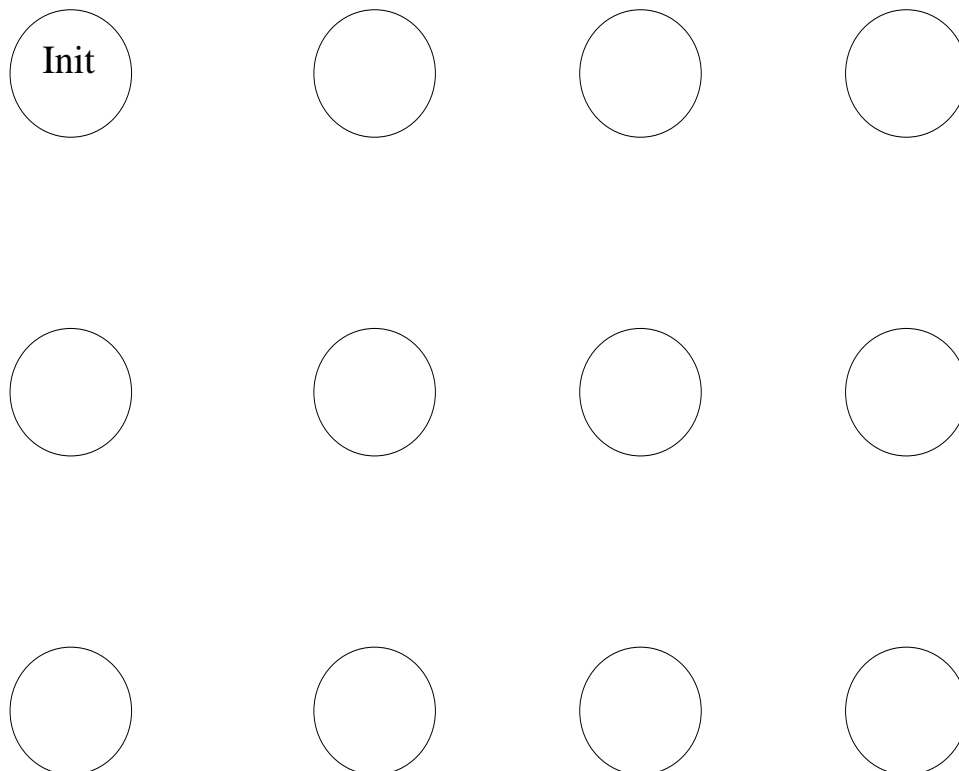


Name: \_\_\_\_\_

Question 6 (15 pts)

The IEEE has decided to modify their previous coke controller. They still sell cokes for 35 cents, but now the controller will only accept quarters and dimes. The purchaser puts in coins, one at a time, pushing a pushbutton after inserting each coin. If at least 35 cents has been put in, the machine will output a coke, but **WILL KEEP THE CHANGE** (to pay for Dr. Patt's trip to Hawaii).

Your job: Using as many states as you really need, construct the finite state machine for the coke controller. The process starts with no money in, and the machine in the initial state (shown below). After a coke has been dispensed, another coke can be purchased by first pushing the pushbutton to return the controller to the initial state. (Note: although we have provided 12 states below for your use, you will not need to use them all.)



Name: \_\_\_\_\_

Question 7 (20 pts)

In class, we have represented numbers in base-2 (binary), and in base-16 (hex). We are now ready for unsigned base-4, which we will call quad numbers. A quad digit can be 0,1,2, or 3.

- a) What is the maximum unsigned decimal value that one can represent with 3 quad digits.
  
  
  
  
  
  
  
  
  
  
- b) What is the maximum unsigned decimal value that one can represent with n quad digits (Hint: your answer should be a function of n).
  
  
  
  
  
  
  
  
  
  
- c) Add the two unsigned quad numbers: 023 and 221.
  
  
  
  
  
  
  
  
  
  
- d) What is the quad representation of the decimal number 42.
  
  
  
  
  
  
  
  
  
  
- e) What is the binary representation of the unsigned quad number 123.3.
  
  
  
  
  
  
  
  
  
  
- f) Express the unsigned quad number 123.3 in IEEE Floating Point format.

