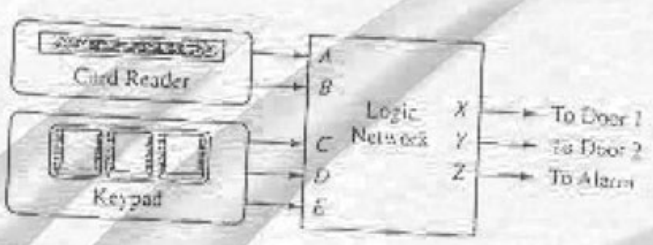
EEN 220
Logic Design

SPRING 2001
Test 2

NDU ECE Dept
S C Elmurr

Note 1: Open book, open Notes, Closed Neighbours
Note 2: Show all work in order to receive full credit
Note 3: Start each problem on a new page.

1:25 Pts A simple security system for two doors consists of a card reader and a keypad.



A person may open a particular door if he or she has a card containing the corresponding code, and enters an authorized keypad code for that card. The outputs from the card reader are as follows:

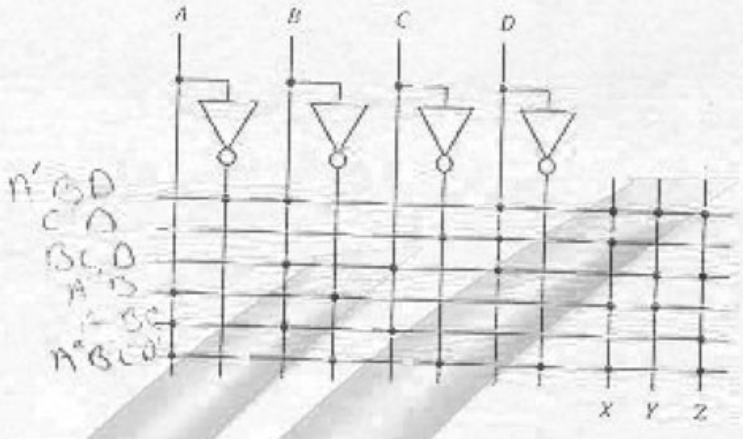
	A	B
No card inserted	0	0
Valid code for door 1	0	1
Valid code for door 2	1	1
Invalid card code	1	0

To unlock a door, a person must hold down the proper keys on the keypad and then insert the card in the reader. The authorized keypad codes for door 1 are 101 and 110, and the authorized keypad codes for door 2 are 101 and 011. If the card has an invalid code or if the wrong keypad code is entered, the alarm will ring when the card is inserted. If the correct keypad code is entered, the corresponding door will be unlocked when the card is inserted.
Design the logic network for this simple security system. Your network's inputs will consist of a card code AB, and a keypad code CDE. The network will have three outputs XYZ (if X or Y = 1, door 1 or 2 will be opened; if Z= 1, the alarm will sound). Design your network and implement in NAND/NAND form.

2: 20 Pts Realize the function
(a) using a 16-to-1 MUX with control inputs A,B,C, and D
(b) using an 8-to-1 MUX with control inputs A, B, and C and added gates

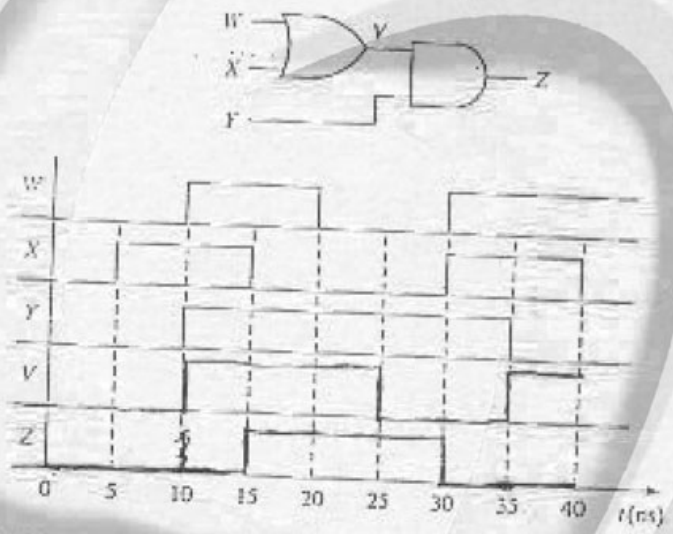
$$F(A,B,C,D,E) = \Sigma\, m(0,2,6,7,8,10,11,12,13,14,16,18,19,29,30) + \Sigma\, d(4,9,21)$$

3. 20 Pts. The internal connection diagram for a PLA is given below.
(a) Write the equations realized by the PLA.



(b) Specify the truth table for a ROM which would realize the same functions as the PLA.

4. 20 Pts. Complete the timing diagram for the given network. Assume that both gates have a propagation delay of 5ns.



5. 15 Pts. Braille is a system which allows a blind person to "read" alphanumerics by feeling a pattern of raised dots. Design a network that converts BCD to Braille. The table shows the correspondence between BCD and Braille.
(a) Use a multiple-output NAND-gate network.

A	B	C	D	W	X	Y	Z
0	0	0	0				
0	0	0	1				
0	0	1	0				
0	0	1	1				
0	1	0	0				
0	1	0	1				
0	1	1	0				
0	1	1	1				
1	0	0	0				
1	0	0	1				

Solution SPRING 2001

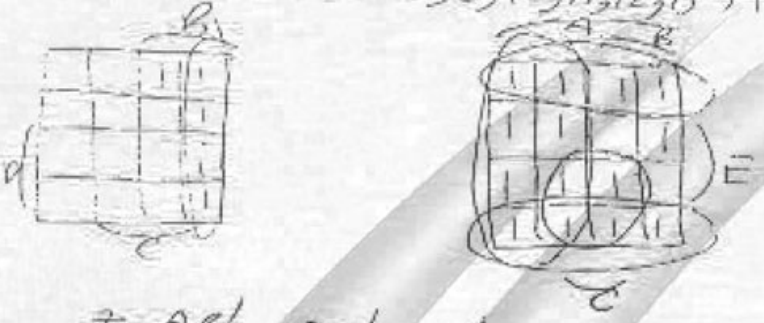
Logic Design — Test 2

1) $x = A'BCD'E + A'BCDE'$

$y = ABCD'E + ABC'DE$

$z = AB' + A'B(\Sigma m(0,1,2,3,4,7)) + AB(\Sigma m(0,1,2,4,5,7))$

$t = AB' + \Sigma m(8,9,10,11,12,15) + \Sigma m(24,25,26,28,30,31)$



$t = AB' + AE' + A'BC' + ACD + AC'D' + BD'E'$

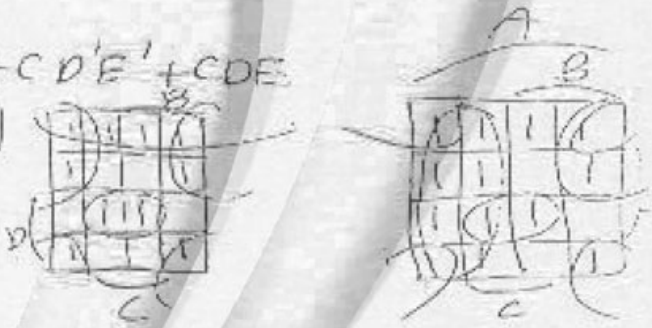
$t = \left((AB')'(AE')'(A'BC')'(ACD)'(AC'D')'(BD'E')\right)'$

$x = \left((A'BCD'E)'(A'BCDE')'\right)'$

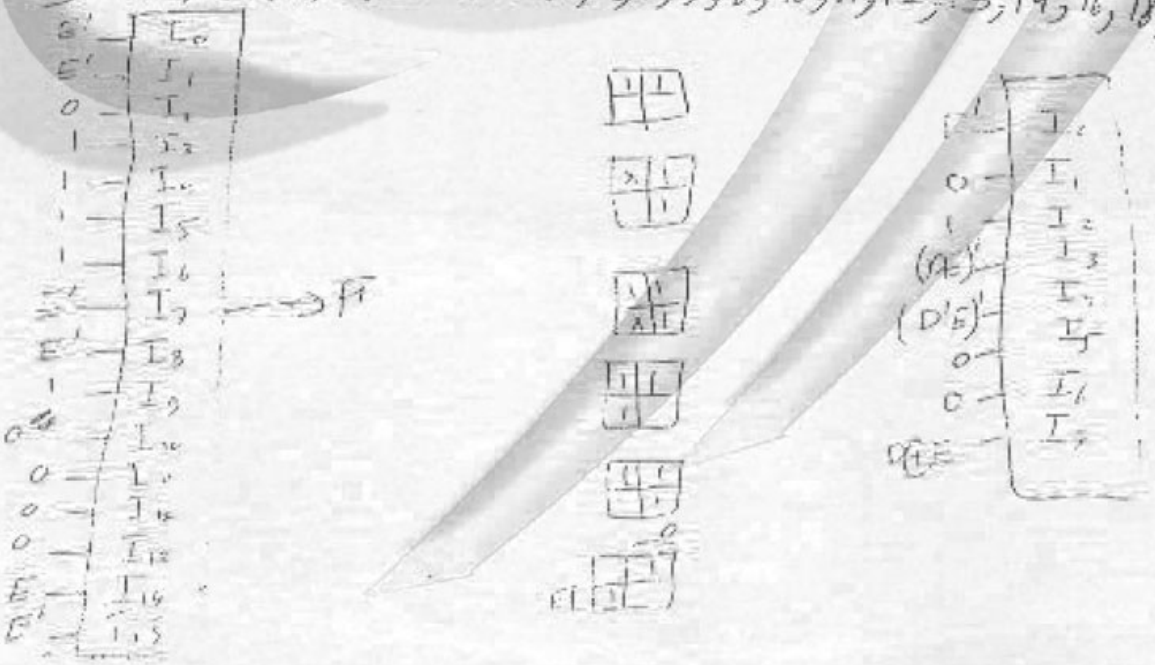
$y = \left((ABCD'E)'(ABC'DE)'\right)'$

$t = AB' + C'D'E' + C'D'E + C'DE' + CD'E' + CDE$

$t = AB' + C'D' + C'E' + D'E' + CDE$



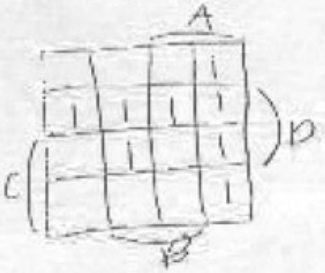
2) $F(A,B,C,D,E) = \Sigma m(0,2,6,7,8,10,11,12,13,14,16,18,19,29,30) + \Sigma d(4,$



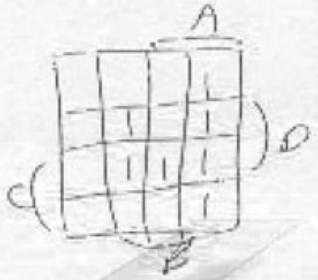
3) $x = A'BD + C'D + AB' + AB'C'D'$

$= A'BD + BCD + AB'$

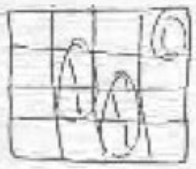
$z = A'BD + BCD + ABC + AB'C'D'$



$x = AB' + C'D + A'BD$



$J = AB' + BCD + A$



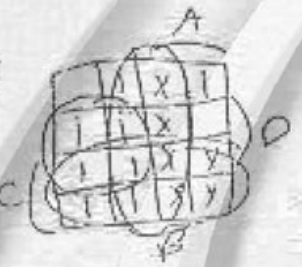
$z = A'BD + ABC + AB'C'D'$

$x = \Sigma_{--}(1,5,7,8,9,10,11,13)$

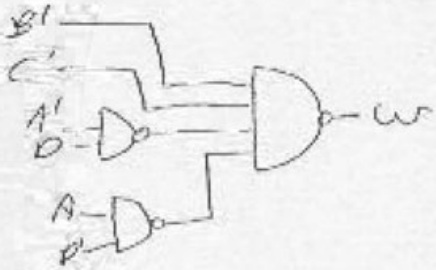
$J = \Sigma_{--}(5,7,8,9,10,11,15)$

$z = \Sigma_{--}(5,7,8,14,15)$

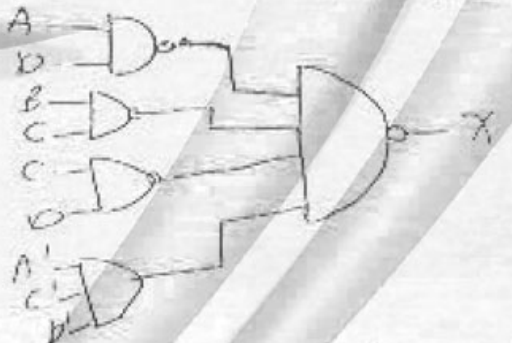
5)



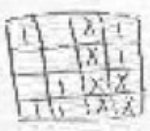
$W = C + B + A'D + AD' = (B'C'(A'D)'(AD)')'$



$x = AD + BC + CD + A'C'D'$



4)



$z = A + B'D' + BC$