Review For Final

Sunday, May 5, 2024 5:28 PM

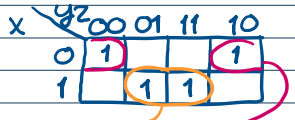
Question 1:

$A(x,y,z) = \Sigma(0,2,5,7) = \Pi(1,3,4,6)$

$B(x,y,z) = \Sigma(2,3,5,7) = \Pi(0,1,4,6)$

$C(x,y,z) = \Sigma(2,3,4,6) = \Pi(0,1,5,7)$

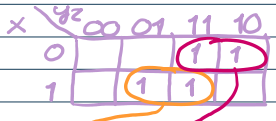
a) Draw logic diagram in two level NAND logic of minimal combinational circuit implementing the functions.



$A = xz + x'z'$

$= ((xz + x'z')')'$

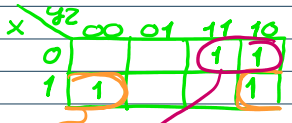
$= ((xz)' \cdot (x'z')')'$



$B = xz + x'y$

$= ((xz + x'y)')'$

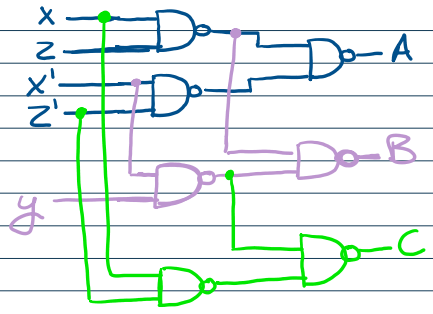
$= ((xz)' \cdot (x'y)')'$



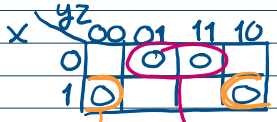
$C = xz' + x'y$

$= ((xz' + x'y)')'$

$= ((xz')' \cdot (x'y)')'$



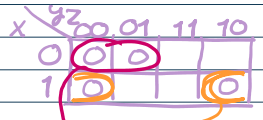
b) Draw logic diagram in two level NOR logic of minimal combinational circuit implementing function.



$A = (x'+z) \cdot (x+z')$

$= ((x'+z) \cdot (x+z'))')'$

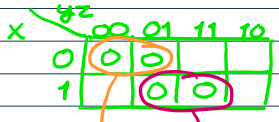
$= ((x'+z)' + (x+z')')'$



$B = (x+y) \cdot (x'+z)$

$= (((x+y) \cdot (x'+z))')'$

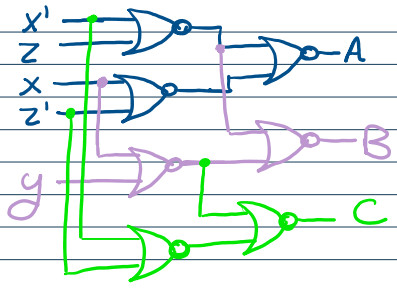
$= ((x+y)' + (x'+z)')'$



$C = (x+y) \cdot (x'+z')$

$= (((x+y) \cdot (x'+z'))')'$

$= ((x+y)' + (x'+z')')'$

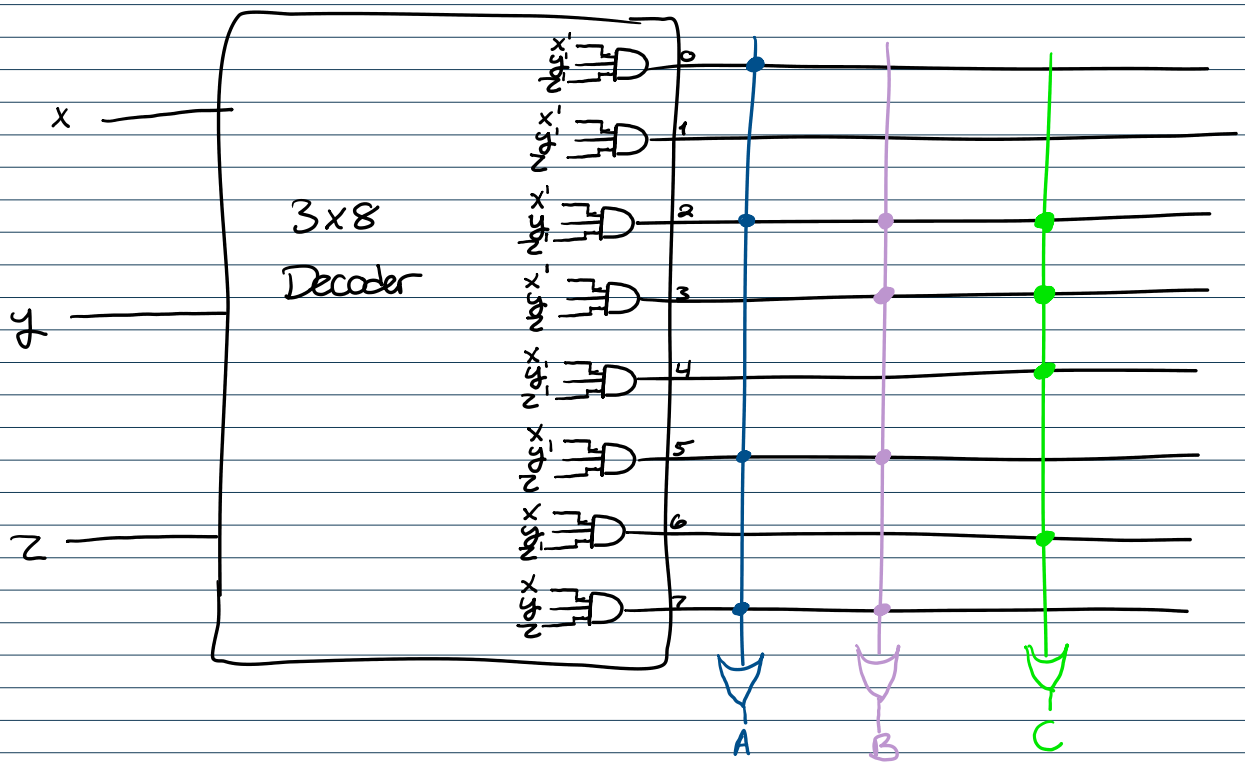


c) Implement the functions with decoder constructed with AND Gates and external OR Gates.

$A = xz + x'z'$
$= xz(y+y') + x'z'(y+y')$
$= xyz + xy'z + x'yz' + x'y'z'$

$B = xz + x'y$
$= xz(y+y') + x'y(z+z')$
$= xyz + xy'z + x'yz + x'yz'$

$C = xz' + x'y$
$= xz'(y+y') + x'y(z+z')$
$= xyz' + xy'z' + x'yz + x'yz'$



d) What type of ROM is needed to implement the function?

$2^k \times n = 2^3 \times 3$

8×3
ROM

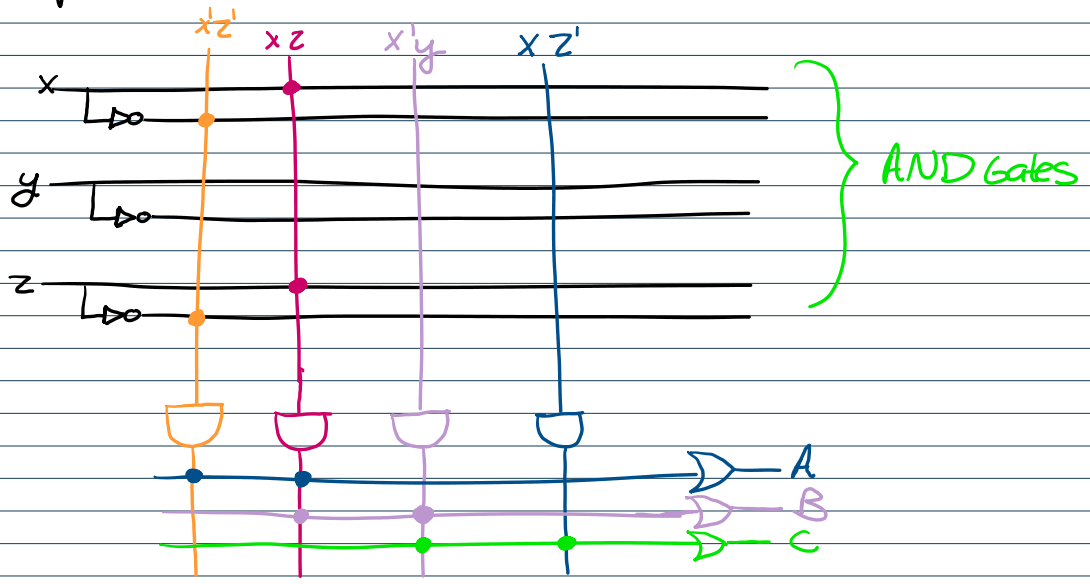
k (inputs) → $2^k \times n$ ROM → n (outputs)

e) Show the truth table of the ROM that implements the functions. What is the value stored at address 3 in ROM?

x	y	z	A	B	C
0	0	0	1	0	0
0	0	1	0	0	0
0	1	0	1	1	1
0	1	1	0	1	1
1	0	0	0	0	1
1	0	1	1	1	0
1	1	0	0	0	1
1	1	1	1	1	0

→ 3 is stored in address 3 in ROM

f) Implement functions with PLA.



Question 2:

Sequential circuit has two T flipflops, A & B, one input x and one output y.
flipflop functions:

$TA = Ax + Bx'$
$TB = A + x$
$y = ABx'$

a) What model does this circuit implement (Mealy or Moore)?

Mealy
(present state)(input) → output (output may change)

Moore
(present state) → output

Present A	Present B	x	Next A	Next B	output y
0	0	0	0	0	0
0	0	1	0	1	0
0	1	0	1	0	0
0	1	1	0	0	0
1	0	0	1	1	1
1	0	1	0	1	0
1	1	0	0	0	0
1	1	1	0	0	0

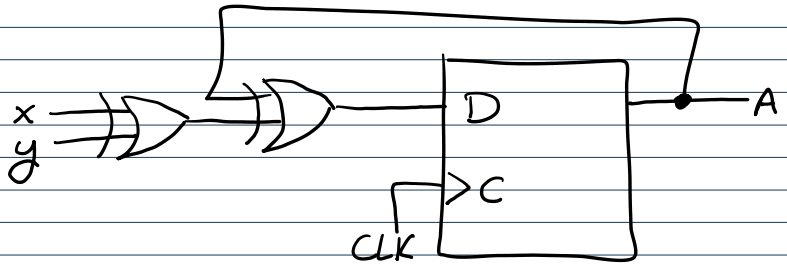
Mealy

b) If the circuit in is state 0 and the input is 1
what is the next state?

The next state would be 1

Question 3:

Synchronous sequential circuit



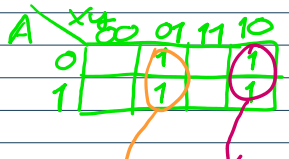
a) Create state table of circuit

$$DA = (x \oplus y) \oplus A$$
$$= (x'y + xy') \oplus A$$
$$= z \oplus A$$
$$= A'z + Az' = A'(x'y+xy') + A(x'y+xy)'$$

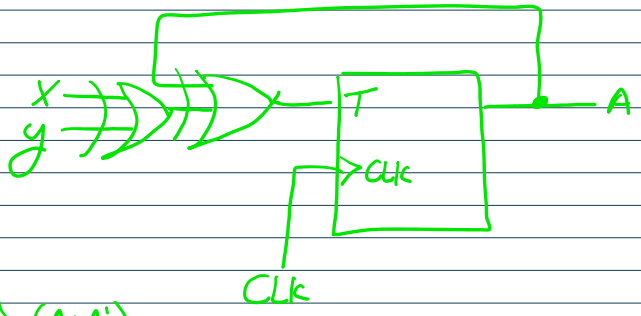
Present A	Input x	y	Next State A
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

b) Using the state table from part A, design a synchronous sequential circuit with a T Flip Flop

Present A	Input x	y	Next State A	TA
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	0
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	0



$$TA = x'y + xy'$$
$$= (x'y).(A+A') + (xy').(A+A')$$



CLk

$= (x'y).(A+A') + (xy').(A+A')$

$= Ax'y + A'x'y + Axy' + A'xy'$

$= A(x'y + xy') + A'(x'y + xy')$

$= A \oplus (x \oplus y)$

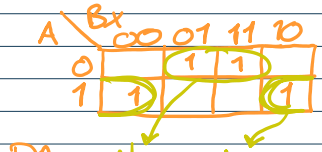
Question 4:

Design a synchronous sequential circuit with two D flip flops A & B and input x.

x = 0 state remains the same
x = 1 circuit goes through states from 11 to 10, to 01, to 00 back to 11

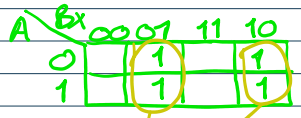
Show functions DA and DB

Present A	Present B	x	Next A	Next B
0	0	0	0	0
0	0	1	1	1
0	1	0	0	1
0	1	1	1	0
1	0	0	1	0
1	0	1	0	1
1	1	0	1	1
1	1	1	0	0



$DA = A'x + Ax'$

$= A \oplus x$



$DB = B'x + Bx'$

$= B \oplus x$