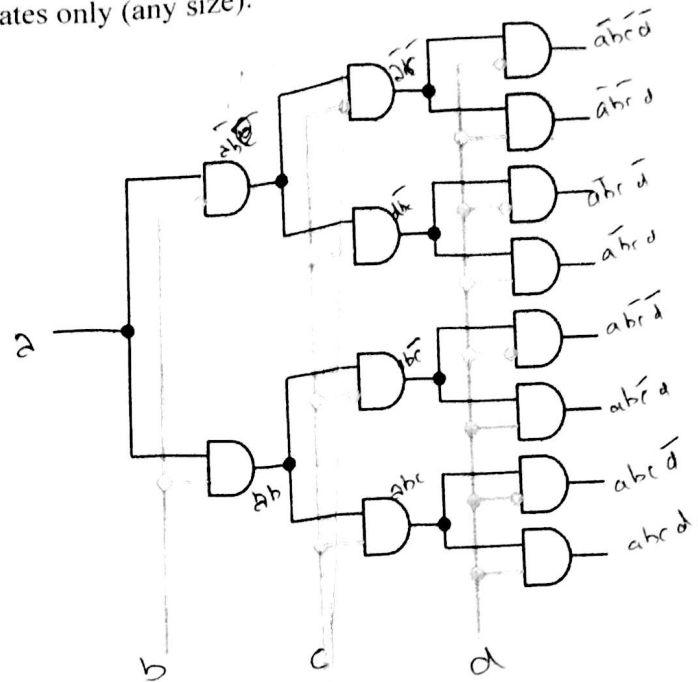


28.08.2016

1. What does the circuit shown below do? Write a VHDL description for it. Give an equivalent circuit using NAND gates only (any size).



[3]

2. Truth table for a Boolean function  $f$  of 4 variables  $x_1, x_2, x_3$  and  $x_4$  is shown.

- Find minimum SOP expression for this function using Karnaugh Map.
- Find minimum POS expression for this function using Karnaugh Map.
- Transform the POS form obtained in (b) into an SOP form algebraically.
- Check if result of (c) fully or partially matches result of (a).

$x_1$	$x_2$	$x_3$	$x_4$	$f$
0	0	0	0	1
0	0	0	1	-
0	0	1	0	1
0	0	1	1	-
0	1	0	0	1
0	1	0	1	0
0	1	1	0	-
0	1	1	1	-
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

[3]

3. A 4 bit Gray code counter is to be designed which cycles through the sequence 0000, 0001, 0011, 0010, 0110, 0111, 0101, 0100, 1100, 1101, 1111, 1110, 1010, 1011, 1001, 1000. Do you see any interesting property of this sequence? There is an input  $w$  that controls the counting. When  $w = 0$ , counting stays still. When  $w = 1$ , the counting progresses. Draw a state transition diagram and use it to design the counter.

[4]

$$T_0 = 1, w$$

$$T = x_1 x_2' x_3' + x_1 x_2 x_4 + x_1' x_3' x_4'$$