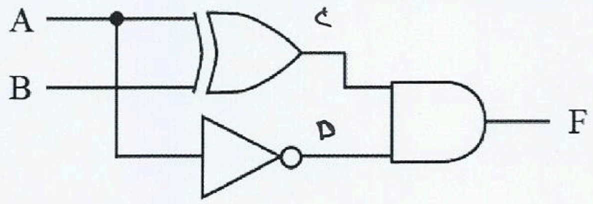
ECE 1250
S 13

EXAM #3 prob 2 solution

Ex:

a) Create a truth table for the logic circuit shown below.



b) Find the simplest Sum-Of-Products (SOP) form for the following expression:

$$F = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}\,\overline{B}C + \overline{A}\,BC + A\overline{B}\,\overline{C} + A\overline{B}C + ABC$$

c) Using only inverters (i.e., Not gates) and exclusive-or (i.e., XOR) gates, design a circuit to implement the following logic expression in the simplest possible way (i.e., with the fewest gate inputs):

$$F = \overline{A}\,\overline{B} + AB$$

soln: a) It is helpful to add labels C and D as shown on the above diagram.

A	B	C	D	F
0	0	0	1	0
0	1	1	1	1
1	0	1	0	0
1	1	0	0	0

b) We look for terms that are the same except for one variable that appears with and without a bar.

$$F = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}\,\overline{B}C + \overline{A}BC + A\overline{B}\,\overline{C} + A\overline{B}C + ABC$$

We have the following reductions:

$$\bar{A}\bar{B}\bar{C} + A\bar{B}\bar{C} = \bar{B}\bar{C}$$
$$\bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C = \bar{A}\bar{B}$$
$$\bar{A}\bar{B}C + A\bar{B}C = \bar{B}C$$
$$\bar{A}\bar{B}C + \bar{A}BC = \bar{A}C$$
$$\bar{A}BC + ABC = BC$$
$$A\bar{B}\bar{C} + A\bar{B}C = A\bar{B}$$
$$A\bar{B}C + ABC = AC$$

We once again pair up terms differing only by one variable appearing as inverted and non-inverted.

$$\bar{B}\bar{C} + \bar{B}C = \bar{B}$$
$$\bar{A}\bar{B} + A\bar{B} = \bar{B}$$
$$\bar{B}C + BC = C$$
$$\bar{A}C + AC = C$$

We now see that F in its simplest form is

$$F = \bar{B} + C.$$

c) The formula for F is the same as XNOR, which is an XOR gate followed by a NOT.

A	B	F
0	0	1
0	1	0
1	0	0
1	1	1