Digital and Embedded Systems
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Tutorial 2 – Combinatorial Logic

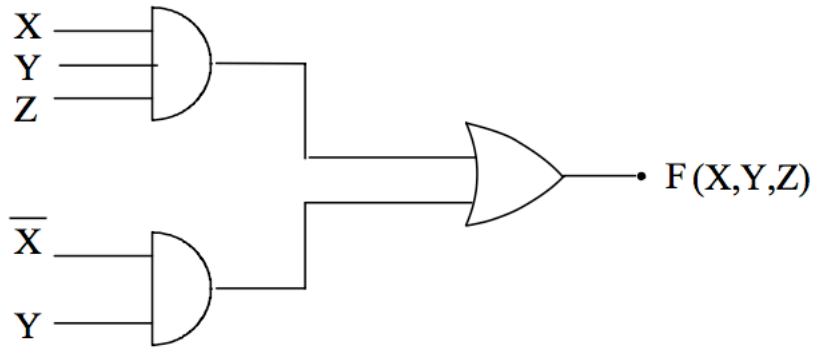
1. Determine the truth table for the following two Boolean functions:

(a) F(X,Y,Z) = X'Z' + XYZ

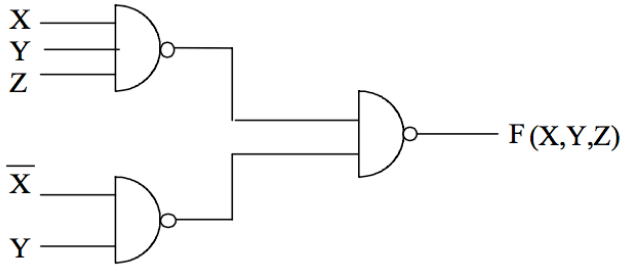
(b) G(X,Y,Z)=X'+XY'Z+YZ'

2. Determine the truth table for the following logic circuits

(a)



(b)



(c) What can you say about the above two circuits?

3. Find the complement of the following Boolean function and reduce it to seven literals in sum-of-products form.

F' = B'D+A'BC'+ACD+A'BC

4. Using a truth table show that the reduced Boolean function for Q.3 is equivalent to the original expression.

5. Implement the simplified expression from Q.3 using AND, OR and NOT logic gates in a 2-level gate circuit.

6. Reduce the following Boolean expressions to the required number of literals.

(a) ABC+A'B'C +A'BC+ABC'+A'B'C' to five literals

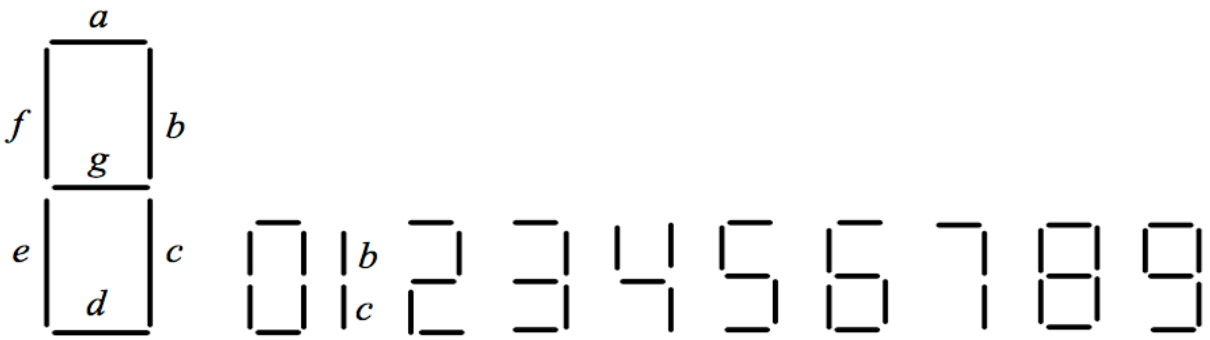
(b) NOT [NOT(CD) + A] + A + CD + AB to three literals

(c) (A+C+D) (A+C+D') (A+C'+D) (A+B') to four literals.

7. For each of the problems in Q.6 draw up a truth table and show that the simplified expressions are equivalent to the original Boolean expressions.

8. For each of the problems in Q.6 draw a logic circuit implementation of the simplified expressions using AND, OR and NOT gates.

9. A Binary Coded Decimal (BCD)-to-seven-segment decoder is a combinational circuit that accepts a decimal digit in BCD (4 bits, ABCD, for each decimal digit) and generates the appropriate outputs for selection of segments in a display indicator used for displaying the decimal digit. The seven outputs of the decoder (*a*, *b*, *c*, *d*, *e*, *f* and *g*) select the corresponding segments in the display as shown below: *a fb ec* The Numeric designation chosen to represent each decimal digit is shown below:



(a) Obtain the truth table for the seven outputs *a*, *b*, *c*, *d*, *e*, *f* and *g*.

(b) Minimise the output functions in sum-of-products form. Take care to keep as many "shared terms" between the outputs in such a form that they will minimise the complete logic circuit.

(c) Implement the logic circuit in (b).