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Homework Unit 4

1. A combinational logic circuit has four inputs (A, B, C, and D) and one output Z. The output is 1 iff the input has three consecutive 0's or three consecutive 1's. For example, if $A=1$, $B=0$, $C=0$, and $D=0$, then $Z=1$, but if $A=0$, $B=1$, $C=0$, and $D=0$, then $Z=0$. Design the circuit using <u>one</u> four-input OR gate and <u>four</u> three-input AND gates.

2. Given $F_1 = \prod M(0, 4, 5, 6)$ and $F_2 = \prod M(0, 4, 7)$, find the maxterm expansion for $F_1 F_2$. State a general rule for finding the maxterm expansion of $F_1 F_2$ given the maxterm expansions of F_1 and F_2. Prove your answer by using the general form of the maxterm expansion.

3. Given $f(a, b, c) = a\,(b+c')$.

   (a) Express f as a minterm expansion (use m-notation).

   (b) Express f as a maxterm expansion (use M-notation).

   (c) Express f' as a minterm expansion (use m-notation).

   (d) Express f' as a maxterm expansion (use M-notation).

4. (a) If m_1 and m_2 are minterms of n variables, prove that $m_1+m_2 = m_1 \oplus m_2$.

   (b) Prove that any switching function can be written as the exclusive OR sum of products where each product does not contain a complemented literal. (*Hint*: Start with the function written as a sum of minterms and use part (a).)