

EE 2720, Fall 2010

Homework # 6

Not to be returned. (It will not be  
graded)

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Problem 1: Design the prime number detector of handout #13 (see page 5 of handout #13) using:

- Ⓐ A decoder with uncomplemented outputs and one 7-input OR gate
- Ⓑ A decoder with complemented outputs and one 7-input NAND gate.
- Ⓒ A decoder with complemented outputs and one 9-input AND gate.
- Ⓓ A decoder with uncomplemented outputs and one 9-input NOR gate.
- Ⓔ A 16-to-1 multiplexer and nothing else.
- Ⓕ An 8-to-1 multiplexer and nothing else.
- Ⓖ Which one of the designs between these in parts Ⓔ and Ⓕ is better? Why?

Problem 2: Using a decoder with uncomplemented outputs and a 12-input OR gate, implement the logic function  $F = (a + b + c) \cdot (b + c + d) \cdot (a + c + d)$ .

Problem 3: Using a decoder with complemented outputs and a 4-input AND gate, implement the logic function of problem 2.

Problem 4: Using a decoder with uncomplemented outputs and a 6-input OR gate, implement the logic function  $F = a \cdot b \cdot c + b \cdot c \cdot d + a \cdot d$ .

Problem 5: Using a decoder with complemented outputs and a 10-input AND gate, implement the logic function of problem 4.

Problem 6: Using Karnaugh maps, derive simplified product-of-sums expressions for the outputs a, b, c, d, e, f, g of the seven-segment decoder presented in handout # 17; (look on page 11 of handout # 17).

Problem 7: Using four 3-to-8 decoders and one 2-to-4 decoder, construct a 5-to-32 decoder. Each one of the 3-to-8 decoders as well as the 2-to-4 decoder must have an active high enable input named E. Your design must be a two-level design here.

Problem 8: Using four 2-to-4 decoders each with one active high enable input named EN1 and two active low enable inputs named EN2 and EN3, plus one inverter, construct a 4-to-16 decoder.

Problem 9: Using two 16-to-4 priority encoders each with an enable input named EI, a group select output named GS as well as an enable output named EO plus few OR gates, construct a 32-to-5 priority encoder; (look in handout # 19 for EI, GS, EO).

Problem 10: Using four 8-to-1 multiplexers and one 4-to-1 multiplexer, design a 32-to-1 multiplexer. This is going to be a two-level design similar to examples 1, 2 of handout # 20.

Problem 11: Using four 4-to-1 multiplexers, one inverter and one 4-input OR gate, design a 16-to-1 multiplexer. Each of the four 4-to-1 multiplexers must have one active high enable input named EN1 and two active low enable inputs named EN2 and EN3.

Problem 12: Using a 4x3 PLA with 6 product terms, implement the following functions:

$$X = \sum_{A, B, C, D} (1, 7)$$

$$Y = \prod_{A, B, C, D} (2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15)$$

$$Z = A \cdot B'$$

Note: 4x3 PLA means a PLA with 4 inputs and 3 outputs. When I say 6 product terms, I mean that the PLA contains 6 AND gates.

Problem 13: Using a 4x3 PLA with 6 product terms, implement the following functions:

$$X = A \cdot B' \cdot C' \cdot D' + A \cdot B \cdot C \cdot D$$

$$Y = \prod_{A, B, C, D} (2, 3, 4, 6, 7, 8, 10, 11, 12, 13, 14, 15)$$

$$Z = \sum_{A, B, C, D} (5, 9, 12)$$

Note: From problem 12, you should know what 4x3 PLA means and what 6 product terms means.