

CS/EE 3700 — Digital Logic Design
Mid-Term Practice Exam

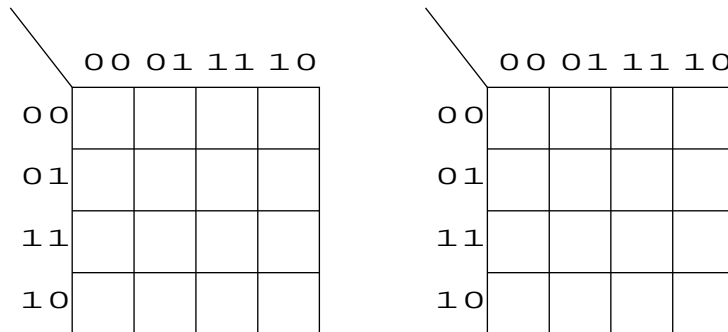
Name:

Instructions Work independently. Show your work! Answers with no justification will not be given credit. *Don't Panic!* Note that this is just a sample. The list of topics that could potentially be covered on the real exam was sent out in email!

Put your name at the top of each sheet of the exam before you start!

1 Canonical Forms of Boolean Functions

Given the following Boolean function expressed as a 5-variable K-map:



If you want to try one in particular, try

$$F(A, B, C, D, E) = \sum m(2, 4, 5, 6, 7, 11, 12, 15, 19, 20, 23, 27, 28) + d(0, 3, 13, 16, 22, 25, 31)$$

With the variables in this order I would assume that the left map is $A=0$ and the right map is $A=1$. The columns of the maps are BC and the rows of the maps are DE .

- a. Write $F(A, B, C, D, E)$ in “little m” notation.
- b. Write $F(A, B, C, D, E)$ in “big M” notation.
- c. Write $F(A, B, C, D, E)$ in minimum sum-of-products notation.
- d. Write $F(A, B, C, D, E)$ in minimum product-of-sums notation.
- e. Write $\overline{F}(A, B, C, D, E)$ in minimum sum-of-products notation.
- f. Write $\overline{F}(A, B, C, D, E)$ in minimum product-of-sums notation.

2 Electronics

2.1 Resistors

What is the maximum voltage that can be connected across a series combination of a 180Ω , 2-W resistor, and a 120Ω , 1-W resistor without exceeding the power rating of either one?

2.2 Resistors

A 90A current flows into 4 resistors connected in parallel. The four resistors are 5Ω , 6Ω , 12Ω , and 20Ω . Find the current in each resistor.

3 Boolean Manipulation

Which two Boolean expressions given below implement the same function? Show your work! No work - no credit!

Hint: Use DeMorgan's law and Boolean simplification rules to put the equations in similar forms.

a. $\overline{X(\overline{Y} + V + \overline{X})} + \overline{(X + \overline{Z} + \overline{W})(\overline{Y} + V + \overline{W})}$

b. $\overline{X(\overline{W} + \overline{X}(W + \overline{Z}))}(X + \overline{Y} + \overline{V})$

c. $XZ + YV(\overline{X} + Z) + X\overline{Z}$

d. $(Y\overline{V} + \overline{X}V)\overline{(\overline{Y} + \overline{V})(\overline{W} + X)\overline{W}}$

4 Logic Minimization

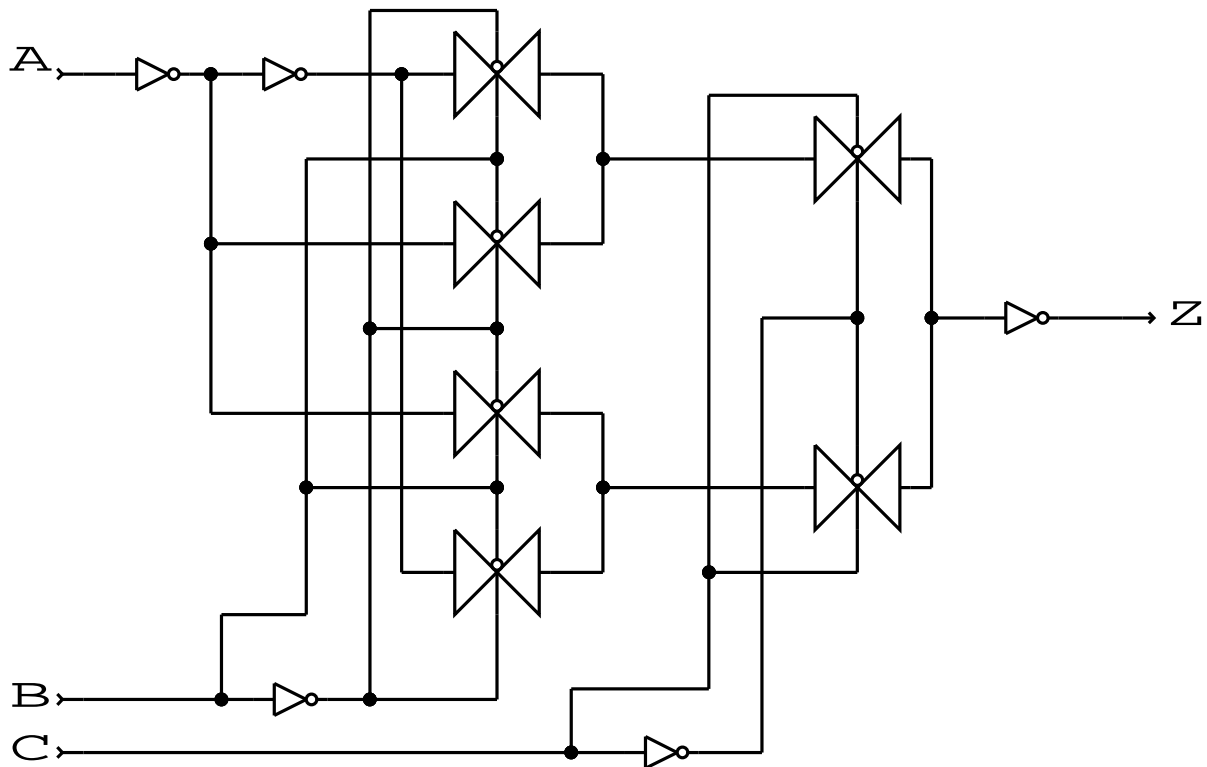
Given the following function:

$$F(A, B, C, D) = \sum m(1, 2, 9, 10, 13, 14, 15) + d(5, 7, 8)$$

Use the Quine-McCluskey method to minimize the function. Show all the tables that you use. Give the following results:

- a. Give the final minimized function
- b. List the prime implicants of the function
- c. List the essential prime implicants of the function

5 CMOS Transmission Gates



- What function is performed by the circuit shown here? Recall that the “butterfly gate” is a transmission gate that passes its input signal to the output if the control signal is asserted, and disconnects from the output (tri-state) when the control signal is not asserted.
- Draw a gate-level circuit that implements the same function.

6 Circuit Design

Design a circuit with output f and inputs A, B, C , and D . Let the two inputs AB represent a two-bit number with A as the high order bit, and CD represent another two-bit number. That is, the values on AB represent four values 00 (0), 01 (1), 10 (2), and 11 (3). The output f should be 1 only if the number represented by AB is greater than or equal to the number represented by CD .

- a. Draw the truth table for this function (four inputs and one output).
- b. Show the simplest SOP expression for f .
- c. Implement this circuit using only two-input NAND gates (you can assume that you have inverted input literals available for free if needed).