ENSC-150 - Midterm 1 - Answers
(TYPE 1)

1. **(3 Points)** Perform the following subtraction in Hexadecimal (base 16). Show your work. Do not convert to Decimal.

$E(11)_{16} \rightarrow 17$

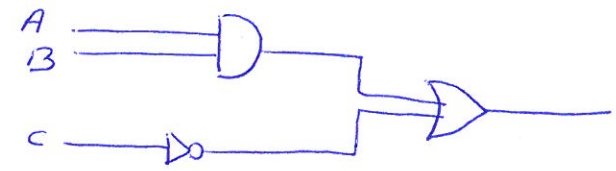
$$\begin{array}{r} F\ 1\ B \\ -\ B\ 3\ 5 \\ \hline 3\ E\ 6 \end{array}$$

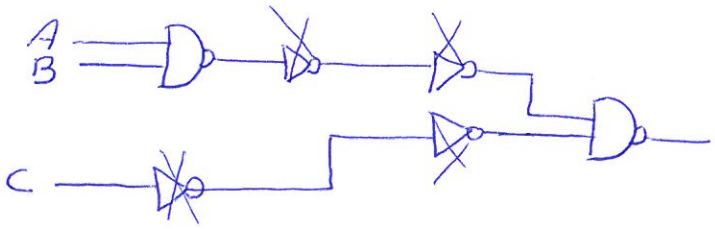
2. **(2 Points)** (This question is from one of your assignments) Using Demorgan's Theorem, express the following function with only OR and Complement (NOT or Inverse) operators. (No need to simplify the function first.)

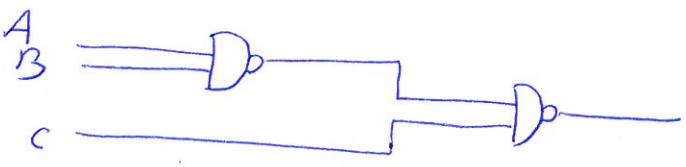
$$A\,B\,\overline{C} + B\,C + \overline{B}\,\overline{A} = \overline{\overline{A\,B\,\overline{C}} + \overline{B\,C} + \overline{\overline{B}\,\overline{A}}}$$

$$= \overline{(\overline{A} + \overline{B} + C)} + \overline{(\overline{B} + \overline{C})} + \overline{(B + A)}$$

3. **(4 Points)** Implement the function $F = AB + \overline{C}$, using a library that includes only "2-input NAND" and "NOT" gates.

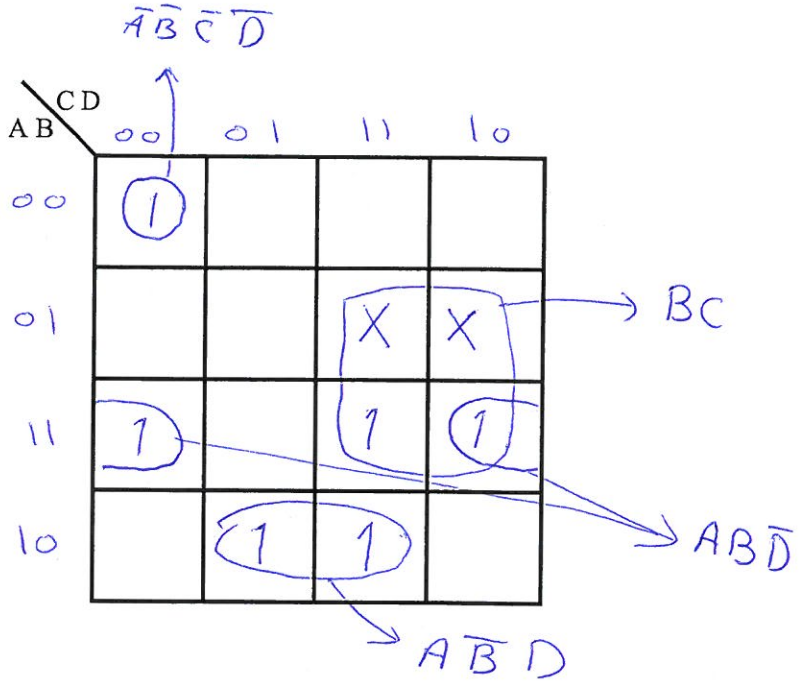






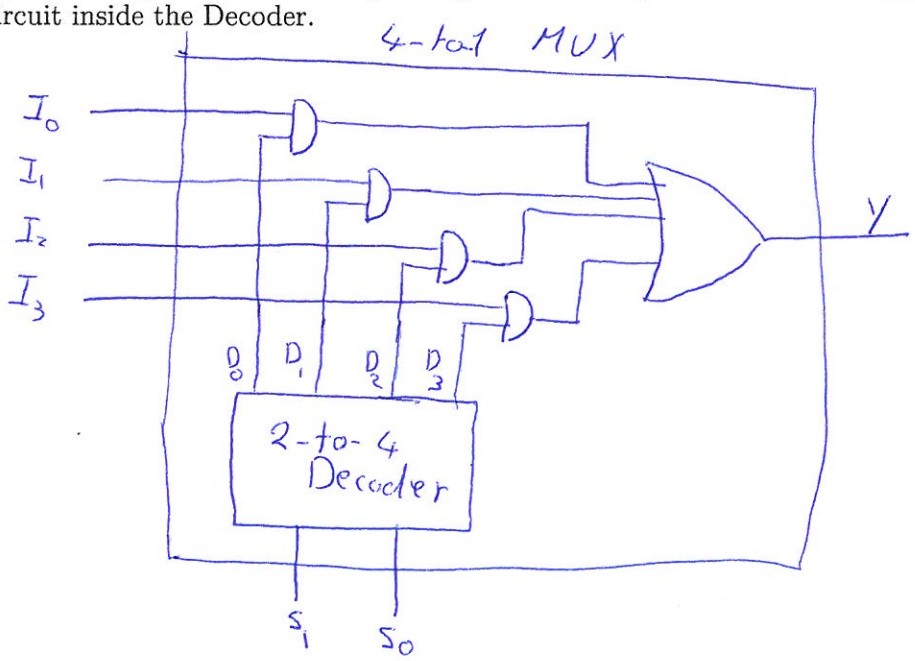
4. **(6 Points)**The Truth Table for the Boolean function, F, is given below. Fill out the K-map given beside it based on this function and optimize the function in Sum of Products (SoP) form. Clearly label your K-map and show the combinations you are using.

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



$$F = \bar{A}\bar{B}\bar{C}\bar{D} + BC + AB\bar{D} + A\bar{B}D$$

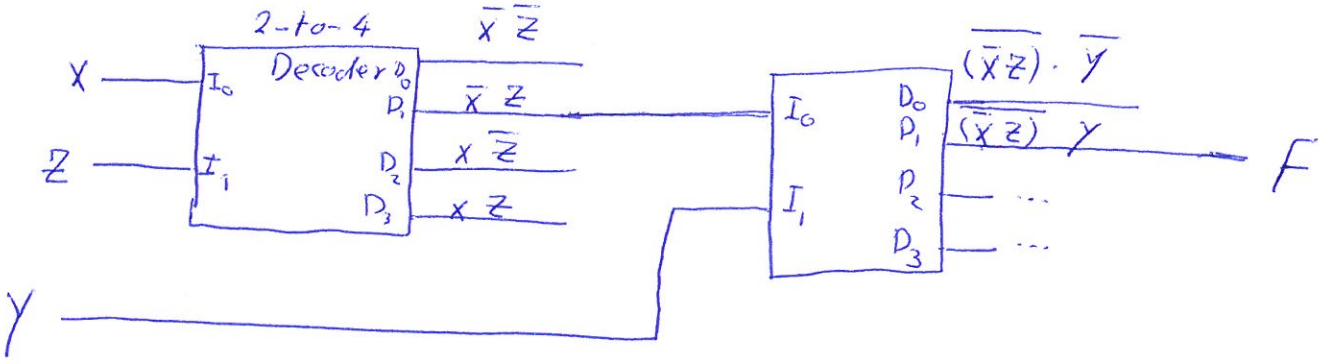
5. **(5 Points)** Construct a 4-to-1 Multiplexer (MUX), using one Decoder of appropriate size and additional gates as required. Make sure your signals are clearly labeled. You do **not** need to show the circuit inside the Decoder.



6. (**5 Points**)Implement the following Boolean function using **only two 2-to-4 line Decoders.**

$$F = X\,Y + Y\,\overline{Z}$$

$F = Y(X + \overline{Z}) = Y\,\overline{\overline{X + \overline{Z}}} = Y(\overline{X} \cdot Z)$



Verify (optional!):

$F = \overline{(\overline{X}Z)} \cdot Y = (X + \overline{Z}) \cdot Y = XY + Y\overline{Z}$