ECE 2030 Spring 06
Dr. Heck

Problem 1 (25 Points):

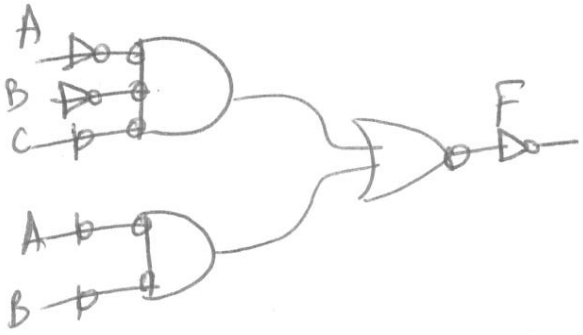
Consider an expression: $F = AB\overline{C} + \overline{A}\overline{B}$

a) Create a switch level implementation for F using n-type and p-type transistors. Assume that both the inputs and their complements are available. Your design should contain no shorts and no floats.
Give the total number of transistors needed to implement your design (include transistors needed for complements).

10T + 2(2T) = 14T

b) Use mixed logic to create a gate level design for F using only NOR gates. Give the total number of transistors needed to implement your design.

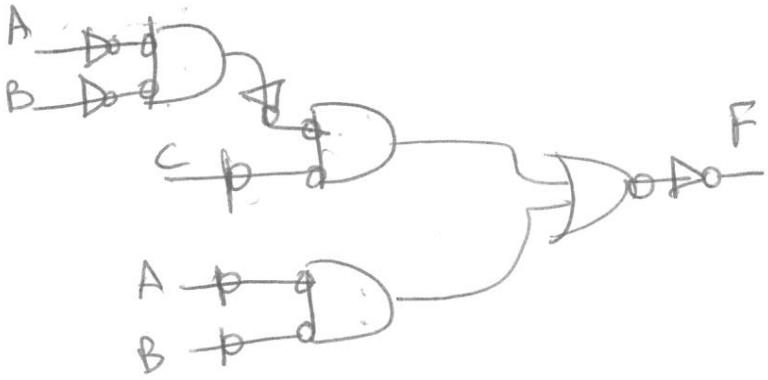
with 3-input gates



6T + 2(4T) + 3(2T) =

20T

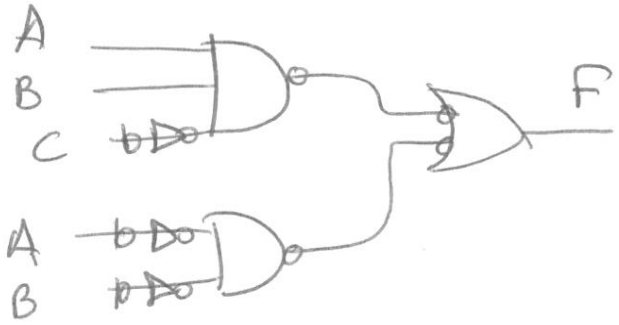
with 2-input gates



4(4T) + 4(2T) = 24T

c) Use mixed logic to create a gate level design for F using only NAND gates. Give the total number of transistors needed to implement your design.

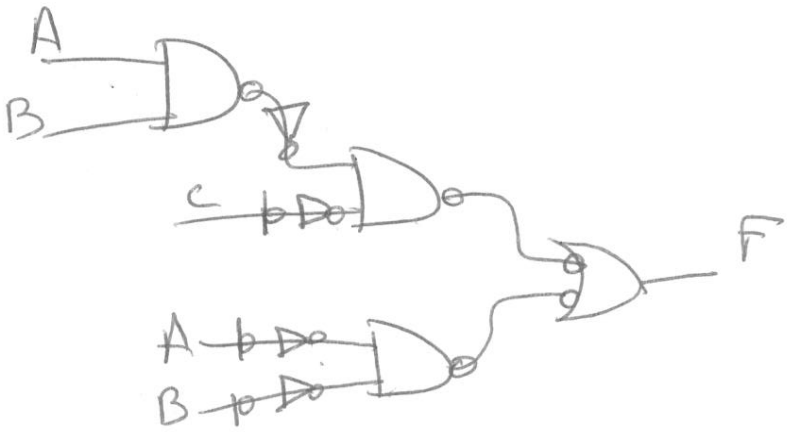
with 3-input gates



$6T + 2(4T) + 3(2T) =$

$20T$

with 2-input gates



$4(4T) + 4(2T) = 24T$

Problem 2 (25 Points):

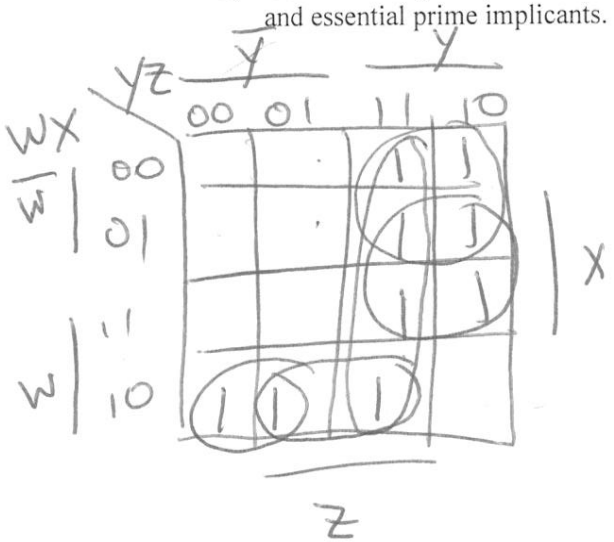
Given the following truth table:

WXYZ	F
0 0 0 0	0
0 0 0 1	0
0 0 1 0	1
0 0 1 1	1
0 1 0 0	0
0 1 0 1	0
0 1 1 0	1
0 1 1 1	1
1 0 0 0	1
1 0 0 1	1
1 0 1 0	0
1 0 1 1	1
1 1 0 0	0
1 1 0 1	0
1 1 1 0	1
1 1 1 1	1

a) Find an SOP expression for F.

SOP = $\bar{W}\bar{X}y\bar{z} + \bar{W}\bar{X}yz + \bar{W}Xy\bar{z} + \bar{W}Xyz + W\bar{X}\bar{y}\bar{z} + W\bar{X}\bar{y}z + W\bar{X}yz + WXy\bar{z} + WXyz$

b) Use a Karnaugh map to write a simplified SOP expression for F. Identify the prime implicants and essential prime implicants.



Prime Implicants	Essential?
$\bar{W}y$	Y
Xy	Y
yz	N
$W\bar{X}z$	N
$W\bar{X}\bar{y}$	Y

F = $\bar{W}y + Xy + W\bar{X}\bar{y} + yz$

Problem 3 (25 Points):

Perform the following conversions:

a) 1010110_2 = 86 $_{10}$

b) $3FA4_{16}$ = 111111.10100100 $_2$

c) 85.75_{10} = 1010101.11 $_2$

d) 104_{10} = 68 $_{16}$

e) 1100011.101_2 = 63.A $_{16}$

Problem 4 (25 Points):

a) Perform the following operations and determine if the result has an error. Assume that you have 5 bit signed representation (with 2's complement notation).

1 1 1 1	1 1	1 1 1 1
1 0 1 1 1	0 1 1 0 1	1 1 0 1 1
+ 0 1 0 1 1	+ 0 0 1 1 0	+ 1 1 1 0 1
0 0 0 1 0	1 0 0 1 1	1 1 0 0 0
error? no	error? yes	error? no

b) Determine the representation of the following numbers in 2's complement notation using a 4 bit representation. Indicate for a particular number if this is impossible (due to overflow).

-1_{10} = 1111

10_{10} = not possible

-7_{10} = 1001

8_{10} = not possible

c) Repeat part b) using a 6 bit representation.

-1_{10} = 111111

10_{10} = 001010

-7_{10} = 111001

8_{10} = 001000