Your Name:__________ Sample Solution _________________

Your Student ID: ________________________________

Your Instructor Name:__________________________________

Your Section #:___________________ ; Your Lecture Times:__________________

Read The Following Instructions Carefully:

1. This exam booklet has 6 numbered pages and 9 problems. Check that your exam includes all 6 pages. Show ALL of your work on these pages. Two blank pages are added at the end for your scratch work.
2. WRITE your name (in Arabic) and student number in the spaces above. Also, make sure to write your instructor's name, section # and lecture times.
3. You are NOT permitted to use notes, books, calculators, or mobile phones during this exam.
4. This exam lasts for 75 minutes. Point values are listed for each problem to assist you in making the best use of time.

Problem	Max Points	Score
1	4	
2	5	
3	3	
4	2	
5	4	
6	2	
7	3	
8	3	
9	4	
Total	30	

Problem 1 (4 points)

Perform the following conversions. Show the details of your solution in the space below.

a. Decimal 78 to Hexadecimal is ________4E_______________

b. Decimal 0.625 to binary is _____________0.101_______________________

c. Hexadecimal A.4 to Decimal is __________10.25_________________

d. Binary 1011011.011 to decimal is __________91.375__________

Grading: 1 point per correct answer

Problem 2 (5 points) Fill in the blanks

1- The dual of the following expression **(X + XY)** is:

___________________X(X+Y)________________________

2- The complement of the function **F= X(Y\`Z\` + YZ)** is:

_____________________ X\`+(Y+Z)(Y\`+Z\`)__________________________

3- The following identity **X+YZ = (X+Y).(X+Z)** is called:

_____________________ Distributive ___________________________

4- Without simplifying, the equivalent expression for the following function **F(A,B,C) =∑ m (3,5,7)** is:

_____________________ A\`BC+AB\`C+ABC ______________________

Grading: 1 point per correct answer

5- The Simplest form for the Boolean expression **B(A⊕C) + C(A⊕B)** is:

_____________________ A\`BC+AB\`C+ABC' __________________________________

Problem 3 (3 points)

Optimize the following Boolean function F together with the don't care conditions d in product-of-sums form, use a Karnaugh map.

F(A,B,C,D) = ΠM (3,7, 13,15), d(A,B,C,D) =$\sum m$ (4,5,11, 12)

AB \ CD	00	01	11	10
00			0	
01	X	X	0	
11	X	0	0	
10			X	

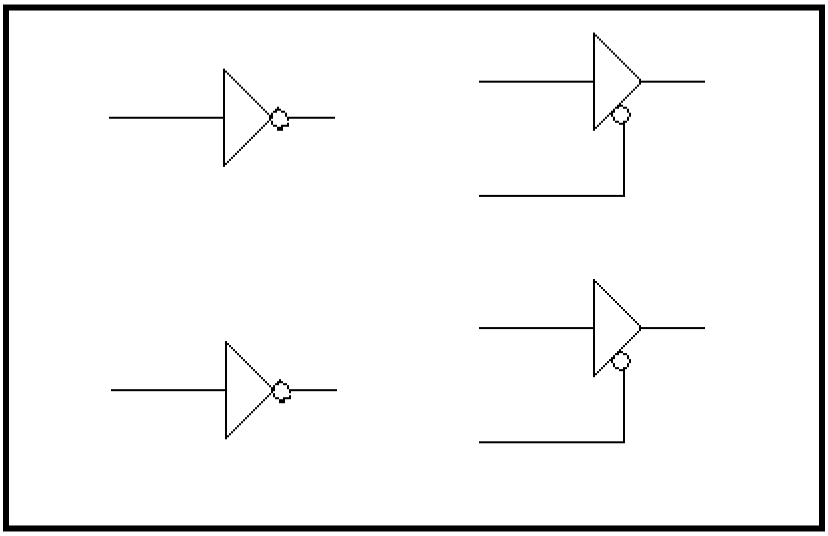
Grading:: 1 mark for filling K-map correctly; 1 mark for the term (B\` +D\`); 1 mark for the term (C\`+D\`)

F(A,B,C,D) = (B\` +D\`) (C\`+D\`)

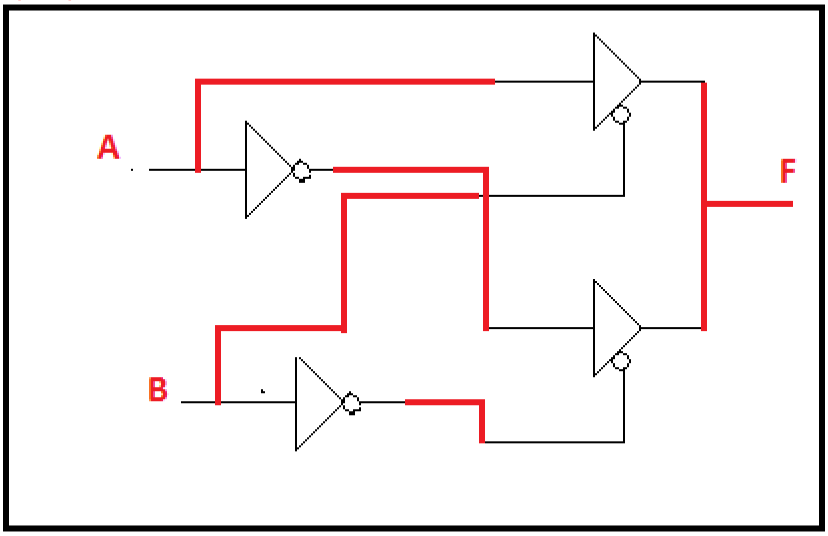
Problem 4 (2 points)

Write the Boolean function for the exclusive-OR function then construct the function by connecting the two three-state buffers and two inverters provided below.

$F(A,B) = \quad A \oplus B$



F(A,B) = AB`+A`B



Grading:
1 mark for the Boolean function.
1 mark for the right connection.

Problem 5 (4 points)

For each problem below, compute the result using the rules of arithmetic, and by selecting YES or NO indicate whether an overflow occurs. Assume all numbers are expressed using a **seven bit two's complement** representation.

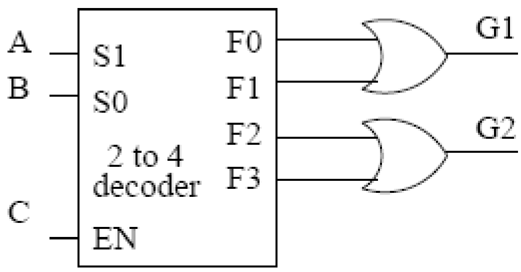
	101 1.110 + 0100.101	011 1.1 1 1 + 0000.001	1000.000 - 0000.001	1010.1 1 1 - 0101.010
Result	0000.011	1000.000	0111.111	0101.101
Overflow?	☐ YES ☒ NO	☒ YES ☐ NO	☒ YES ☐ NO	☒ YES ☐ NO

Grading:
.5 point for result
If the result is correct, then an additional .5 point for correct answer regarding overflow

Problem 6 (2 points)

Fill in the truth table for the circuit below.

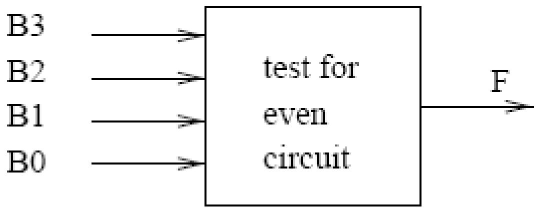
A	B	C	G_1	G_2
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	1	0
1	0	0	0	0
1	0	1	0	1
1	1	0	0	0
1	1	1	0	1



Grading:
1 point for the output of gate G1
1 point for the output of gate G2

Problem7 (3 points)

The circuit below accepts BCD inputs for a decimal digit 0 through 9. The output, F, is 1 only if the BCD input is even. Find a minimum SOP expression for F. The outputs for invalid BCD codes are don't-cares.



Grading:
1 point for the truth table with the output function F
1 point for the K-map or writing the function F in terms of minterms and don't care
1 point for simplification considering don't care terms.
Some students can deduce the function F=B0' directly from the truth table then they get the full mark (3 points)

Solution

B3	B2	B1	B0	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
X	X	X	X	X

By using K-Map or by inspection of the truth table

B3B2 \ B1 B0	00	01	11	10
	1			1
	1			1
	X	X	X	X
	1		X	X

$F = m_o + m_2 + m_4 + m_6 + m_8 + d_{10} + d_{11} + d_{12} + d_{13} + d_{14} + d_{15}$

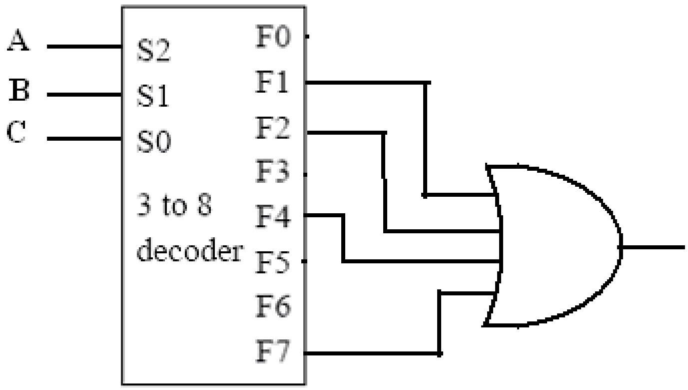
$F = B_0'$

Problem 8 (3 points)
Implement a three bit (A,B,C) even parity generator using a decoder.

Solution

A= S2	B=S1	C=S0	F= Parity bit	
0	0	0	0	
0	0	1	1	F1
0	1	0	1	F2
0	1	1	0	
1	0	0	1	F4
1	0	1	0	
1	1	0	0	
1	1	1	1	F7

P= Parity bit = F1 + F2 + f4 + F7



Grading:
1 point for the truth table with the parity bit as an output
2 points for implementing the output in terms of F's (0.5 point for each input of the OR gate)
If the student draws the circuit directly without truth table, he can get the full marks

Problem 9 (4 points)

Design a full adder with three inputs using two 4-to-1 line multiplexer and an inverter.

Solution

Grading:

1 point for the truth table with the output functions C and S

1 point for completing the truth table with C and S in terms of input Z

1 point for drawing the circuit for C

1 point for drawing the circuit for Z

Truth Table for 1-Bit Binary Adder

X	Y	Z	C	S	C	S
0	0	0	0	0	$C = 0$	$S = Z$
0	0	1	0	1		
0	1	0	0	1	$C = Z$	$S = \overline{Z}$
0	1	1	1	0		
1	0	0	0	1	$C = Z$	$S = \overline{Z}$
1	0	1	1	0		
1	1	0	1	0	$C = 1$	$S = Z$
1	1	1	1	1