Student ID: _____

CS 151
Quiz 1

Name : _____ , _____
(Last Name) (First Name)

Student ID : _____

Signature : _____

Instructions:

1. Please verify that your paper contains **8 pages** including this cover.
2. Write down your Student-Id on the top of each page of this quiz.
3. This exam is **closed book**. No notes or other materials are permitted.
4. Total credits of this midterm are **50 points.**
5. To receive full credits, you must show your work clearly.
6. **No re-grades will be entertained if you use a pencil.**
7. Calculators are **NOT** allowed.

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Q1: [Data Conversion] [9 points]

(a)- Convert the following decimal number to binary using divide-by-2 method: (3 points)

232

232/2 = 116/2 = 58/2 = 29/2 = 14/2 = 7/2 = 3/2 = **1**
Remainder**: 0 0 0 1 0 1 1**

=> $232_{10} = 11101000_2$

(b)- Convert the following binary number to decimal: (3 points)

1 0 1 0 1 1 1 0

$10101110 = 1*2^7 + 0*2^6 + 1*2^5 + 0*2^4 + 1*2^3 + 1*2^2 + 1*2^1 + 0*2^0$
$= 128 + 32 + 8 + 4 + 2$
$= 174_{10}$

(c)- Convert the following hexadecimal number to binary: (3 points)

C1F

$C1F_{16} = (1100\ 0001\ 1111)_2$

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Q2: [Combinational Logic Design] [10 points]

A binary adder has two inputs A = a_1a_0 and B = b_1b_0 and two outputs S = s_1s_0 and C_{out} which is the carry out of the adder saying if a_1 + b_1 generates a carry. Using truth table write the equation for output C_{out}.

You are NOT needed to simplify the function.

NOTE: The truth table has 4 inputs and one output.

a_1	a_0	b_1	b_0		c_{out}
0	0	0	0		0
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		0
0	1	1	1		1
1	0	0	0		0
1	0	0	1		0
1	0	1	0		1
1	0	1	1		1
1	1	0	0		0
1	1	0	1		1
1	1	1	0		1
1	1	1	1		1

Cout = a1'a0b1b0 + a1a0'b1b0' + a1a0'b1b0 + a1a0b1'b0 + a1a0b1b0' + a1a0b1b0

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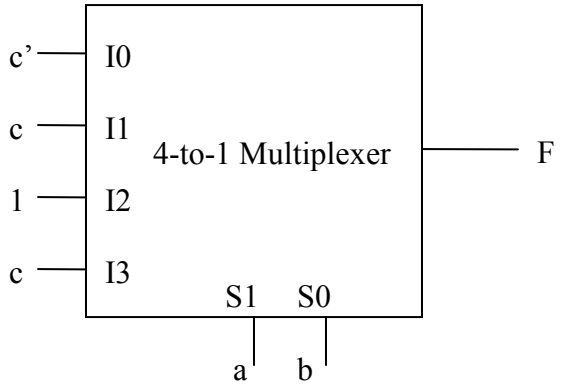
Q3: [Mux/Decoder application] [15 points]

(a) For function **F**(a,b,c) = a'bc + ab'c' + abc + ab'c + a'b'c':
Implement **F** by means of a 4-to-1 multiplexer. You should not simplify the function. (8 points)

(HINT: You can use NOT gates to invert the input to the MUX)



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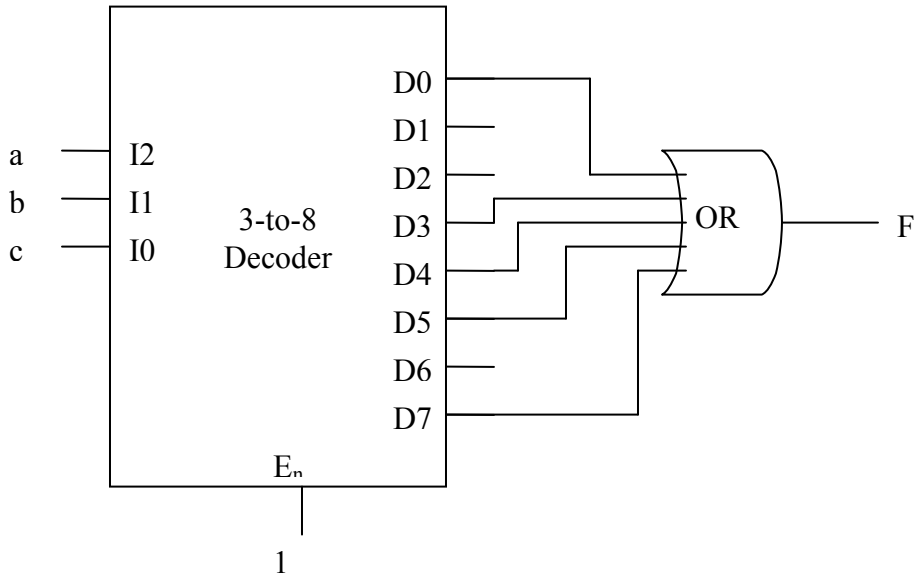
(b) For the same function **F**(a,b,c) = a'bc + ab'c' + abc + ab'c + a'b'c':
Implement **F** by means of a 3-to-8 decoder. You should not simplify the function.
(7 points)



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Q4: [Combinational Logic Design] [5 points]

A network router connects multiple computers together and allows them to send messages to each other. If two or more computers send messages simultaneously, they collide and the messages must be resent. Create a collision detection circuit for a router that connects 3 computers. The circuit has 3 inputs labeled M0, M1 and M2 that are 1 when the corresponding computer is sending a message and 0 otherwise. The circuit has one output labeled C that is 1 when a collision is detected and 0 otherwise. Write the equation for C.

C = M2M1M0' + M2M1'M0 + M2'M1M0 + M2M1M0

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Q5: [Boolean algebra] [11 points]

(a) Prove the following Boolean equation using Boolean algebra: (6 points)

a(a + b + c)(a' + b + c')(a + b + c')(a' + b'c) = 0

$$\left.\begin{array}{l}(a+b+c)(a+b+c') = a+b+c.c' = a+b \\ (a'+b+c')(a'+b'c) = a'+b'c(b+c') = a'\end{array}\right\} \Rightarrow a(a+b)a' = 0$$

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(b) Use algebraic manipulation to convert the following equation to sum-of-product form: (5 points)

x(y + z)(w) + x(y+w)' + y(xz)'

xyw + xzw + x (y'w') + y (x' + z') = <u>xyw + xzy + xy'w' + yx' + yz'</u>