CS 151
Quiz 1

Name : ____________________, ____________________
      (Last Name)      (First Name)

Student ID : ______________

Signature : ____________________

Instructions:

1. Please verify that your paper contains 7 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 credit you must show your work clearly.
6. No re-grades will be entertained if you use a pencil.
7. Calculators are NOT allowed.
Q1: [Data conversion] 10 points

a) Convert the following decimal number to binary number using divide-by-2 method: (5 points)

\[
\begin{array}{c|cccc}
2 & 1 & 1 & 2 & 0 \\
\hline
2 & 5 & 6 & 0 \\
2 & 2 & 8 & 0 \\
2 & 1 & 4 & 0 \\
2 & 7 & 1 \\
2 & 3 & 1 \\
\hline
1
\end{array}
\]

\[(112)_{10} = (11100000)_{2}\]

b) Convert the following hexadecimal number to binary form: (5 points)

ACF1

\[
\begin{align*}
A & : 1010 \\
C & : 1100 \\
F & : 1111 \\
\end{align*}
\]

\[(\text{ACF1})_{16} = (1010 1100 1111 0001)_{2}\]
Q2: [Boolean algebra] 10 points

a) Prove the following Boolean equation using boolean algebra: (5 points)
\[ x'yz'w' + xy'zw' + xy'z'w' + x'y'zw' = y'w' \]

\[
\begin{align*}
x'y'z'w' + xy'z'w' + xy'zw' + x'y'zw' & = y'w' (x'z' + xz + xz' + x'y') \\
& = y'w' (x'(z' + z) + x (y + z')) \\
& = y'w' (x' + x) \\
& = y'w'
\end{align*}
\]

Distributive Property

b) Use algebraic manipulation to convert the following equation to sum-of-product form: (5 points)
\[ (a + b)'(cd)' + a(b+c)'d + (bc)d' \]

\[
\begin{align*}
(a' + b')(c' + d') + a(b + c)'d + (bc)d' & = (a' + b')(c' + d') + a(b' + c')d + bc'd' \\
& = (a' + b')(c' + d') + a(b' + c')d + bc'd' \\
& = a'b'c' + a'b'd' + ab'c'd + bc'd' \\
& \quad \text{(Distributive)}
\end{align*}
\]
Q3: [Combinational logic design] 10 points

There are three major courses X, Y and Z, and two minor courses A and B in a department. A student can graduate if he or she passes:

1- all the major courses from X to Z
or
2- two major courses and both minor courses

Write a Boolean equation to represent the graduation condition. Use the name of the courses as the variables of your equation.

Let $X$ be 1 if student passes course $X$. Similarly for other variables.

First Condition:

$X \cdot Y \cdot Z$

Second Condition:

$X \cdot Y \cdot (A \cdot B) + X \cdot Z \cdot (A \cdot B) + Y \cdot Z \cdot (A \cdot B)$

Let $G$ be a variable which is 1 if student passes graduation condition:

$G = X \cdot Y \cdot Z + X \cdot Y \cdot A \cdot B + X \cdot Z \cdot A \cdot B$

+ $Y \cdot Z \cdot A \cdot B$
Q4: [Muxer/Decoder Application] 12 points

For function $F(x, y, z) = xy'z' + x'yz' + x'y'z$

(a) Create the truth table (4 points)

<table>
<thead>
<tr>
<th>$x$</th>
<th>$y$</th>
<th>$z$</th>
<th>$F$</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>
(b) Implement $F$ by means of 8-to-1 Multiplexer (8 points)
(c) Implement $F$ by means of a 3-to-8 Decoder (8 points)