CS 210 Midterm Exam

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Solve the following problems. Show all of your work. Clearly indicate your final answers (e.g., by boxing them).

1. Convert $(543.21)_{10}$ to base 15, showing fractional digits exactly.

2. Consider subtracting the following binary numbers.

$$
\begin{array}{r}
0 \quad 0 \quad 1 \quad 1 \quad 0 \quad 1 \quad 0 \\
- \quad 1 \quad 0 \quad 1 \quad 1 \quad 1 \quad 0 \quad 1 \\
\hline
\end{array}
$$

   (a) Assuming the numbers are unsigned, compute the difference using diminished radix complement subtraction.

   (b) Assuming the numbers are in signed 2's complement form, compute the difference using signed 2's complement arithmetic.

3. What is the value of the binary number $(101100)_2$ in each of the following interpretations?

   (a) Unsigned (b) Signed magnitude (c) Signed 1's complement (d) Signed 2's complement

4. Consider the Boolean equation

$$y + x'z + (y' + z)(y' + z') = 1$$

   (a) What is the value of the equation?

   (b) Give the dual of the equation.

   (c) Algorithmically convert the Boolean expression on the left-hand side of the equation (the *LHS*) into its canonical sum of minterms form. **Show your work.**

   (d) Convert the LHS into its canonical product of maxterms form.

   (e) Give a Karnaugh map for the LHS.

5. Use algebraic inference to prove that the following logic circuit implements an exclusive-OR operation (denoted $x \oplus y$), which is defined by $x \oplus y = x'y + xy'$.