Show your work on all of the problems below.

1. Perform the indicated conversions.
   (a) $362.89_{10}$ to octal and to binary
   (b) $93.33_{10}$ to binary and to hexadecimal

2. Perform the indicated conversions.
   (a) $1001101.1101_2$ to octal and to hexadecimal
   (b) $341.23_5$ to decimal and to hexadecimal

3. Perform the indicated arithmetic operations in binary.
   (a) $1011101 + 1011$
   (b) $111011 - 1001$
   (c) $110100 \times 11011$

4. Simplify each of the following expressions by applying one of the laws and theorems of Boolean algebra. State the theorem used.
   (a) $AC'(D + B)' + (D + B)$
   (b) $(A + B)(A + C)$

5. Multiply out to obtain a sum of products.
   (a) $(A + B')(A + C + D')(A + B + D')$
   (b) $(A + B)(B + C)(B + D')(ACD' + E)$

6. Factor each of the following expressions to obtain a product of sums.
   (a) $XYZ' + YZP'$
   (b) $WXY + W'X'Y + YZ'$

7. Draw a network to realize the function $ABCD + ABCE + ABCF$ using only one AND gate and one OR gate.

8. (Optional 2 Points) Prove $(A + C)(AB + C') = AB + AC'$ using truth tables.

9. Find the complement and dual of the following expressions (do not simplify the result).
   (a) $[a'bc(a'd + cf) + bf](df + ac'd)$
   (b) $a'bc + 1 + bd(0 + g') + ad$

10. Multiply out and simplify $(C' + D)(A' + D')(A + D)(AC' + F)$ to obtain a sum of two products.

11. Factor out and simplify $C'D + CD' + A'BD$ to obtain a product of three sums.