CSI 250 - SAMPLE EXAM

In this exam you will find algebraic expressions. Be sure to remember the fact that $\overline{A}\ \overline{B}$ is not the same expression as $\overline{AB}$. Show your work or 0 credit. Items inside (*) are alternate questions or explanation for how I may alter a question.

1. Convert $(11100000)_2$ into
   (a) decimal
   (b) hexadecimal
   (c) octal (base 8)
   (d) and base 6

2. Information in computers is always stored in binary as individual bits. Often bits are grouped in packages of 8 into bytes. How many different numbers can a byte (8 bits) represent? If integers were stored without a sign, starting at 0, what is the largest possible integer value in 8 bits? (*How about in excess 4? How about in two's complement?)

3. Convert $(145.625)_{10}$ into binary fixed point with 8 digits before the decimal (radix point) and 4 digits after the decimal (radix point). Remember, that in other bases, the "." is no longer considered to be the decimal point but is rather the radix point. (*What is it in floating point?)

4. Use a K-map to find a simple expression for $f_2(A, B, C, D)$. f_2 is 1 when precisely one input is 1. If 2 or 3 inputs are 1, then the output does not matter. For all other inputs, the function is 0.

5. What is Q and $\overline{Q}$ in an S-R flip flop if both S and R are set to one? You may assume that Q begins as 0 and $\overline{Q}$ begins as 1. Show a brief timing diagram or justification of your answer.

6. Are the following functions (f and g) equivalent? Justify your answer.
   $f(A, B, C) = \overline{AB} + \overline{A}B\overline{C}$
   $g(A, B, C) = \overline{A}C + \overline{A}B$

7. Draw a gate diagram of f(A,B,C) from the previous question. (*Be prepared to go from a gate diagram into a truth table or algebraic expression as well).

8. Use deMorgan's law to get rid of both negations available in the original expression: $\overline{A\overline{B+C}}$. This expression requires 4 gates. How many gates does it take after simplification using deMorgan's law? Comment on the comparison.

9. Given 4 inputs (A, B, C and D) into a system and 2 outputs (F and G). F should be a 1 if either of the first two inputs is a 1 and 0 otherwise. G should be a 1 if the first two inputs are 0 and either C or D are 1. Draw a K-map for this system and produce the simplified algebraic form of F and G.

10. Represent $(32.5)_{10}$ in single precision IEEE floating point.

11. Use a boolean equation and truth table to describe the function below in SOP form.
$g(A, B, C) = \overline{A}C + \overline{A}B$

12. Use a Karnaugh map to simplify:
$F_3(A, B, C, D) = ABCD + AB\overline{C}D + ABC\overline{D} + A\overline{B}CD + \overline{A}BCD + A\overline{B}\,\overline{C}D$

13. Give the two's complement value of -89 using 8 bits.

14. What is the maximum two's complement positive integer and negative integer available with 64 bits. Give your answer in unsimplified form, do not use a calculator. Generalizing, what are these values given n bits?

15. Some numbers in decimal cannot be precisely encoded given a finite number of bits. For example the number represented by $\frac{1}{3}$, may be written as $0.\overline{3}$. Given a limited number of digits after the decimal, this number would have to be approximated (and perhaps severely). For example, if only 4 decimal digits were available after the decimal, this number would be approximated by 0.3333. To resolve this, for any fraction, we could represent this fraction precisely as long as the base were the same as the denominator. Give an explanation for this. Start by describing what a number like $(wx.yz)_n$ actually means generally for some base n.

16. Describe the steps that might be required to tell if one IEEE binary floating point number is bigger than another. Be thorough and explain each distinct part of the floating point number representation.

17. This question has many steps, so be sure to complete each. Convert the gate diagram below into an algebraic equation. Then use the diagram below to construct a truth table and to rewrite the equation in SOP form. Using this SOP, develop a Karnaugh map and provide a simplified version of this equation. Draw the final gate diagram.