Roll no:

Marks: 100

CS225: Midterm Examinations (2018)

Q1:. Two new types are defined as follows: **Nine_ints** are 9-bit signed two's complement integers. **Nine_floats** are 9-bit floating point numbers with 4 bits for the exponent, 4 bits for the fraction, and 1 bit for the sign. **Nine_floats** are similar to IEEE floating point as far as layout of sign, exponent and fraction and represent special values (e.g. 0, pos and neg infinity, NAN) similar to how they are represented in 32 bit IEEE floating point.

a) What is the largest positive number we can represent with **Nine_ints?**
b) What is the largest positive number we can represent with **Nine_floats?**
c) How many numbers can be represented **Nine_ints?**
d) How many numbers can be represented **Nine_floats?** You need not count ∞ or NaN.
e) How many additional numbers could be represented in **Nine_floats** if ∞ and NaN were not represented?

Assuming rules similar to those for conversions between IEEE floats and ints and addition in C, check statements below that are TRUE and give brief explanation.

x) It is possible to lose precision when converting from **Nine_ints** to **Nine_floats**.
y) It is possible to lose precision when converting from **Nine_floats** to **Nine_ints**.
z) The smallest negative number representable as a **Nine_int** < The smallest negative number representable as a **Nine_float**.

(10 Points)

Q2:. A *priority encoder* has 2^N inputs. It produces an N-bit binary output indicating the most significant bit of the input that is TRUE, or 0 if none of the inputs are TRUE. It also produces an output *NONE* that is TRUE if none of the input bits are TRUE. Design an eight-input priority encoder with inputs $A7{:}0$ and outputs $Y2{:}0$ and *NONE*. For example, if the input is 00100000, the output Y should be 101 and *NONE* should be 0. Give a simplified Boolean equation for each output, and sketch a schematic.

(10 Points)

Q3:. Show that (using Boolean Algebra) $\prod M(1,3,4) = \sum m(0,2,5,6,7)$ (10 points)

Q4:. Express $\bar{F} = \overline{(x + yz)}$ as a product of maxterms (using Boolean Algebra).

(10 points)

PTO

Q5: Design a hall light circuit to the following specification. There is a switch at either end of the hall that controls a single light. If the light is off, changing the position of the either switch causes the light to turn on. Similarly, if the light is on, changing the position of either switch causes the light to turn off. Write your assumptions, derive truth table, and implement using NAND gates only.

(10 points)

Q6: Determine the minimized realization of the following functions in the sum-of-products form.

(10 points)

a) $f(W,X,Y,Z) = \sum m(0,2,8,9) + \sum d(1, 3)$
b) $f(AB,C, D) = \prod M(2,5,6,8,9, 10) * \prod D(4,11,12)$

Q7: Simplify the following using a 6-variable K-map. (10 points)

$F(A,B,C,D,E,F) = \sum m(2,8,10,18,24,26,34,37,42,45,50,53,58,61)$

Q8: Use the Quine McCluskey method to find the minimum sum of products form for the following Boolean function. Show your process of deriving the prime implicants. Include the implication chart from which your minimum sum-of-products derived.

$F(A,B,C,D,E) = \sum m(1, 2, 3, 4, 9, 10, 11, 12) + \sum d(0, 13, 14, 15)$ (10 points)

Q9: Develop a minimized Boolean implementation of a 2-bit combination divider. The subsystem has two 2-bit inputs A, B and C, D and generates two 2 bits outputs, the quotient W,X and the remainder Y,Z.

(a) Draw the truth tables for W, X, Y and Z
(b) Minimize the functions, W, X, Y, Z using a 4-variable K-maps. Write down the Boolean expressions for the minimized sum-of-products form of each function
(c) Repeat the minimization process deriving product of sums form

(Assume that division by zero will not happen) (20 Points)