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END SEMESTER EXAMINATION

EC-744 Hardware Algorithms for VLSI

Maximum Marks 50

Time allowed 150 minutes maximum

There are 5 questions in all. One additional question is for extra credit. All the questions are compulsory and carry 10 marks each. Questions vary considerably in difficulty and in how long each will take but they are all worth the same marks. This is an open-book exam. You may use your books and notes but not consult with anyone.

Que 1:

Consider the radix $r = -1 + j$, where $j = \sqrt{-1}$ with the digit set $[0,1]$.

c. Express the complex number $-49 + j$ in this number system.
d. Devise a procedure for determining whether a given bit string represents a real number.

Que2:

A 4-bit binary adder can be used to implement many logic functions besides its intended function. Show how a 4-bit binary adder can be used to realize the following:

h. A 3-bit adder, with carry-in and carry-out.
i. Two independent single-bit full adders.
j. A circuit to realize the four-variable logic function $\bar{w}x + \bar{y}z$.

Que 3:

Consider a fixed-point number system, with k whole and l fractional digits, using the digit set $[-3, 3]$.

c. Determine the range of numbers represented as a function of k and l.
d. Devise a procedure for converting such a radix-4 number to a radix-8 number that uses the digit set $[-7, 7]$.

Que 4:

Multiply the following 4-digit decimal numbers using both the right-shift and left-shift multiplication algorithms. Present your work in the form of figure 9.2 in your text book.

c. A = 8765 and x = 4321
d. A = 0.8765 and x = 0.4321

Que 5:

Perform the division z/d for the unsigned numbers $z = 1011$ and $d = 101$ using both non-restoring as well as restoring algorithms. Present your work in the form of figure 13.6 in your text book.

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Extra Credit:

Design array multipliers for the following number representations.

a. Binary signed-digit numbers using the digit set [-1, 1] in radix 2.
b. One's-complement numbers.

GOOD LUCK!