**COT 4210: Discrete Structures II**

**Exam #2**

**October 21, 2010**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Lecturer: Arup Guha**

**(Directions: Please justify your answer to each question. No answer, even if it is correct, will be given full credit without the proper justification.)**

1) (25 pts) Give the full, formal description of a Turing Machine that accepts the following language:

L = { w#wR | where w consists of only 0s and 1s and has length at least 1. }

The input alphabet will be {0, 1, #}.

The tape alphabet will include 0, 1, #, B, and any other symbols you choose to include in it.

After the formal description, give a simple intuitive description of what each state in the machine represents.

2) (15 pts) A Lazy Turing Machine is one that has the ability to stay in the same spot, in addition to moving left or right at the end of a transition. Prove that a Lazy Turing Machine is equivalent in power to a standard Turing Machine.

3) (15 pts) The language COMPDFA is defined as follows:

 COMPDFA = { <A, B> | A and B are DFAs and $L\left(A\right)=\overbar{L(B)}$ }

Prove that COMPDFA is decidable.

4) (15 pts) Let C be the set of complex numbers of the form a + bi, where a and b are integers. Determine, with proof, whether or not C is countable.

5) (15 pts) Let S be the set of subsets of prime numbers. For example, {2, 5, 7, 97} is an element of S as is {3, 71, 101}. But, (2, 8, 11} is not, since 8 is not prime. Determine, with proof, whether or not S is countable.

6) (10 pts) Let EQTM = { <M1, M2> | M1 and M2 are Turing Machines with L(M1) = L(M2). }. Show that EQTM is not decidable by showing that if you had a decider for EQTM, you could build a decider for ATM.

7) (5 pts) Tomorrow marks the 16th annual Spirit Splash at UCF. What year did the first Spirit Splash occur?

**Scratch Page – Please clearly mark any work on this page you would like graded.**