**COT 4210: Discrete Structures II**

**Exam #1**

**June 11, 2012**

**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) (10 pts) Create a DFA over the alphabet {a, b} that contains all strings without any consecutive b’s. (For example, your DFA should accept aaababab, babab, b, and ba, but it should reject bb, aaaaabb, and ababababbaaaaa.)

2) (10 pts) Design an NFA over the alphabet {0, 1} that accepts all strings that either start with 01 or end with 1011. In order to get full credit, your machine MUST have some non-determinism.

3) (15 pts) Given the following DFA, run the algorithm in the textbook that converts this DFA to an equivalent regular expression. Run the algorithm by **first ripping out state q2, followed by stated q1 and finishing by ripping out state q0.** Show your intermediate results after each rip.

 

4) (10 pts) Let L = { 0x1y | x > 3y } over the alphabet {0,1}. Prove, via the pumping lemma, that L is not regular.

5) (15 pts) Let L = { 0n | n = xy, where x and y are distinct prime numbers } over the alphabet {0}. Prove, via the pumping lemma, that L is not regular.

6) (10 pts) Design a Context Free Grammar for a language over the alphabet of open and close braces and open and close parentheses. In particular, any matching pair of open braces may contain a sequence of matching braces or parentheses, but a pair of matching parentheses may only contain other pairs of matching parentheses. For example, { ( ) ( ) ( ) ( ) }, { } { { } { ( ) } } and { { { ( ) } { } ( ) ( ( ) ( ) ) } ( ) } are all part of the language, but { ( { } ) } is not.

7) (15 pts) Convert the following grammar with the start symbol S and terminals 0, 1 to Chomsky Normal Form:

S → ABBA | B

A → 0A0 | 1 | ε

B → BS | AAA | 00

8) (14 pts) Design a PDA that accepts the following language over the alphabet {a,b,c}: L = {aibjck | j ≥ i + k }. Briefly describe how your machine works and justify that it accepts precisely the strings in L.

9) (1 pt) Name one country other than the United States that borders the Gulf of Mexico.

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