Ph.D. Qualifying Exam (Spring 2003)
Automata and Formal Languages
Answer ALL questions

Question 1.

(a) (10%)
Suppose we state the pumping lemma for context-free languages (CFL) as

$$\forall \text{ CFL } A, \ P(A)$$

What is $P(A)$?

(b) (25%)
Let $L = \{a^i b^i c^j \mid i \neq j\}$. Is $P(L)$ true or false? Prove your answer.

Question 2.

(a) (10%)
Consider the following grammar:

```
<stmt>           --> <if-then> | <if-then-else> | <assign>
<if-then>        --> if <condition> then <stmt>
<if-then-else>   --> if <condition> then <stmt> else <stmt>
<assign>         --> x=1
<condition>      --> y==1
```

Show that the grammar is ambiguous.

(b) (25%)
The general rule for parsing if-then and if-then-else statements can be summarized as "Match each **else** with the closest previous unmatched **then**". Give the design of a deterministic PDA that parses nested if-then and if-then-else statement correctly. You can describe the PDA using plain English or pseudo code in C/Pascal style.

Question 3

(a) (15%)
Give a 7-state DFA for the regular language $(0+1)^*110111(0+1)^*$.

(b) (15%)
Give a 7-state DFA for the regular language $(0+1)^*110111$.