- This examination is closed books.

- Please turn off your cell phones.

- Remember that there are 2 pages of the qualify examination.

- Answer all questions as possible. You may have a partial score if you answer the correct direction.

1. Deterministic Finite Acceptor (DFA) (10 pts)

    Find a dfa for the following language on $\Sigma = \{a, b\}$:
    $L = \{w : |w| \bmod 3 = 0 \ , \ |w| \neq 6\}$.

2. Nondeterministic Finite Acceptor (NFA) (10 pts)

    Find an nfa with four states for $L = \{a^n : n \geq 0\} \cup \{b^n a : n \geq 1\}$.

3. Find a regular grammar that generates the language on $\Sigma = \{a, b\}$ consisting of all strings with no more than two a's. (10 pts)

4. Determine whether or not the following language on $\Sigma = \{a, b, c\}$ is regular: (10 pts)
    $L = \{a^n b^l a^k : k \leq n + l\}..$

5. Show that the following grammar is ambiguous. (10 pts)
    $S \to aSbS|bSaS|\lambda$.

6. Prove that all finite languages are regular. (10 pts)

7. Construct a nondeterministic pushdown automata that accepts the following language on $\Sigma = \{a, b, c\}$: (10 pts)

    $L = \{a^n b^{n+m} c^m : n \geq 0, m \geq 1\}$.

8. Construct a dfa that accepts the language generated by the grammar: (10 pts)
    $S \to abA$,
    $A \to baB$,
    $B \to aA|bb$.

9. Fill the following languages into the language hierarchy (If L_i is a regular language and also a context-free language, please fill L_i in the set of regular languages): (20 pts)

$L_1 = \{a^n b^i c^j d^k : n + k \leq i + j\}$,

$L_2 = \{a^n b^m c^{n+m} : n \geq 0, m \geq 0\}$,

$L_3 = \{a^3 b^n c^n : n >= 0\}$,

$L_4 = \{a^n b^k c^n d^k : n \geq 0, k > n\}$,

$L_5 = \{a^n b^n c^n : n \geq 0\}$,

$L_6 = \{ww : w \in \{a, b\}^*\}$,

$L_7 = \{ab, ad, ac, b, cd, acd\}$,

$L_8 = \{a^{n!} : n \geq 0\}$,

$L_9 = \{a^n : n \text{ is a prime number}\}$,

$L_{10} = \{a^n b^j : n \leq j^2\}$.

(3)

Context-Free Languages

(2)

Regular Languages

(1)