

BACHELOR OF COMPUTER SCIENCE ENGINEERING
EXAMINATION, 2012

(4th Year, 1st Semester)

FORMAL LANGUAGE AND AUTOMATA THEORY

Time : Three Hours

Full Marks - 100

Answer any **Five** questions

1. a) Construct a DFA which accepts all strings of $\{a, b\}$ where the absolute difference between the number of a's and b's in each prefix is at most 1. Give necessary justifications.

 b) Let A be a regular set. Which of the following statements are true?

 i) "Every set B such that $A \subseteq B$ is also regular"

 ii) "Every set B such that $B \subseteq A$ is also regular"

 Give necessary explanation. 10+10

2. a) State and prove the Pumping Lemma for regular languages.

 b) Find out if the language $L = \{xx^Ry : x \in \{a, b\}^+, y \in \{a, b\}^+\}$ is regular. 12+8

3. a) State and prove a theorem which can determine the equivalence relation R_{k+1} on the states of a DFA when R_k is known.

[Turn over

- b) Prove that for each DFA, a positive integer m exists such that $R_m = R_\infty$ holds.
- c) Assuming that the equivalence classes under R_∞ known for a DFA M , explain how the minimum state DFA equivalent to M can be found. 4+5+11
4. a) Prove that if L is a context-free language, then so is L^* .
- b) Using suitable languages, show that the complement of a context-free language may or may not be context-free. If any theorem is used, its proof must be given. 6+14
5. a) Let A be an internal node in a derivation tree of a Context-Free-Grammar. If the yield of the subtree rooted at this A is z , prove that the yield of the whole subtree is xzv for some strings u, v .
- b) State and prove the Pumping Lemma for Context Free Languages. 4+16
6. a) Describe an algorithm for determination of nullable non-terminals of a context-free grammar. Prove its correctness.
- b) Prove that for each context-free grammar G , there exists another context-free grammar G' such that

- $L(G') = L(G) - \{\epsilon\}$ and there is no empty production rule in G' . 8+12
7. a) Develop a grammar which generates all strings of a, b where the number of a 's in every prefix is greater than equal to the number of b 's. Give necessary proof.
- b) Find out if the language $\{a^i b^j c^k : 0 \leq i < j < k\}$ is a context-free language. 10+10