B.C.S.E. FINAL EXAMINATION, 2009

1st Semester

FORMAL LANGUAGE & AUTOMATA THEORY

Answer any *five* questions

All parts of the same question must be answered together

Time : Three hours   Full Marks : 100

1. (a) Construct a DFA for the language of all binary strings where every alternate symbol is 1 starting with the *first* symbol for strings of *odd* length and starting with the *second* symbol for strings of *even* length.

   (b) Construct a DFA for the language of all binary strings where length of a string is ≤ 3 or every substring of length 4 contains at least three 1's. Use minimum number of states and give necessary justifications.

   10+10

2. (a) State and prove the *pumping lemma* for languages accepted by a DFA.

   (b) Find out if the language $\{a^i b^j : i \text{ is odd or } i > j\}$ is accepted by a DFA.

   12+8

3. (a) Prove that every *finite* language is accepted by a DFA. Also prove any other theorem which you may use for proving this result.

   (b) Let the language L be accepted by a DFA. Prove that the language $MAX(L) = \{x \in L : xy \notin L \text{ for every } y\}$ is also accepted by a DFA.

   12+8

4. (a) Describe an algorithm for determination of the reachable states from a given subset of states. Prove the correctness of the algorithm.
   Explain under what conditions the outermost loop of this algorithm may terminate before $n-1$ iterations.

   (b) Prove that if the language L is accepted by a DFA, then so is the language $\text{Prefix}(L)$. Is the converse of this result true?

   12+8

5. (a) Construct a DFA for all binary strings where *at least* one pair of 1's is separated by a string of *even* length. Note that 0 is considered to be an even number.

   (b) Find out if the language $\{ww : w \in \{a,b\}^*\}$ is accepted by a DFA.

   10+10

6. (a) State and prove a result which characterizes structure of all strings with same number a's and b's.

   (b) Hence develop a grammar for the language of all strings of a,b with same number of a's and b's.

   12+8

7. (a) Find out the language generated by the following grammar with necessary proof:

   $S \to \epsilon \quad S \to aB \quad S \to bA$

   $A \to aS \quad A \to bAA$

   $B \to bS \quad B \to aBB$

   (b) Develop a grammar for the language $\{a^i b^j c^k d^l : i + j = k + l, i, j, k, l \geq 0\}$ with necessary proof.

   10+10