1129
B.E. (Computer Science and Engineering)
Fifth Semester
CS-505: Theory of Computation

Time allowed: 3 Hours   Max. Marks: 50

NOTE: *Attempt* five *questions in all, including Question No. I which is compulsory and selecting two questions from each Section.*

x-x-x

I.   Write short answers of the following:
   a.   What are ϵ-moves?
   b.   Prove or disapprove: $(R + S)^*S = (R^*S)^*$
   c.   Define finite automaton. Why it is called finite?
   d.   What are unit productions and null productions?
   e.   State the halting problem.

(10 marks)

Section-A

II.
   a.   For $\Sigma = \{a, b\}$, construct a DFA that accepts the sets consisting of all strings with at least one a and exactly two bs.
   b.   Prove that for every NDFA, there exists a DFA which simulates the behavior of NDFA.

(4,6)

III.
   a.   With the help of an example, describe an algorithm to minimize the number of states of an automaton.
   b.   Construct the finite automaton equivalent to the regular expression $(a+b(bb)^*ba)b+b(bb)^*c)$.

(5,5)

IV.
   a.   What is Chomsky Normal Form? Reduce the following grammar G into CNF
        $S\rightarrow aAD$, $A\rightarrow aB|bAB$, $B\rightarrow b$, $D\rightarrow d$
   b.   State pumping lemma for regular sets. Using the pumping lemma, show that the following set is not regular: $\{a^n b^m | 0 < n < m\}$.

(5,5)

Section-B

V.
   a.   Design a Push-down Automaton to accept the language $\{0^n 1^m 0^n | m, n \geq 1\}$. Accept either by final state or empty stack.
   b.   Describe multi-head and multi-tapes Turing machines in detail.

(5,5)

VI.
   a.   State pumping lemma for CFLs. Show that $\{a^m b^n | n = m^2\}$ is not a context free language.
   b.   With the help of an example, describe a technique for Turing machine construction.

(5,5)

VII. Write short notes on
   a.   Recursive and recursively enumerable languages
   b.   Polynomial time reductions

(5,5)

x-λ-x