

1078
B.E. (Computer Science and Engineering)
Fifth Semester
CSE-505: Theory of Computation

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section.

x-x-x

- I. Write short answers of the following:
 - a. Prove or disapprove: $(R + S)^*S = (R^*S)^*$
 - b. Is the grammar $S \rightarrow SS|S(S)S|\epsilon$ ambiguous? Why or why not?
 - c. What are recursive and recursively enumerable languages?
 - d. What is difference between Kleene closure and Kleene positive closure? Give example.
 - e. State the halting problem of Turing machines.

Section-A

- II.
 - a. State pumping lemma for regular sets. Using pumping lemma, show that the set $\{a^n b^{2n} | n > 0\}$ is not regular.
 - b. Construct a minimum state automaton equivalent to DFA whose transition table is given below:

State	0	1
$\rightarrow Q_1$	Q ₂	Q ₃
Q ₂	Q ₃	Q ₅
Q ₃ Final state	Q ₄	Q ₃
Q ₄	Q ₃	Q ₅
Q ₅ Final state	Q ₂	Q ₅

- III. Begin with the grammar:

$S \rightarrow ABC|BaB$
 $A \rightarrow aA|BaC|aaa$
 $B \rightarrow bBb|a|D$
 $C \rightarrow CA|AC$
 $D \rightarrow \epsilon$

- a. Eliminate ϵ -productions.
 - b. Eliminate any unit productions in the resulting grammar.
 - c. Eliminate any useless symbols in the resulting grammar.
 - d. Put the resulting grammar into Chomsky Normal Form.
- IV.
 - a. Define regular expression. Show that $(1 + 00^*1) + (1 + 00^*1)(0 + 10^*1)^*(0 + 10^*1) = 0^*1(0 + 10^*1)^*$.
 - b. Convert the regular expression $011(0 + 1)^*$ to equivalent
 - i. NFA with ϵ -transitions
 - ii. NFA without ϵ -transitions
 - iii. DFA

Section-B

V.

- a. Convert the grammar $S \rightarrow S0S1S0S|S0S0S1S|S1S0S0S|\epsilon$ to a PDA that accepts the same language by empty stack.
- b. State the pumping lemma for Context-free languages. Using pumping lemma, show that the language $\{0^m1^n|m \neq n\}$ is not context-free.

VI.

- a. Describe Turing machine model. Describe multi-tape Turing machine as an extension to the basic Turing machine. Does the multi-tape Turing machine and basic Turing-machine have same language-recognizing power? Comment.
- b. Design a Push-down Automaton to accept the language $\{0^n1^m0^m1^n|m, n \geq 1\}$. Accept either by final state or empty stack.

VII.

Write short notes on:

- a. Tractable and intractable problems
- b. Polynomial time reductions
