B.Sc. DEGREE EXAMINATION,APRIL 2020
III Year VI Semester
Formal Languages and Automata Theory

Time : 3 Hours **Max.marks :75**

Section A $(10 \times 2 = 20)$ Marks

Answer any **TEN** questions

1. Define a context-sensitive grammar.
2. Write the Chomskian hierarchy.
3. Let $G=(N,T,P,S)$ where $N=\{S,A\}$, $T=\{a,b\}$ and $P=\{S \rightarrow aAb,\ S \rightarrow abSb,\ S \rightarrow a,\ A \rightarrow bS,\ A \rightarrow aAAb\}$. Find the derivation tree for the word $abab$.
4. Define product of two languages.
5. Define Greibach normal form.
6. Give an example of a reduced grammar.
7. Define $\in$-CLOSURE of a state.
8. Define a deterministic finite automaton.
9. Find a regular expression for the following language over the alphabet $\{0,1\}$.
   "All strings of 0's and 1's with at least two consecutive 0's"
10. Let $L_1=\{10,1\}$ and $L_2=\{011,11\}$. Then find $\mathbf{L}_1 L_2$.
11. When do you say that a phrase structure grammar is length increasing?
12. Define a regular expression.

Section B $(5 \times 5 = 25)$ Marks

Answer any **FIVE** questions

13. Find the language generated by the grammar
    $G=(\{S\},\{a,b\},\{S \rightarrow aSa,\ S \rightarrow bSb,\ S \rightarrow c\},S)$
14. Show that the family of CFL is not closed under intersection.
15. Given a context-free grammar $G=(N,T,P,S)$, there exists an equivalent context-free grammar G_1 such that for each non-terminal $A \neq S$ in G_1, $L_A=\{w \mid A \Longrightarrow^* w,\ \ w \in T^*\}$ is infinite.

16. Let $M=(Q,\Sigma,\delta,q_0,F)$ where $Q=\{q_0,q_1,q_2,q_3\}$, $\Sigma=\{0,1\}$, $F=\{q_0\}$ and δ is given by

States	Inputs 0	1
q_0	q_2	q_1
q_1	q_3	q_0
q_2	q_0	q_3
q_3	q_1	q_2

Draw the transition diagram of M and check whether the string 110101 is accepted by M

17. Show that the language $L=\left\{0^{i^2}:i \text{ is an integer, } i\geq 1\right\}$ is not regular.

18. Find a regular grammar to generate the language

$\left\{w \mid w \text{ is in } \{a,b\}^{+}\text{and w does not contain two consecutive a's}\right\}$

19. Construct an NFA for the regular expression $01^{*}+1$.

Section C $(3\times 10=30)$ Marks

Answer any **THREE** questions

20. Let $G=\{(S,Z,A,B\},\{a,b\},P,S\}$ where P consisting of the following productions: $S\rightarrow aSA$, $S\rightarrow aZA$, $Z\rightarrow bZB$, $Z\rightarrow bB$, $BA\rightarrow AB, bAB\rightarrow baB$, $aAB\rightarrow aaB$, $aB\rightarrow ab, bB\rightarrow bb$. Find the language generated by G.

21. Show that the family of CFL is closed under both substitution and homomorphism.

22. State and prove Chomsky normal form theorem.

23. Let $M=(\{q_0,q_1\},\{0,1\},\delta,q_0,\{q_1\})$ be an NFA where

$\delta(q_0,0)=\{q_0,q_1\}$, $\delta(q_0,1)=\{q_1\}$, $\delta(q_1,0)=?$ and $\delta(q_1,1)=\{q_0,q_1\}$. Construct an DFA $\mathbf{M'}$ to accept $L(M)$.

24. Let r be a regular expression. Show that there exist an NFA with $\in$-transitions that accepts $L(r)$.

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