B.Sc DEGREE EXAMINATION,APRIL 2019
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. Define a word and length of a word.
3. Let $G = (\{S\}, \{a, b\}, \{S \to aSb,\ S \to ab\}, S)$. Find a derivation tree for the word a^2b^2.
4. What is meant by reflection of a language?
5. Give an example of a context-free grammar which is in Chomsky normal form.
6. When do you say that a grammar is reduced?
7. Define $\in$-closure of a state.
8. Define a deterministic finite automaton.
9. Define regular expression.
10. If $L_1 = \{10, 1\}$ and $L_2 = \{011, 11\}$. Find L_1L_2.
11. Write down the Chomsky hierarchy.
12. Define Greibach normal form.

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

Answer any **FIVE** questions

13. Define a language generated by a grammar. Find the language generated by the grammar $G = (N, T, P, S)$ where $N = \{S\},\ T = \{a, b\}$ and $p = \{S \to aSb,\ S \to ab\}$.
14. When do you say that a grammar is ambiguous? Show that the grammar $G = (N, T, P, S)$ where $N = \{S, A\},\ T = \{a, b\}$ and

    $P = \{S \to aAb,\ \ S \to abSb,\ S \to a,\ A \to bS,\ A \to aAAb\}$ is ambiguous.
15. Let $G = (N, T, P, S)$ be any context-free grammar generating a non-empty language. Show that it is possible to find an equivalent grammar G_1 such that for every non-terminal A in G_1, there is a terminal string w such that $A \Rightarrow^* w$.

16. Let $M = (\{q_0, q_1\}, \{0,1\}, \delta, q_0, \{q_1\})$ be an NFA where $\delta(q_0, 0) = \{q_0, q_1\}$, $\delta(q_0, 1) = \{q_1\}$, $\delta\{q_1, 0) = \phi$, $\delta(q_1, 1) = \{q_0, q_1\}$. Construct and equivalent DFA.

17. Construct an NFA for the regular expression $01^* + 1$.

18. Show that the family of CFL is closed under substitution.

19. State and prove the pumping lemma for regular sets.

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

Answer any **THREE** questions

20. (a) Obtain a context sensitive grammar for the language $\{a^n b^n c^n \quad : n = 1\ \}$.

    (b) Find a regular grammar $\mathbf{G}$ to generate the language

    $\mathbf{L} = \left\{\mathbf{w} \mid \mathbf{w} \text{ is in } \{\mathbf{a}, \mathbf{b}\}^+ \ \ \& \ \mathbf{w} \text{ consist of an even number of } \mathbf{a}'\text{s} \text{ and an even number of } \mathbf{b}'\text{s}\right\}$

21. Show that the family of context free languages is closed under homomorphism but not under intersection.

22. Construct a context-free grammar in Greibach normal form to generate the language $L = \left\{ww^R \mid \ w \text{ is in } \{a, b\}^+\right\}$.

23. Show that if L is accepted by an NFA with $\in$-transition, then L is accepted by an NFA without $\in$-transitions.

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

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