B.Sc. DEGREE EXAMINATION,NOVEMBER 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 length of the a word and product of two words?
2. Define a regular grammar and a regular language.
3. Define reflexion of a word and reflexion of a language.
4. When is a grammar said to be ambiguous and inherently ambiguous.
5. When do you say that a grammar is reduced?
6. Let $G = (\{S\}, \{a\}, P_1, S)$ where $P_1 = \{S \to SS,\ S \to a\}$. Find a derivation tree for the string a^3.
7. Define $\in$-closure of a state in a finite automata.
8. Define a non-deterministic finite automata.
9. Write regular expression for the language "set of all strings of $\mathbf{0}$'s and $\mathbf{1}$'s beginning with a 1 and not having consecutive $\mathbf{0}$'s.
10. State any two applications of the pumping lemma for regular sets..
11. Give an example of a context-sensitive language.
12. If $\mathbf{L_1}$=$\{\mathbf{10}, \mathbf{11}\}$ and $\mathbf{L_2}$=$\{\mathbf{011}, \mathbf{1}\}$, then find $\mathbf{L_1L_2}$.

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

Answer any **FIVE** questions

13. Find the language generated by the context free grammar $\mathbf{G}$=$(\{\mathbf{S}\}, \{\mathbf{a}, \mathbf{b}\}, \{\mathbf{S} \to \mathbf{a}Sa, \mathbf{S} \to \mathbf{b}Sb, \mathbf{S} \to \mathbf{c}\}, \mathbf{S})$.
14. Show that PSL is closed under reflection.
15. Given a context-free grammar $\mathbf{G}$=$(\mathbf{N}, \mathbf{T}, \mathbf{P}, \mathbf{S})$, show that there is an equivalent grammar $\mathbf{G}'$ with no rules of the form $\mathbf{A} \to \mathbf{B}$, where $\mathbf{A}, \mathbf{B} \in \mathbf{N}$.
16. Let $M = (Q, \Sigma, \delta, q_0, F)$ where $Q = \{q_0, q_1, q_2\}$, $\Sigma = \{a, b\}$, $F = \{q_2\}$ and δ is given by

δ	a	b
q_0	$\{q_0, q_1\}$	?
q_1	ϕ	$\{q_2\}$
q_2	ϕ	$\{q_2\}$

Draw the transition diagram of M and find the language recognized by it.

17. Construct an non-deterministic finite automaton for the regular expression $\mathbf{01^*+1}$.
18. Convert the grammar $\mathbf{G=(N,T,P,S)}$ where $\mathbf{N=\{S\}}$, $\mathbf{T=\{a,b,c\}}$, and $\mathbf{P=\{S \to aSa,\ S \to bSb,\ S \to c\}}$ into Chomsky normal form.
19. Show that the language $\mathbf{L=\left\{a^i b^i c^i \mid i \geq 1\right\}}$ is not context-free.

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

Answer any **THREE** questions

20. Construct a regular grammar to generate the language

    $\mathbf{L=}$ $\left\{\mathbf{w} \mid \mathbf{w}\ is\ in \left\{\mathbf{a,b}\right\}^+ \text{ and } \mathbf{w} \text{ consists of an even number of } \mathbf{a}'s \text{ and an even number of } \mathbf{b}'s\right\}$
21. Show that the family of CFL is closed under substitution but not under intersection.
22. State and prove Greibach normal form theorem.
23. Let $\mathbf{L}$ be a set accepted by a nondeterministic finite automaton. Show that there exists a deterministic finite automaton that accepts L.
24. State and prove the pumping lemma for regular sets.

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