B.Sc. DEGREE EXAMINATION,NOVEMBER 2018
III Year VI Semester
Core Elective - Paper II
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 and context-sensitive language.
2. Give an example for a context-free grammar.
3. Let $\mathbf{G}= (\{\mathbf{S}\}, \{\mathbf{a}\}, \mathbf{P}, \mathbf{S})$ where $\mathbf{P}= \{\mathbf{S} \rightarrow \mathbf{S}S,\ \mathbf{S} \rightarrow \mathbf{a}\}$. Find a left most derivation for the string $\mathbf{a^4}$.
4. Define the reflection of a language.
5. When do you say that a grammar is reduced?
6. State the Greibach normal form theorem.
7. Define a finite automaton.
8. Define a non-deterministic finite automata with ϵ- moves.
9. If $\mathbf{L_1}= \{10, \mathbf{1}\}$ and $\mathbf{L_2}= \{\mathbf{0}11,\ \mathbf{1}1\}$. Then find $\mathbf{L_1 L_2}$.
10. State the pumping lemma for regular sets.
11. Define a regular set and give an example.
12. 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.

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

Answer any **FIVE** questions

13. Find the language generated by the grammar $\mathbf{G}= (\{\mathbf{S}, \mathbf{A}\}, \{\mathbf{a}, \mathbf{b}\}, \mathbf{P}, \mathbf{S})$ where $\mathbf{P}= \{\mathbf{S} \rightarrow \mathbf{a}Sb,\ \mathbf{S} \rightarrow \mathbf{a}Ab,\ \mathbf{A} \rightarrow \mathbf{b}Aa,\ \mathbf{A} \rightarrow \mathbf{b}a\}$
14. Show that phrase-structure languages are closed under product.
15. Convert the following grammar in to Greibach normal form: $\mathbf{G}= (\mathbf{V}, \mathbf{T}, \mathbf{P}, \mathbf{S})$ where $\mathbf{N}= \{\mathbf{S}, \mathbf{S_1}\}$, $\mathbf{T}= \{\mathbf{a}, \mathbf{b}\}$ and $\mathbf{P}= \{\mathbf{S} \rightarrow \mathbf{S_1 S},\ \mathbf{S} \rightarrow \mathbf{S_1},\ \mathbf{S_1} \rightarrow \mathbf{a S_1 b},\ \mathbf{S_1} \rightarrow \mathbf{a}b\}$.
16. Let $\mathbf{M}= (\mathbf{Q}, \mathbf{\Sigma}, \delta, \mathbf{q_0}, \mathbf{F})$ where $\mathbf{Q}= \{\mathbf{q_0}, \mathbf{q_1}, \mathbf{q_2}, \mathbf{q_3}\}$, $\mathbf{\Sigma}= \{\mathbf{0}, \mathbf{1}\}$, $\mathbf{F}= \{\mathbf{q_0}\}$ and δ is given by

Inputs

states	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 $\mathbf{1}10101$ is accepted by $\mathbf{M}$.

17. Show that the set $\mathbf{L}=\left\{\mathbf{0}^{\mathbf{i}^{2}} \mid \mathbf{i}\ \mathbf{i}s\ \mathbf{a}n\ \mathbf{i}nteger\right\}$ is not regular.

18. When do you say that a grammar is ambiguous? Show that the grammar $\mathbf{G}=(\mathbf{N}, \mathbf{T}, \mathbf{P}, \mathbf{S})$ where $\mathbf{N}=\{\mathbf{S}, \mathbf{A}\}$, $\mathbf{T}=\{\mathbf{a}, \mathbf{b}\}$ and $\mathbf{P}=\{\mathbf{S} \rightarrow \mathbf{a}Ab,\ \ \mathbf{S} \rightarrow \mathbf{a}bSb, \mathbf{S} \rightarrow \mathbf{a}, \mathbf{A} \rightarrow \mathbf{b}S, \mathbf{A} \rightarrow \mathbf{a}AAb\}$ is ambiguous.

19. Construct an non-deterministic finite automata for the regular expression $\mathbf{01}^{*}+\mathbf{1}$.

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

Answer any **THREE** questions

20. Find a regular grammar $\mathbf{G}$ to generate the language
$$\mathbf{L}=\left\{\begin{array}{c}\mathbf{w} \mid \mathbf{w} \text{ is in } \{\mathbf{a}, \mathbf{b}\}^{+} \\ \& \ \mathbf{w} \text{ consist of an even number of } \mathbf{a}'\text{s and an even number of } \mathbf{b}'\text{s}\end{array}\right\}$$

21. Show that context-free language is closed under homomorphism but not closed under intersection.

22. State and prove Chomsky normal form theorem.

23. If $\mathbf{L}$ is accepted by an non-deterministic finite automata with ϵ-transitions, then show that $\mathbf{L}$ is accepted by an non-deterministic automata without ϵ-transitions.

24. Show that if $\mathbf{L}$ is accepted by a deterministic finite automata, then $\mathbf{L}$ is denoted by a regular expression.

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