**B.Sc. DEGREE EXAMINATION, APRIL 2016**

**III YEAR — VI SEMESTER**

**Elective II — FORMAL LANGUAGES AND AUTOMATA THEORY**

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

**SECTION A — (10 × 2 = 20 marks)**

**Answer any *TEN* questions.**

1. Write down the Chomsky hierarchy.
2. Define a regular set and give an example.
3. Define the product of two languages $L\_{1}$ and $L\_{2}$.
4. When is a grammar said to be ambiguous and inherently ambiguous.
5. Let $G=\left(\left\{S\right\},\left\{a\right\},P\_{1},S\right) $where $P\_{1}=\left\{S\rightarrow SS, S\rightarrow a\right\}$. Find a derivation tree for the string $a^{3}$.
6. When do you that a given grammar is reduced?
7. Define Greibach normal form.
8. Define a non-deterministic finite automaton.
9. If $L\_{1}=\left\{10,1\right\}$and $L\_{2}=\left\{011,11\right\}$. Find $L\_{1}L\_{2}$.
10. Define regular expression.
11. State the pumping lemma for context-free languages.
12. Define reflection of a language.

**SECTION B — (5 × 5 = 25 marks)**

**Answer any *FIVE* questions.**

1. Obtain a context sensitive grammar for the language $\left\{a^{n}b^{n}c^{n} :n\geq 1 \right\}$.
2. Find a grammar that generate the language

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

1. Prove that the family of context free languages is closed under substitution.
2. Given a context free grammar $G=(N,T,P,S)$, show that there exit an equivalent grammar $G'$ with no rules of the form $A\rightarrow B, A,B\in N$.
3. Let $M=\left(Q,Σ,δ,q\_{0},F\right)$ where $Q=\left\{q\_{0},q\_{1},q\_{2}\right\}, Σ=\left\{a,b\right\}, F=\left\{q\_{2}\right\}$ and $δ$ is given by

|  |  |  |
| --- | --- | --- |
| $$δ$$ | $$a$$ | $$b$$ |
| $$q\_{0}$$ | $$\{q\_{0},q\_{1}\}$$ | $$ϕ$$ |
| $$q\_{1}$$ | $$ϕ$$ | $$\left\{q\_{2}\right\}$$ |
| $$q\_{2}$$ | $$ϕ$$ | $$\left\{q\_{2}\right\}$$ |

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

[P.T.O.]

1. Construct an NFA for the regular expression $01^{\*}+1$.
2. Show that the language $L=\left\{a^{i}b^{i}c^{i} :i\geq 1\right\}$ is not context free.

**SECTION C — (3 × 10 = 30 marks)**

**Answer any *THREE* questions.**

1. Define context free grammar. Obtain a context free grammar for the following language$ L= \{w: w$ is in $\left\{a,b\right\}^{+}$ and $w$ consists of an equal number of $a$’s and $b$’s}.
2. Define intersection of two languages. Show that the family of context free languages is closed under homomorphism but not under intersection.
3. State and prove Chomsky normal form theorem.
4. If $L$ is accepted by an NFA with $ϵ$-transitions, then show that $L$ is accepted by an$ NFA$ without $ϵ$-transitions.
5. State and prove the pumping lemma for regular sets.

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