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**1 SEM TDC CSC G 1**

**2014**

( November )

COMPUTER SCIENCE

( General )

Course : 101

**( Theoretical Foundation of Computer Science )**

*Full Marks* : 80

*Pass Marks* : 32 (Backlog) / 24 (2014–15 Session)

*Time* : 3 hours

*The figures in the margin indicate full marks for the questions*

**1.** Answer as directed : 1×8=8

*(a)* Define finite automata.

*(b)* Write one difference between NFA and DFA.

*(c)* The grammar

$G = \{N, T, P, S\}$
$N = \{S, A, B\}$
$T = \{a, b, c\}$
$P : S \rightarrow aSa,\ S \rightarrow aAa,\ A \rightarrow bB,$
$B \rightarrow bB,\ B \rightarrow C$

*(i)* is type 3

(ii) is type 2 but not type 3
(iii) is type 1 but not type 2
(iv) is type 0 but not type 1

(Choose the correct option)

(d) Which of the following strings is not generated by the given grammar?

$S \rightarrow SaSbS|\in$

(i) *aabb*
(ii) *abab*
(iii) *aababb*
(iv) *aaabb*

(Choose the correct option)

(e) "Context-free grammar is closed under intersection."

(State True or False)

(f) Recursive language is —— of CFL.

(Fill in the blank)

(g) A language $L$ is accepted by an FSA iff it is ——.

(Fill in the blank)

(h) Define pushdown automata.

2. (a) Construct a DFA for the regular expression $aa^*|bb^*$. 3

(b) State pumping lemma for CFG. 3



( Continued )



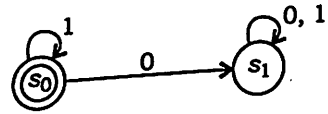
(c) Write the CFG to generate the set $\{a^m b^n c^p \mid m+n=p \text{ and } p \geq 1\}$. 3

(d) Show that the grammar

$G = S \rightarrow aSbS|bSaS|\wedge$

is recursive. 3

3. (a) Determine the language recognized by the finite-state automaton



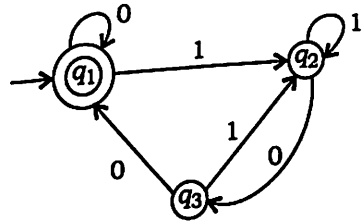

5

(b) Construct a DFA with reduced state equivalent to the regular expression $10+(0+11)0^*1$. 5

(c) Write a short note on Chomsky classification of language. 5

*Or*

Construct a regular expression to the transition diagram




15

( Turn Over )

4. (a) Explain minimization of finite automata in brief. 5

(b) If $G$ is the grammar $S \rightarrow SbS|a$, show that $G$ is ambiguous. 5

(c) Explain the closure properties of regular languages. 5

*Or*

Determine whether the language given by

$$L = \{a^{n^2} \mid n \geq 1\}$$

is context-free or not. 15

5. (a) Show that set of all strings over $\{a, b\}$ consisting of equal numbers of $a$'s and $b$'s is accepted by deterministic PDA. 5

(b) Consider the following productions :

$$S \rightarrow aB \mid bA$$

$$A \rightarrow aS \mid bAA \mid a$$

$$B \rightarrow bS \mid aBB \mid b$$

For the string $aaabbabbba$, find a leftmost derivation. 5

(c) Find a derivation tree of $a*b+a*b$ given that $a*b+a*b$ is in $L(G)$, where $G$ is given by

$$S \rightarrow S+S|S*S,\ S \rightarrow a|b$$ 5



( Continued )

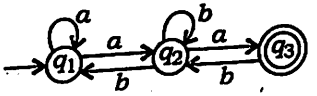


*Or*

Explain in detail about equivalence of pushdown automata and CFG. 15

6. (a) Prove that a language $L$ is accepted by some $\epsilon$–NFA if and only if $L$ is accepted by some DFA. 5

(b) Construct the regular expression from the following transition diagram : 5




(c) For the finite state machine $M$ given in the following table, test whether the strings 101101 and 11111 are accepted by $M$ : 5

| State | Input | |
|---|---|---|
| | 0 | 1 |
| → $q_0$ | $q_0$ | $q_1$ |
| $q_1$ | $q_3$ | $q_0$ |
| $q_2$ | $q_0$ | $q_3$ |
| $q_3$ | $q_1$ | $q_2$ |

( Turn Over )

*Or*

Construct a minimum-state automaton equivalent to a given automaton $M$ whose transition table is given below : 15

| State | Input | |
|---|---|---|
| | $a$ | $b$ |
| $\rightarrow q_0$ | $q_0$ | $q_3$ |
| $q_1$ | $q_2$ | $q_5$ |
| $q_2$ | $q_3$ | $q_4$ |
| $q_3$ | $q_0$ | $q_5$ |
| $q_4$ | $q_0$ | $q_6$ |
| $q_5$ | $q_1$ | $q_4$ |
| $(q_6)$ | $q_1$ | $q_3$ |

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