44 (6) BCA–HE–6016

2024

AUTOMATA THEORY AND LANGUAGES

Paper : BCA–HE–6016

Full Marks : 80

Time : Three hours

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

Answer Q. No. **1** *and* ***any five*** *from Q. No.* **2** *to Q. No.* **7**.

1. Answer the following : 1×5=5

   (a) An unrestricted language can be accepted by

   (i) Finite automata

   (ii) Turing Machine

(iii) Push Down automata

(iv) Cellular automata

(b) A language is regular if any only if

(i) accepted by DFA

(ii) accepted by PDA

(iii) accepted by LBA

(iv) accepted by Turing Machine

(c) Which is the data structure used to implement in Push Down Automata ?

(i) Link list

(ii) Queue

(iii) Stack

(iv) Array

(d) The context free grammar defined by ab^* is

(i) $S \rightarrow Sb/a$

(ii) $S \rightarrow XY,\ X \rightarrow ax,\ Y \rightarrow by$

(iii) $C \rightarrow ss/baa/abb,\ s \rightarrow \varepsilon$

(iv) $S \rightarrow as,\ S \rightarrow bs$

(e) Consider the grammar G with production $S \rightarrow ass$

$$S \rightarrow b$$

The string 'aababbb' is the output of

(i) Left Most Derivation

(ii) Mixed Derivation

(iii) Right Most Derivation

(iv) All of the above

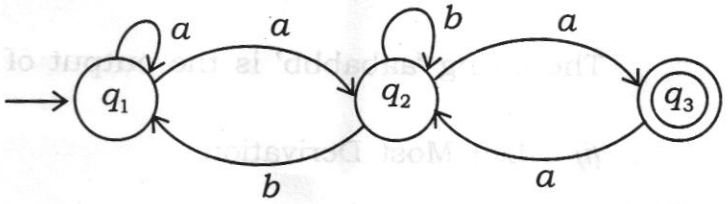
2. *(a)* Construct deterministic finite automata to recognize odd number of 1's and even number of 0's. 5

(b) Explain the properties of context-free languages. 5

(c) Show that the language : 5

$L = \{a^i b^i c^i / i > 0\}$ is not context free

3. *(a)* Find out the string accepted by the following system. 5



(b) Construct a DFA with reduced states equivalent to the regular expression

$10 + (0 + 11)\ 0^*1$. 5

(c) Define regular expression with example. Show that regular sets are closed under union operation. 2+3=5

4. (a) Eliminate the unit production from the CFG with P given by

$S \rightarrow Aa/B,\ B \rightarrow a/bb,\ A \rightarrow a/bc/B$ 5

(b) Construct a reduced grammar equivalent to the grammar

$S \rightarrow aAa$

$A \rightarrow Sb/bcc/DaA$

$C \rightarrow abb/DD$

$D \rightarrow aDA,\ E \rightarrow aC$ 5

(c) What do you mean by ambiguity of a grammar? What is left most derivation and right most derivation.

If G is the grammar

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

Show that G is ambiguous. 5

5. *(a)* Prove that CFL are closed under union and concatenation operation. 5+5=10

(b) Reduce the following grammar G to CNF :

G is $S \rightarrow aAD$, $A \rightarrow aB/bAB$,

$B \rightarrow b$, $D \rightarrow d$. 5

6. *(a)* Construct a PDA to accept the language

$L = \{a^n b^m / n>m \ \& \ n,m>=0\}$

(i) Through empty stack

(ii) Through final state 4+4=8

(b) Define Push Down Automata. Give the instantaneous description of PDA.

3·5+3·5=7

7. Write short notes on : ***(any three)*** 5×3=15

(a) Turing machine

(b) Pigeonhole principle

(c) Chomsky classification

(d) GNF

(e) Pumping Lemma for regular languages