MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : CS-402

FORMAL LANGUAGE AND AUTOMATA THEORY

Time Allotted : 3 Hours | *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

   i) Regular grammar is
      a) context free grammar
      b) context sensitive grammar
      c) non-context grammar
      d) none of these.

   ii) In Moore machine, output is associated with
      a) present state only
      b) next state only
      c) present state and input
      d) none of these.

[Turn over

iii) Compatible pairs are obtained from

a) Merger Graph b) Compatible Graph

c) Testing Table d) Testing Graph.

iv) The string 1101 does not belong to the set represented by

a) 110 * (0 + 1)

b) 1 (0 + 1) * 101

c) (10) * (01) * (00 + 11) *

d) (00 + (11) * 01)*

v) Regular expression is accepted by

a) Finite automata

b) Mealy machine

c) Pushdown automata

d) all of these.

vi) If P and Q are regular expression (P is not null), then $R = Q + RP$ has the unique solution

a) $R = Q * P$ b) $R = PQ*$

c) $R = Q * P*$ d) $R = QP*$.

vii) Which of the following is common in both CNF & GNF ?

a) (NT) → (Single T) (String of NT)

b) (NT) → (String of exactly two NT)

c) (NT) → (String of NT)

d) (NT) → (Single T).

viii) Consider the languages :

$L_1 = \{ ww^R \mid w \in \{0,1\}^* \}$

$L_2 = \{ w \# w^R \mid w \in \{0,1\}^* \}$, where # is a special symbol

$L_3 = \{ ww \mid w \in \{0,1\}^* \}$.

Which one of the following is true ?

a) L_1 is a deterministic CFL

b) L_2 is a deterministic CFL

c) L_3 is a CFL, but not a deterministic CFL

d) L_3 is a deterministic CFL.

ix) Difference between Turing Machine & Two way FA is in

a) Input tape b) Read wire head

c) Finite control d) all of these.

x) Which of the following statements is *false* ?

a) The halting problem of Turing machine is undecidable.

b) Determining whether a context-free grammar is ambiguous is undecidable.

c) Given two arbitrary context free grammars G_1 and G_2. It is undecidable whether $L(G_1) = L(G_2)$.

d) Given two regular grammars G_1 and G_2. It is undecidable whether $L(G_1) = L(G_2)$.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. What do you mean by unit production ? Remove unit productions from the grammar

$S \rightarrow AB, A \rightarrow a, B \rightarrow C, C \rightarrow D, D \rightarrow b.$ 1 + 4

3. Construct grammar of the following :

a) For the language $a^n b^n$, where $n >= 0$.

b) All even integers up to 998. 2 + 3

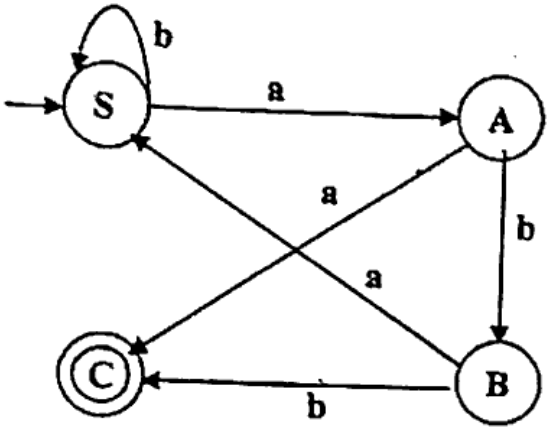
4. Define *NFA*. Construct equivalent *DFA* from the given *NFA*.

Present State	*Next State*	
	0	1
$\rightarrow q_0$	q_0, q_1	q_2
q_1	q_2	q_1
q_2	q_1	q_2

1 + 4

5. Design a two-input two-output sequence detector which generates an output 1 every time the sequence 1101 is detected. And for all other cases output 0 is generated. Overelapping sequences are also counted. 2 + 1 + 2

6. Define Left Linear and Right linear grammar. Construct grammar for the following *FA* :



2 + 3

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. State and prove Arden's theorem in regular expression.

Minimize the following incompletely specified machine :

PS	*NS, Z*		
	I_1	I_2	I_3
A	*A*, 1	*D*, _	*C*, _
B	*A*, _	*D*, _	*E*, _
C	*E*, 0	*A*, 1	_ , _
D	*E*, _	*A*, 1	_ , _
E	*E*, 0	_ , _	*C*, _

5 + (5 + 2 + 3)

8. Convert the following Mealy machine to equivalent Moore machine :

Present State	*I/P = 0*		*I/P = 1*	
	Next State	*O/P*	*Next State*	*O/P*
$\rightarrow q_0$	q_1	1	q_2	1
q_1	q_3	0	q_0	1
q_2	q_4	0	q_3	1
q_3	q_1	0	q_4	0
q_4	q_2	1	q_4	0

Using Pumping lemma prove that

$L = \left\{ a^n b^n \mid n \geq 1 \right\}$ is not regular.

Construct Finite Automata equivalent to the Regular Expression

$L = ab\,(a + b)\,(ab)^* b.$ 6 + 5 + 4

9. Find a reduced grammar equivalent to the grammar :

$S \rightarrow aAa$

$A \rightarrow bBB$

$B \rightarrow ab$

$C \rightarrow aB$

Convert the following grammar into GNF.

$S \rightarrow AA/a$

$A \rightarrow SS/b$

Prove that Context Free Languages are not closed under intersection.

5 + 6 + 4

10. Define PDA by giving a block diagram. Explain how a string be accepted by a PDA ? Design a non-Deterministic Pushdown Automata for accepting the string $L = \{WCW^R \mid W \in (a, b)^*$ and W^R is the reverse of Wby Empty stack.

    Construct an equivalent PDA for the following Context Free Grammar.

    $S \rightarrow aA$

    $A \rightarrow aABC/bB/a$

    $C \rightarrow c$

    Show an ID for the string *aabbbc* for the PDA generated.

    2 + 3 + 10

11. Design a Turing Machine which accepts the language $L = \{a^n b^n,\ n \geq 1\}$. Write a short note on Multi-Tape and Multi Head Turing Machine. 10 + 5