Total number of printed pages–7

3 SEM BCA (CBCS) FLAT 3.2

2024

(December)

COMPUTER APPLICATION

Paper : 3·2

(Formal Language and Automata Theory)

Full Marks : 60

Time : Three hours

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

1. Fill in the blanks : 1×5=5

   (a) If NFA of 7 states is converted into DFA, maximum possible number of states for the DFA is _____.

   (b) If control enters no way to come out from the state, then that state is called _____.

Contd.

(c) Type 2 language is called _____.

(d) _____ is used to represent regular languages.

(e) CNF stands for _____.

2. Answer the following : 2×5=10

(a) Define derivability and reachability in CFG.

(b) A transition table for finite state machine M is given :

Present State	Next State	
	a 0	b 1
$\rightarrow q_0$	q_2	q_1
q_1	q_3	q_0
q_2	q_0	q_3
q_3	q_1	q_2

Check whether the string 101101 is accepted by the automata or not.

(c) Design a DFA that accepts all strings over (a, b), starting with a and ending with b.

(d) Write the regular expression having at least 2 a's, from the alphabet (a, b).

(e) Convert the following CFL to CFG :

$$L(G) = \{a^n b^n, n \geq 1\}$$

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

(a) Show that the following grammar is ambiguous :

$S \rightarrow SBS \mid a$

$B \rightarrow b$

(b) Construct a context free grammar G which generates all integers.

(c) Describe the variations of turing machines.

(d) Explain the structure of a PDA with diagram.

(e) Eliminate all the null productions from the grammar G with production rules

$$S \rightarrow ABAC$$

$$A \rightarrow aA \mid \varepsilon$$

$$B \rightarrow bB \mid \varepsilon$$

$$C \rightarrow c$$

(f) Consider the grammar G with production rules

$$S \rightarrow aAB$$

$$A \rightarrow bBb$$

$$B \rightarrow A \mid \lambda$$

For the string 'abbbb', find the left most derivation and right most derivation. Also generate the derivation tree for the given string.

4. Answer the following questions : ***(any five)*** 6×5=30

(a) $M = (\{q_1, q_2, q_3\}, \{0, 1\}, \delta, q_1, \{q_3\})$ is an NFA, where δ is given by

$$\delta(q_1, 0) = \{q_2, q_3\}$$

$$\delta(q_1, 1) = \{q_1\}$$

$$\delta(q_2, 0) = \{q_1, q_2\}$$

$$\delta(q_2, 1) = \{\phi\}$$

$$\delta(q_3, 0) = \{q_2\}$$

$$\delta(q_3, 1) = \{q_1, q_2\}$$

Construct an equivalent DFA.

(b) Construct a Moore machine equivalent to a Mealy machine given by the transition table : 5+1=6

Present State	Next State			
	$a=0$	Output	$a=1$	Output
$\rightarrow q_1$	q_3	0	q_2	0
q_2	q_1	1	q_4	0
q_3	q_2	1	q_1	1
q_4	q_4	1	q_3	0

Fig : Transition Table of Mealy machine.

Also construct the transition diagram.

(c) Write the differences between NFA and DFA. Whether NFA is equivalent to DFA, justify your answer. 4+2=6

(d) Find a regular expression corresponding to the following with alphabet (0, 1) : 2×3=6

(i) The language of all strings containing exactly two 0's.

(ii) The language of all strings containing at least two 0's.

(iii) The language of all strings that contains 00 as substring.

(e) Convert the grammar G with production rules

$$S \to ABa$$
$$A \to aab$$
$$B \to Ac$$

to CNF.

(f) Design a Turing machine M over $\{0, 1\}$ such that string contains equal number of 0's and 1's.

(g) Describe the Chomsky hierarchy.
