2015

MCA

3rd SEMESTER EXAMINATION

THEORY OF FORMAL LANGUAGES AND AUTOMATA

PAPER—MCA-302

Full Marks : 100

Time : 3 Hours

The figures in the margin indicate full marks.

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

Illustrate the answers wherever necessary.

Answer any five questions. 5×14

1. (a) Construct a DFA that accepts all strings over \{a, b\} ending with aba. 5

(b) Construct a transition system which can accept strings over the alphabets a, b, ... containing either cat or rat. 5

(Turn Over)
(c) Construct a Mealy machine which is equivalent to the Moore machine defined by the following table:

<table>
<thead>
<tr>
<th>Present State</th>
<th>Next State $a = 0$</th>
<th>Next State $a = 1$</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>$q_0$</td>
<td>$q_1$</td>
<td>$q_2$</td>
<td>1</td>
</tr>
<tr>
<td>$q_1$</td>
<td>$q_3$</td>
<td>$q_2$</td>
<td>0</td>
</tr>
<tr>
<td>$q_2$</td>
<td>$q_2$</td>
<td>$q_1$</td>
<td>1</td>
</tr>
<tr>
<td>$q_3$</td>
<td>$q_0$</td>
<td>$q_3$</td>
<td>1</td>
</tr>
</tbody>
</table>

2. (a) Define Grammar. What do you understand by Context Sensitive Grammar? Give example. Examine if the production BC $\rightarrow$ CB is Context Sensitive or not.

   2+2+1+2

(b) Find a grammar generating:

   $$L = \{ WCW^T \mid W \in \{a, b\}^* \}$$

3. (a) What do you mean by Regular Expressions? Find the regular expression that represents the set of all strings over \{a, b\} having exactly 3 a's.

(b) Construct a transition system which accepts the regular expression:

   $$a^* + (ab + a)^*$$

(c) Construct a regular grammar generating the regular set represented by:

   $$(a + b)^* a^*b$$
4. (a) Show that \( L = \{0^i 1^i \mid i \geq 1\} \) is not regular.

(b) Prove that if \( L \) is regular, then \( L^T \) is also regular.

5. (a) What do you mean by Leftmost & rightmost derivations? Give examples.

(b) Show that the following grammar is ambiguous:
\[
S \rightarrow AB | aaB, \quad A \rightarrow a | Aa, \quad B \rightarrow b
\]

(c) Find a reduced form and get an equivalent grammar of the following grammar:
\[
S \rightarrow AB \mid AD \\
A \rightarrow a \\
B \rightarrow b \\
E \rightarrow c
\]

6. (a) Consider the grammar \( G \) whose productions are:
\[
S \rightarrow aS \mid AB \\
A \rightarrow \wedge \\
B \rightarrow \wedge \\
D \rightarrow b.
\]

Construct a grammar without null productions generating \( L(G) = \{\wedge\} \).
(b) What do you mean by Chomsky Normal Form? Give an example.

Reduce the following grammar into its equivalent CNF:

\[
S \rightarrow a\ AbB \\
A \rightarrow aA \mid a \\
B \rightarrow bB \mid b
\]

2+1+6

7. (a) Reduce the grammar into CNF:

\[
S \rightarrow AA \mid a \\
A \rightarrow SS \mid b
\]

(b) Construct a PDA accepting the language:

\[L = \{ a^nbc^n \mid n \geq 1 \} \]

7

8. (a) Construct a Turing machine that accepts all strings consisting of an even no. of 1's.

(b) Construct a PDA equivalent to the following context-free Grammar:

\[
S \rightarrow OBB \\
B \rightarrow OS \mid 1S \mid 0
\]

Test whether 010^4 is accepted by the PDA or not.

**Internal Assessment — 30**