# 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

(c) Construct a Mealy machine which is equivalent to the Moore machine defined by the following table : 4

| *Present State* | *Next State* | | *Output* |
|---|---|---|---|
| | *a = 0* | *a = 1* | |
| → $q_0$ | $q_1$ | $q_2$ | 1 |
| $q_1$ | $q_3$ | $q_2$ | 0 |
| $q_2$ | $q_2$ | $q_1$ | 1 |
| $q_3$ | $q_0$ | $q_3$ | 1 |

**2.** (a) Define Grammar. What do you understand by Context Sensitive Grammar ? Give example. Examine if the production BC → CB is Context Sensitive or not. 2+2+1+2

(b) Find a grammar generating :

$$L = \{WCW^T \mid W \in \{a, b\}^*\}$$ 7

**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. 3+3

(b) Construct a transition system which accepts the regular expression : 4

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

(c) Construct a regular grammar generating the regular set represented by : 4

$$(a + b)^* a^*b$$

**4.** (a) Show that $L = \{0^i 1^i \mid i \geq 1\}$ is not regular. 7

(b) Prove that if L is regular, then $L^T$ is also regular. 7

**5.** (a) What do you mean by Leftmost & rightmost derivations ? Give examples. 2+2

(b) Show that the following grammar is ambiguous :

$S \rightarrow AB \mid aaB,\ A \rightarrow a \mid Aa,\ B \rightarrow b$ 4

(c) Find a reduced form and get an equivalent grammar of the following grammar : 6

$S \rightarrow AB \mid AD$

$A \rightarrow a$

$B \rightarrow b$

$E \rightarrow c$

**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 $L(G) - \{ \wedge \}$. 5

(b) What do you mean by Chomsky Normal Form ? Give 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 : 7

$S \rightarrow AA \mid a$

$A \rightarrow SS \mid b$

(b) Construct a PDA accepting the language : 7

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

**8.** (a) Construct a Turing machine that accepts all strings consisting of an even no. of 1's. 7

(b) Construct a PDA equivalent to the following context-free Grammar : 4+3

$S \rightarrow OBB$

$B \rightarrow OS \mid 1S \mid 0$

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

***Internal Assessment — 30***