2016

MCA 3rd Seme. 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* from the rest.

1. (a) Define a nondeterministic finite automation.

(b) Find a deterministic acceptor equivalent to the following nondeterministic finite automation :

State/Σ	a	b
$\rightarrow q_0$	q_0, q_1	q_0
q_1	q_2	q_1
q_2	q_3	q_3
(q_3)	–	q_2

(c) Consider the Moore machine described by the transition table given below :

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

Construct the corresponding Mealy machine. 3+5+6

2. (a) Define Context Free and Context Sensitive Grammars with suitable examples.

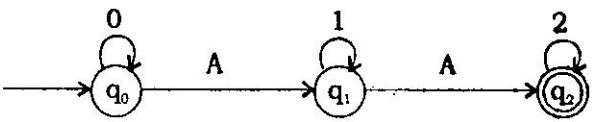
(b) According to Chomsky, find the highest type which can be applied to the following grammar :

$$S \rightarrow Aa,\ A \rightarrow c \mid Ba,\ B \rightarrow abc$$

(c) Construct a regular grammar accepting $L = \{w \in \{a, b\}^* \mid$ the number of a's in w is divisible by 3$\}$. (2+2)+3+7

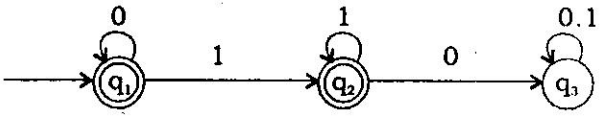
3. (a) Prove that : $(1 + 00^*1) + (1 + 00^*1)(0 + 10^*1)^* (0 + 10^*1) = 0^*1(0 + 10^*1)^*$.

(b) Consider a finite automation, with null moves, given below :



Obtain an equivalent automation without null moves.

(c) Construct a regular expression corresponding to the following state diagram :



3+4+7

4. (a) Construct a transition system corresponding to the regular expression : a + bb + bac*a.

(b) Show that L = {a^p | p is a prime} is not regular.

(c) Construct a finite automation recognizing L(G), where G is the grammar

$$S \rightarrow as \mid bA \mid b$$

$$A \rightarrow aA \mid bS \mid a$$

3+7+4

5. (a) Consider the grammar whose productions are

$$S \rightarrow aAS \mid a,\ A \rightarrow SbA \mid SS \mid ba$$

Test if the grammar is ambiguous or not with a suitable example.

(b) Find a reduced grammar equivalent to the following grammar :

$$S \rightarrow AB \mid CA,\ B \rightarrow BC \mid AB,\ A \rightarrow a,\ C \rightarrow aB \mid b$$

(c) Consider the grammar given below :

$S \rightarrow AB, A \rightarrow a, B \rightarrow C \mid b, C \rightarrow D, D \rightarrow E, E \rightarrow a$

Eliminate unit productions and get an equivalent grammar. 4+6+4

6. (a) Reduce the following grammar to CNF :

$S \rightarrow aAC, A \rightarrow aB \mid bAB, B \rightarrow b, C \rightarrow c$

(b) Convert the grammar $\{S \rightarrow CD, C \rightarrow DS \mid d, D \rightarrow SC \mid c\}$ into GNF. 7+7

7. (a) Construct a pda A accepting the language :

$L = \{a^n b^{2n} \mid n \geq 1\}$

(b) Design a Turing Machine over {1, b} which can compute a concatenation function over L = {1}. If a pair of words (w_1, w_2) is the input, the output should be $w_1 w_2$. 7+7

8. (a) A context-free grammar G is defined by the productions :

$S \rightarrow a \mid Sa \mid bSS \mid SSb \mid SbS$

Show that every string in L(G) has more a's than b's.

(b) Design a Turing Machine that accepts :

$L = \{0^n 1^n \mid n \geq 1\}$ 7+7

[Internal Assessment : 30]