MCA/IIIS/MCA - 2302/10

MCA 3rd Semester Examination, 2010

FORMAL LANGUAGE AND AUTOMATA

PAPER—CS/MCA/2302

Full Marks : 100

Time : 3 hours

Answer any **five** questions

The figures in the right-hand margin indicate marks

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

Illustrate the answers wherever necessary

1. (*a*) Define transition system. 3

(*b*) Find a deterministic acceptor equivalent to

$$M = (\{q_0, q_1, q_2\}, \{a, b\}, \delta, q_0, \{q_2\})$$

where δ is given by the following table : 5

State	a	b
$\rightarrow q_0$	q_0, q_1	q_2
q_1	q_0	q_1
(q_2)	—	q_0, q_1

(*c*) Construct a Mealy machine equivalent to the Moore machine defined by the following table : 6

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

2. (*a*) Construct a grammar generating

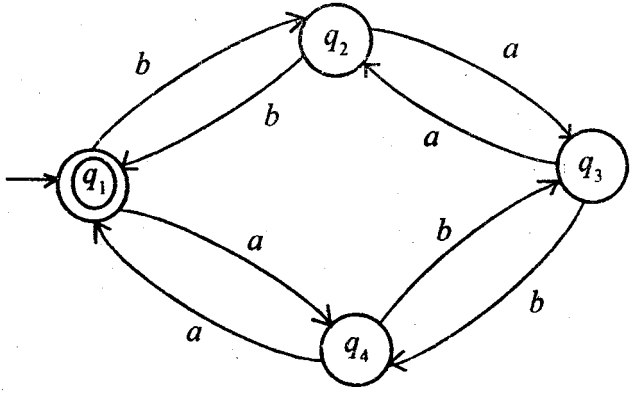
$$L = \{ a^n b^n c^n \mid n \geq 1 \}.$$ 7

(*b*) Classify formal languages according to Chomsky. Describe each briefly with suitable examples. 7

3. (*a*) Construct a transition system corresponding to the regular expression : $(ab + c^*)^* b$. 3

(*b*) Find the regular expression representing the set of all strings over $\{0, 1\}$ in which the number of occurrences of 0 is divisible by 3. 5

(*c*) Find the regular expression corresponding to the automaton given below : 6



4. (*a*) Examine if the following grammar is ambiguous or not :

$$S \rightarrow aB \mid bA$$
$$A \rightarrow aS \mid bAA \mid a$$
$$B \rightarrow bS \mid aBB \mid b$$

if yes, derive unambiguous grammar from it.

(*b*) Construct a reduced grammar equivalent to the grammar :

$$S \rightarrow aAa$$
$$A \rightarrow Sb \mid bCC \mid DaA$$
$$C \rightarrow abb \mid DD$$
$$E \rightarrow aC$$
$$D \rightarrow aDA$$

5. (*a*) Find a grammar in CNF equivalent to the grammar :

$$S \rightarrow \sim S \mid [S \supset S] \mid p \mid q$$

[N.B. : S being the only variable]

(*b*) Reduce the following grammar to GNF :

$$S \rightarrow SS$$
$$S \rightarrow 0S1 \mid 01.$$

6. (*a*) Construct a pda accepting the set of all palindromes over {*a*, *b*}. 7

(*b*) Construct a pda A equivalent to the following context-free grammar :

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

Test whether 010^3 is in N (A). 7

7. (*a*) Define Turing machine. 3

(*b*) Consider the TM described by the following table : 4

Present State	Tape Symbol		
	b	0	1
$\rightarrow q_1$	$1Lq_2$	$0Rq_1$	
q_2	bRq_3	$0Lq_2$	$1Lq_2$
q_3		$0Rq_4$	bRq_5
q_4	$0Rq_5$	$0Rq_4$	$1Rq_4$
(q_5)	$0Lq_2$		

Draw the computation-sequence of the input string 00.

(*c*) Design a Turing Machine of $\{1, b\}$ which can compute a concatenation function over $\Sigma = \{1\}$. If a pair of words (w_1, w_2) is the input, the output has to be $w_1 w_2$. 7

[*Internal Assessment* — 30 Marks]
