Total No. of Questions : 10] [Total No. of Printed Pages : 5

Roll No. ....

MCA–304(N)

M. C. A. (Third Semester) EXAMINATION, June, 2008

(New Course)

THEORY OF COMPUTATION

[MCA – 304(N)]

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 40

Note : Attempt *one* question from each Unit. All questions carry equal marks.

Unit – I

1. (a) Construct a minimum state automation equivalent to given automata A, whose transition graph is as : 10

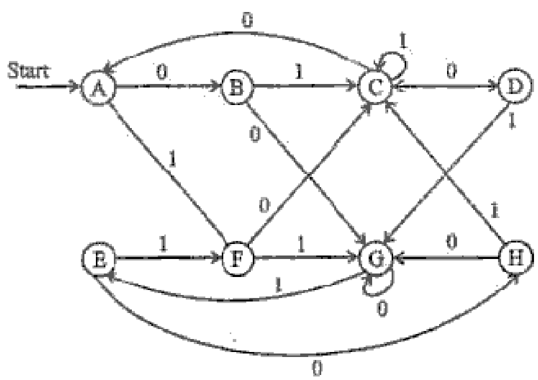


Fig. 1

(b) Construct an NFA equivalent to the 2 DFA : 10
$(\{q_0, q_1, q_2\}, \{0, 1\}, \delta, \{q_0\}, \{q_1\})$ where δ is given as :

	0	1
q_0	(q_0, R)	(q_1, R)
q_1	(q_1, R)	(q_2, L)
q_2	(q_0, R)	(q_2, L)

2. (a) Consider the following $\in$-NFA : 12

	$\in$	a	b	c
$\rightarrow p$	ϕ	$\{p\}$	$\{q\}$	$\{r\}$
q	$\{p\}$	$\{q\}$	$\{r\}$	ϕ
r	$\{q\}$	$\{r\}$	ϕ	$\{p\}$

(i) Compute the $\in$-closure of each state.

(ii) Give all the strings of length three or less accepted by the automaton.

(iii) Convert the automaton to a DFA.

(b) Give DFS's accepting the following languages over the alphabet $\{0, 1\}$: 8

(i) The set of all strings beginning with a 1, when interpreted as a binary integer, is a multiple of 5.

(ii) The set of all strings that, when interpreted in reverse as a binary integer, is divisible by 5.

Unit – II

3. (a) Explain Chomsky classification of languages with suitable examples. 10

(b) Construct a regular expression corresponding to the state diagram given as : 10

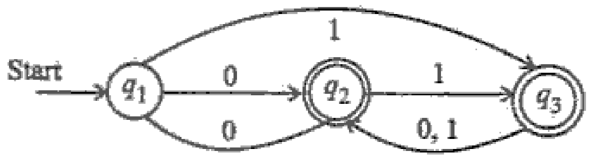
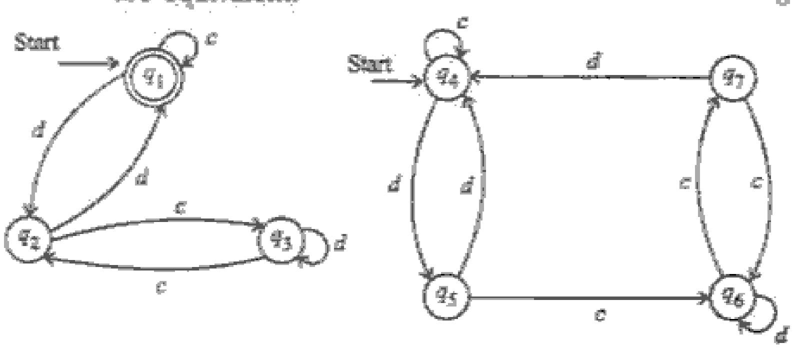


Fig. 2

4. (a) Construct a regular grammar G generating the regular set represented by : 8

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

(b) Show that the automata M_1 and M_2 given in figures are equivalent. 8



M_1 M_2

Fig. 3

(c) State applications of the pumping lemma. 4

Unit – III

5. (a) Convert the Grammar : 10

$$S \rightarrow AB/aB$$

$$A \rightarrow aab/\lambda$$

$$B \rightarrow bbA$$

into Chomsky normal form.

(b) Construct npda's that accept the language : 10

$$L = \{a^n b^m : n \leq m \leq 3n\}$$

on $\Sigma = \{a, b\}$.

6. (a) Find a context-free grammar that generates the language accepted by the npda : 10

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

with transitions :

$$\delta(q_0, a, z) = \{(q_0, Az)\}$$

$$\delta(q_0, b, A) = \{(q_0, AA)\}$$

$$\delta(q_0, a, A) = \{(q_1, \lambda)\}$$

(b) Show that the family of unambiguous context free languages is not closed under intersection. 5

(c) Determine whether or not the following language is context-free : 5

$$L = \{w_1 \subset w_2 : w_1, w_2 \in \{a, b\}^*, w_1 \neq w_2\}$$

Unit – IV

7. (a) Construct a turing machine to compute the function $f(w) = w^R$, where $w \in \{0, 1\}^+$. 10

(b) Show that the Cartesian product of a finite number of countable sets is countable. 5

(c) Suppose we make the restriction that a turing machine must always write a symbol different from the one. It reads, that is, if : 5

$$\delta(q_i, a) = (q_j, b, L \text{ or } R)$$

then a and b must be different. Does this limitation reduce the power of the automation ?

8. (a) Given two positive integers x and y, design a turing machine as transducers that computes $x \div y$. 10

   (b) Discuss Linear Bounded Automata. Show that the class of turing machine with multitape is equivalent to the class of standard turing machine. 10

Unit—V

9. (a) Show that there is no algorithm for deciding if any two turing machines M_1 and M_2 accept the same language. 10

   (b) For every context-sensitive language L not including λ, there exists some linear bounded automation M such that L = L (M). 10

10. (a) Prove that every context-sensitive language L is recursive. 10

    (b) Determine whether or not the following statement is true :

    "Any problem whose domain is finite is decidable." 10