B.E. Sem. VI (Old) (CE)

June – 2009

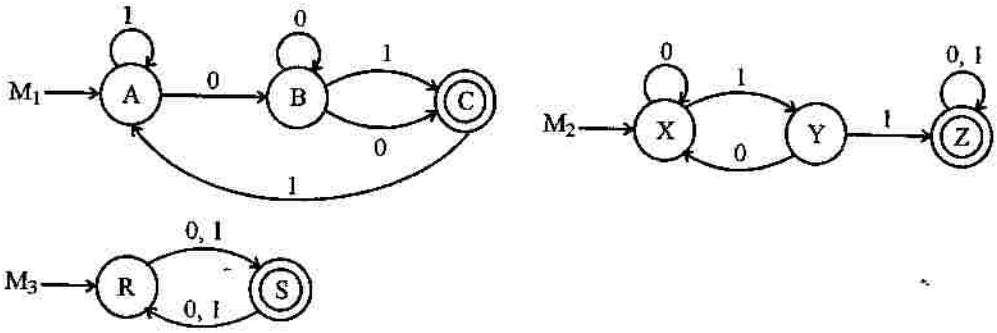
Theory of Computation

Time : 3 Hours] **[Max. Marks : 100**

Instruction : Attempt any **five** questions.

1. Do as directed : **20**
   (i) Answer the following questions :
      (a) List the elements of $2^{2\{0,1\}}$
      (b) Describe infinite set {10, 1100, 111000, 11110000, ...} using a formula that does not involve "...".
   (ii) Prove that integer bigger than 2 have prime factorization.
   (iii) Define the following terms :
      (a) Properties of an equivalence relation.
      (b) The principle of mathematical induction.
      (c) Distinguishable strings with respect to L.
      (d) Λ-closure of a set of states.
   (iv) Prove that L = { ss / s ∈ {a, b}* is not CFL using pumping lemma.
   (v) Give a regular expression corresponding to the given languages.
      (a) The language of all strings containing no more than one occurrence of the string, where L∈ {0, 1}*
      (b) Λ ∈ L; if $x \in L$, then 001x and x11 are elements of L; nothing is in L unless it can be obtained from these two statements.

2. Do as directed (Attempt any **four**) : **20**
   (i) Let m_1, m_2 and m_3 be the FAs shown in figures, recognizing languages L_1, L_2 and L_3, respectively



   Draw FAs recognizing the following languages :
   (a) $L_3 - L_2$
   (b) $L_1 \cap L_3$

(ii) Prove that any regular language can be accepted by a finite automation.

(iii) Prove that ((...(a)...)) is not regular using pumping lemma.

(iv) Draw and describe Turing Machine for deleting a symbol.

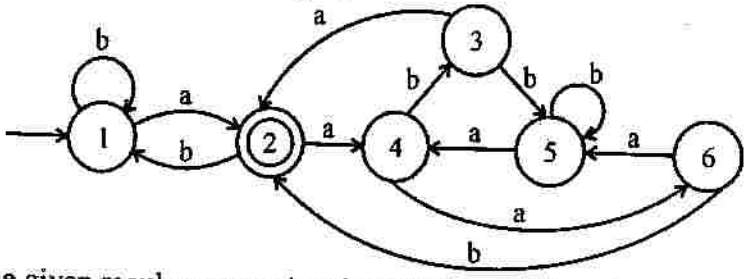
3. Do as directed : **20**

(i) For the given CFG, find a CFG G' that generating the language L(G) – {∧} G has productions

$S \rightarrow ABA, A \rightarrow aA|\wedge, B \rightarrow bB|\wedge$

(ii) Give the top down PDA for palindrom.

(iii) For the following FA, use the minimization algorithm to find a minimum. State FA recognizing the same language.



(iv) For the given regular expression draw NFA-∧, NFA and FA.

$(0 + 1)^* (01)^* (011)^*$

4. Do as directed : **20**

(i) Show that the given grammar is ambiguous and find an equivalent unambiguous grammar.

$S \rightarrow A / B \quad A \rightarrow aAb / ab \quad B \rightarrow abB/\wedge$

(ii) A transition table is given for an NFA-∧ with seven states.

q	δ(q, a)	δ(q, b)	δ(q, ∧)
1	{5}	ϕ	{4}
2	{1}	ϕ	ϕ
3	ϕ	{2}	ϕ
4	ϕ	{7}	{3}
5	ϕ	ϕ	{1}
6	ϕ	{5}	{4}
7	{6}	ϕ	ϕ

Find (a) ∧({2, 3})

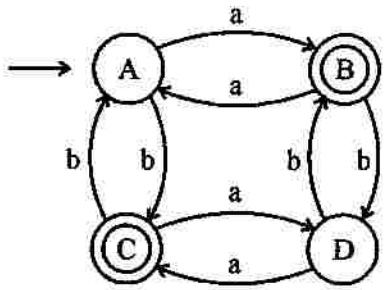
(b) δ* (1, ba)

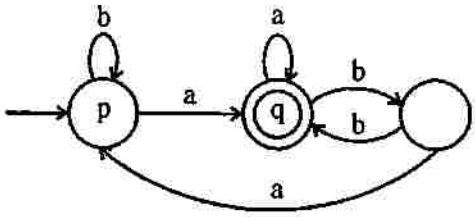
(iii) Draw and describe Turing machine for n mod 4.

(iv) Give transition table and transition diagram for the language of odd-length palindromes.

5. Do as directed : **20**

(i) Let m_1 and m_2 be the FAs shown in figures, recognizing L_1 and L_2 respectively.





Draw NFA-Λ_s recognizing each of the following languages :

(a) $L_1L_1L_2$

(b) $L_1 \cup L_2$

(ii) Find a CFG generating the given languages :

(a) The set of odd length strings in $\{a, b\}^*$ with middle symbol a

(b) The set of even length strings in $\{a, b\}^*$ with the two middle symbols equal.

(iii) Give transition table and transition diagram for DPDA recognizing language $L = \{n \in \{a, b\}^* \mid n_a(x) \neq n_b(x)\}$

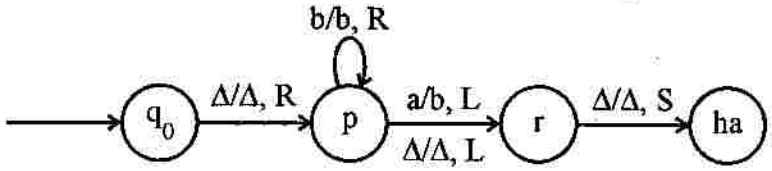
(iv) For each of the following regular expressions, draw an FAs recognizing the corresponding language.

(a) $(111 + 100)^* 0$

(b) $(0 + 1)^* (1 + 00) (0 + 1)^*$

6. Do as directed : **20**

(i) Explain Universal Turring Machining and encode the given Turring Machine.



(ii) Let L be the language $\{0^n 1^n / n \geq 0\}$.

(a) Find two distinct strings x and y that are indistinguishable with respect to L.

(b) Show that L is not regular, by showing that there is an infinite set of strings, any two of which are distinguishable with respect to L.

(iii) Write short notes on the following :

(a) Derivation tree and Ambiguity with reference to CFG.

(b) Pumping Lemma for CFL.

(iv) Answer the following questions :

(a) Discuss P problem, NP problem, PSPACE and NPSPACE.

(b) Give the recursive definition of

(1) The set of natural numbers

(2) The set of positive integers divisible by 2 or 7

7. Do as directed : **20**

(i) Find CFG generating each of the given languages :

(a) $L = \{ a^i b^j / i \leq 2j \}$

(b) $L = \{ a^i b^j c^k / i = j \text{ or } i = k \}$

(ii) Give transition table and transition diagram for DPDA recognizing the following grammar :

$S \rightarrow SS \mid \{S\} \mid [S] \mid \wedge$

(iii) Answer the following questions :

(a) Assume L_1, $L_2 \subseteq \varepsilon^*$ are regular languages, define Union ($L_1 \cup L_2$), intersection ($L_1 \cap L_2$) and difference ($L_1 - L_2$) of them.

(b) State the applications of Computational Theory.

(iv) Answer the following questions :

(a) Explain decision problems.

(b) What do you understand by strong principle of mathematical induction ? How it is different from mathematical induction ? Give an example of a statement where you require strong principle of mathematical induction.