B.E. (Fifth Semester) EXAMINATION, Dec., 2005

(Computer Science & Engg. Branch)

THEORY OF COMPUTATION

(CS-505)

Note : Attempt any *five* questions. All questions carry equal marks.

1. (a) Make a DFA for the language $L = \{x \in \{0,1\}^* \mid x$ ends in 1 and does not contain the substring 00$\}$. 5

   (b) Find a regular expression corresponding to finite automata. 5

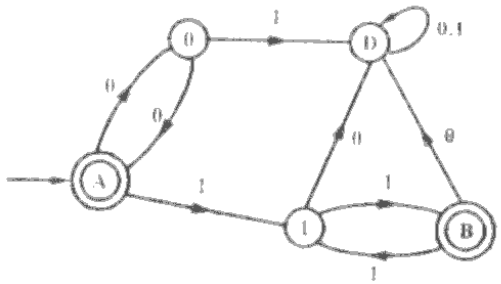

Fig. 1

   (c) For each of these regular expressions over $\{0, 1\}$, draw an NFA with E-move recognizing the corresponding language : 10

   (i) $(0 + 1)(01)^*(011)^*$ (ii) $010^* + 0(01 + 10)^* 11$

2. (a) Prove for any NFA $M = (Q, \Sigma, q_0, A, \delta)$ accepting a language $L \subseteq \Sigma^*$, there is an FA $M1 = (Q_1, \Sigma, q_1, A_1, \delta)$, that also accepts L. 10

   (b) Let $m = (Q, \Sigma, q_0, A, \delta)$ be an NFA. Show that for every $q \in Q$ and every $x, y \in \Sigma^*$: 10

$$\delta^*(q, xy) = \bigcup_{r \in \delta^*(q,x)} \delta^*(r, y)$$

3. (a) Minimize the states of the following finite automata. 12

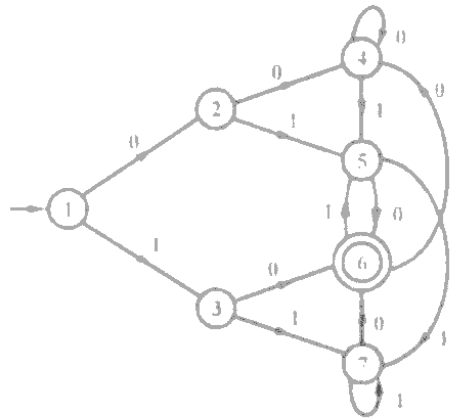

Fig. 2

   (b) Construct the context free grammar (CFG) equivalent to a regular expression $(011 + 1)^*(01)^*$. 8

4. (a) Eliminate ε-productions from a given CFG : 5

$$S \rightarrow ABCBCDA$$
$$A \rightarrow CD$$
$$B \rightarrow Cb$$
$$C \rightarrow a \mid \varepsilon$$
$$D \rightarrow bD \mid \varepsilon$$

   (b) Convert the following CFG to Chomsky Normal form : 15

$$S \rightarrow AACD$$
$$A \rightarrow aAb \mid \varepsilon$$
$$C \rightarrow aC \mid a$$
$$D \rightarrow aDa \mid bDb \mid \varepsilon$$

5. (a) Make a PDA accepting the language of Palindromes. 10

   (b) Give transition table for deterministic PDA recognizing the following language : 10

$$L = \{x \in \{a, b\}^* \mid n_a(x) > n_b(x)\}$$

6. (a) Show using the Pumping Lemma that the given language is not a CFL : 10

$$L = \{a^i b^i c^i \mid i \geq 1\}$$

   (b) Prove that the CFG G_1 with productions : 10

$$SI \rightarrow S1 + T \mid T$$
$$T \rightarrow T * F \mid F$$
$$F \rightarrow (S1) \mid a$$

is unambiguous.

(a) Build a transition table for a Turing Machine (TM) 7

q_0	a	(q_1, A, R)	q_1	a	(q_1, a, R)	q_2	a	(q_2, a, R)
q_0	b	(q_3, A, R)	q_1	b	(q_1, b, R)	q_2	b	(q_2, b, R)
q_0	Δ	(q_7, Δ, R)	q_1	Δ	(q_2, Δ, L)	q_3	a	(q_3, a, R)
q_3	b	(q_3, b, R)	q_3	Δ	(q_4, Δ, L)	q_4	a	(q_5, A, L)
q_4	b	(q_6, A, L)	q_5	a	(q_5, a, L)	q_5	b	(q_5, b, L)
q_5	Δ	(q_0, Δ, R)	q_6	a	(q_6, a, L)	q_6	b	(q_6, b, L)
q_6	Δ	(q_7, Δ, R)						

   (b) What is the final configuration, if the input string is ab^2a?

   (c) What is the final configuration, if the input string is ba^2?

   (d) Describe what the TM does for an arbitrary input string in $\{a, b\}^*$.

8. Write short note on any *four* of the following : 5 each

   (i) Recursively Enumerable language

   (ii) Primitives recursive functions

   (iii) Turing machine as transducers

   (iv) Properties of context free grammars

   (v) Post systems