(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 1032 Roll No.

B.Tech.

FOURTH SEMESTER EXAMINATION, 2004-2005

THEORY OF AUTOMATA AND FORMAL LANGUAGE

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt ALL questions.*

(ii) All questions carry equal marks.

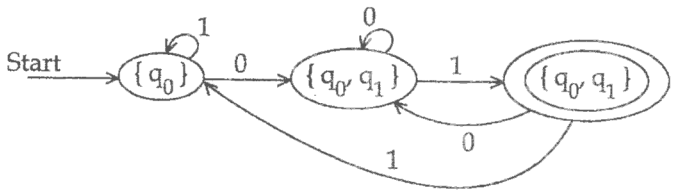
1. Attempt ***any four*** parts of the following : **(5x4=20)**

(a) Differentiate between the Mealy Machine and Moore type Machine with example.

(b) Convert the following NFA to equivalent DFA.

	0	1
→ p	{q, s}	{q}
*q	{r}	{q, r}
r	{s}	{p}
*s	ϕ	{p}

(c) Construct DFA from the graph given below.



(d) Design NFA to recognise the following sets of string. abc, abd and aacd. Assume the alphabet is {a, b, c, d}.

(e) Give the English description of the language of the following regular expression.

$(1+\epsilon)\ (00^*1)^*0^*$

(f) Write the regular expression for the following language :

(i) A set of strings of 0's and 1's with at most one pair of consecutive 1's.

(ii) Set of all strings of 0's and 1's such that every pair of adjacent 0's appear before any pair of adjacent 1's.

2. Attempt ***any four*** parts of the following : **(5x4=20)**

(a) Prove or disprove the following statements about regular expressions.

(i) $(R+S)^* = R^* + S^*$

(ii) $(RS+R)^*RS = (RR^*S)^*$

(b) Explain with example the algebric laws for regular expressions.

(c) Proove that the following is not a regular language.

(i) $\{\phi^n 1^n \mid n \geq 1\}$

(ii) $\{0^n \mid n \text{ is a perfect square}\}$

(d) Prove, if L is a regular language over alphabet Σ, then $\overline{L} = \Sigma^* - L$ is also a regular language.

(e) Design a context free grammer for the following language.

(a) The set $\{0^n 1^n \mid n \geq 1\}$, i.e. the set of all strings of one or more 0's followed by an equal number of 1's.

(b) A set $\{a^i b^j c^k \mid i \neq j \text{ or } j \neq k\}$ i.e., the set of strings of a's followed by b's followed by c's, such that there are either a different number of a's and b's or a different number of b's and c's or both.

(f) The following grammer generates the language of regular expression $0^*1\ (0+1)^*$:

$S \rightarrow A\ 1B$

$A \rightarrow OA \mid \epsilon$

$B \rightarrow OB \mid 1B \mid \epsilon$

Give the left most and right most derivation of the following strings.

(i) 00101

(ii) 1001

3. Attempt *any two* parts of the following : **(10x2=20)**

(a) (i) Convert the PDA $P = (\{p,q\}, \{0,1\}, \{x, z_0\}, \delta, q, z_0)$ to a CFG, if δ is given as $\delta(q, 1, z_0) = \{(q, xz_0)\}$.

(ii) Convert the grammar

$$S \rightarrow OS1 \mid A$$

$$A \rightarrow 1AO \mid S \mid E$$

to PDA that accepts the same language by empty stack.

(b) Show that if P is a PDA, then there is a one-state PDA P_1 such that $N(P_1) = N(P)$.

(c) Show that the language :

$$L = \{0^n 1^n \mid n \geq 1\} \cup \{0^n 1^{2n} \mid n \geq 1\}$$

is a context-free language that is not accepted by any DPDA.

4. Attempt *any two* parts of the following : **(10x2=20)**

(a) Describe the turing machine. Design a turing machine that can accept the following language.

(i) $L = \{a^n b^{2n} \mid n > 0\}$

(ii) $L = \{a^n b^n c^n \mid n > 1\}$

(b) Design the following 2-tape TM to accept the language of all strings of 0's and 1's with an equal number of each. The first tape contains the input and is scanned from left to right. The second tape is used to store the excess of 0's over 1's or vice-versa, in the part of the input seen so far. Specify the states, transitions and the intuitive purpose of each state.

(c) (i) Describe the counter machine accept the following language.

$\{0^n 1^m \mid n \geq m \geq 1\}$

(ii) Explain how :

(a) A computer can simulate a turing mchine.

(b) A turing machine can simulate a computer.

5. Attempt *any two* parts of the following : **(10x2=20)**

(a) Convert the TM

$M = (\{q_1, q_2, a_3\}, \{0, 1\}, \{0, 1, B\}, \delta, q_1, B, \{q_3\})$ where δ is given by :

q_i	$\delta(q_i, 0)$	$\delta(q_i, 1)$	$\delta(q_i, B)$
q_1	$(q_2, 1, R)$	$(q_2, 0, L)$	$(q_2, 1, L)$
q_2	$(q_3, 0, L)$	$(q_1, 0, R)$	$(q_2, 0, R)$
q_3	-	-	-

and input string $w = 01$ to an instance of MPCP.

(b) Show that the following question is decidable :

(a) The set of codes for TM's M such that when started with black tape will eventually write some non blank symbol on its tape.

(c) Show that a set of TM codes for TM's that accept all inputs that are palindrome (possibly along with some other inputs) in undecidable.

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