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

PAPER ID : 1071   Roll No.

B. Tech.

(SEM. IV) EXAMINATION, 2008-09

THEORY OF AUTOMATA & FORMAL LANGUAGES

Time : 3 Hours]   *[Total Marks : 100*

Note :   (1)   Attempt all questions.

        (2)   All questions carry **equal** marks.

1   Attempt any **four** parts of the following: $5 \times 4 = 20$

   (a)   Let S={ab, bb} and let T= {ab, bb, bbbb}, show that $S^* = T^*$

   (b)   What do you mean by the Kleene closure of set A?

   (c)   Construct a grammar for each of the following languages :

       (i) $\left\{ a^m b^m \mid m \geq 1 \right\} \cup \left\{ b^n a^n \mid n \geq 1 \right\}$

       (ii) $\left\{ a^l b^m c^n \mid l + m = n, l, m \geq 1 \right\}$

   (d)   Design a FA recognizing the language over {a,b,c, d} which shall accept only those strings in which no symbol appears in consecutive positions.

1071]   1   [Contd..

(e) Find two different FAs M_1 and M_2 recognizing languages L_1 and L_2 respectively, such that the languages $L_1 \cup L_2$ and $L_1 L_2$ are the same.

(f) Show that every context-free language is context-sensitive.

2 Attempt any **four** parts of the following : 5×4=20

(a) Using induction show that if for some state q and some string n, $\delta^*(q,n) = q$, then for every $n \geq 0$, $\delta^*(q, n^n) = q$.

(b) Construct an NFA which recognizes a set of strings containing three consecutive 0's and three consecutive 1's. Also correct this NFA into an equivalent DFA.

(c) Discuss the various application of FA.

(d) Construct a Moore machine that determines whether an input string contains an even or odd number of 1's. The machine should give I as output if an even number of 1's are in the string and 0 otherwise.

(e) Construct a DFA for the following langauge :

$$\left\{ a^m b^n \mid m \text{ is divisible by 2} \right.$$

and n is divisible by 4

(f) Discuss the conversion of Moore to mealy machine with the help of an example.

1071] 2 [Contd..

3 Attempt any **two** parts of the following :   **10×2=20**

(a) Using pumping lemma, prove that the following languages are not regular :

   (i) $\left\{ wo^n \mid w \in \{0, 1\}^* \wedge |w| = n \right\}$

   (ii) $\left\{ ww \mid we\{a, b\}^* \right\}$

(b) Simplify the following grammar by eliminating uselsess symbols and useless production :

$S \rightarrow a \mid aA \mid B \mid C, \ A \rightarrow aB \mid \varepsilon,$

$B \rightarrow Aa, \ C \rightarrow cCD, \ D \rightarrow dd$

Also find the Chomsky Normal form of the simplified grammar.

(c) (i) Show that the CFG with productions.

$S \rightarrow a \mid Sa \mid bSS \mid SSb \mid SbS$

is ambiguous.

   (ii) Use pumping lemma to prove that the following is not CFL :

$\{a^n \ b^m \ a^n \ b^{n+m} \mid m, n \geq 0\}$

4 Attempt any **two** parts of the following :   **10×2=20**

(a) (i) Non-deterministic PDA is not equivalent deterministic PDA in terms of language recognition. Explain.

   (ii) Covert the following grammar to a PDA that accepts the same langauge.

$S \rightarrow OSI \mid A$

$A \rightarrow IAO \mid S \mid \varepsilon$

(b) Cosntruct a PDA by empty stack which accepts the following :

$\{a^m\ b^m\ c^n\ |\ m,\ n \geq 1\}$

Also convert this PDA into an equivalent CFG.

(c) Construct a two-stack PDA for recognizing the following :

$\{a^n\ b^n\ c^n\ d^n\ |\ n \geq 1\}$

5 Attempt any **two** parts of following :   **10×2=20**

(a) What do you mean by unsolvable problem? Explain.

(b) Design a TM recognizing the following language :

$\{a^m\ ba^n\ ba^p\ ba^{m+n+p}\ |\ m,n,p>1\}$

(c) Design a 2-track TM that takes as input on track-1 a^n and leaves on track-2 the binary representation of **n**.