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

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

Also convert this PDA into an equivalent CFG.

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

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

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 :

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

(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**.

Printed Pages : 4 TCS – 405

(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: **5×4=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) $\{a^m b^m \mid m \geq 1\} \cup \{b^n a^n \mid n \geq 1\}$

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

(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.

(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 :

$\{ a^m b^n \mid m$ is divisible by 2 and n is divisible by 4

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

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

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

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

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

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

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

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

Also find the Chomsky Normal form of the simplified grammar.

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

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

is ambiguous.

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

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

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.

$S \to OSI \mid A$

$A \to IAO \mid S \mid \varepsilon$