8. *(a)* Let G be the grammar given by

$S \rightarrow aABB / aAA;\ A \rightarrow aBB / a;\ B \rightarrow bBB / A$

Construct the PDA that accepts the language generated by this grammar G.

(b) Define deterministic push-down automata. Explain with an example.

9. Give a Turing machine—

(a) that computes one's complement of a binary number;

(b) that shifts the input string over the alphabet (0, 1) by one position right by inserting '#' as the first character.

10. *(a)* Explain about deterministic context-free language and deterministic PDA.

(b) Show that $L = \{a^n b^n c^n : n >= 1\}$ is a CSL.

★★★

Code : 105301

2013 (A)

FORMAL LANGUAGE AND AUTOMATA THEORY

Time : 3 hours *Full Marks* : 70

Instructions :

(i) All questions carry equal marks.

*(ii) There are **TEN** questions in this paper.*

*(iii) Attempt any **FIVE** questions.*

1. *(a)* Explain the differences between NFA and DFA.

(b) Design a DFA which accepts all strings which are ending with 101 over an alphabet {0, 1}.

2. *(a)* Obtain the regular expression for the following sets :

(i) Set of strings over $\Sigma = \{a, b\}$ with exactly two *a*'s

(ii) Set of all strings over $\Sigma = \{0, 1\}$ which should not contain the substring 101

(iii) $L = \{vwv \mid v, w \in \{a, b\}^*, |v| = 2\}$

(iv) Set of strings over $\Sigma = \{a, b, c\}$ with no runs of *a* which has length greater than three

(b) Construct an NFA (without using Thompson's rule) for the following set :

Set of strings over $\Sigma = \{0, 1\}$ with alternate 0's and 1's

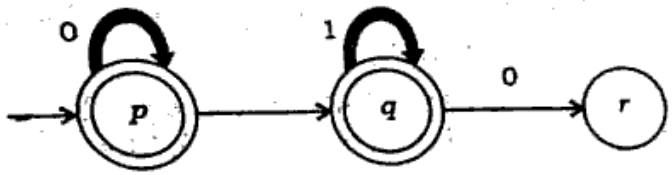
3. (a) Give DFA for the following NFA (s is the final state) :

Current State	Next State	
	A	B
$\rightarrow P$	{p, q}	p
Q	.....	r
R	.....	s
S	.....	.....

(b) Construct an NFA using ε move for $r = (b \mid c) * a(b \mid c)*$.

4. (a) Give DFA for the NFA constructed in Question No. 3. (b).

(b) Find out the regular expression for the following transition diagram :



5. (a) Design a Moore machine to determine the residue mode 4 for each binary string treated as integer.

(b) Design a Mealy machine that uses its state to remember the last symbol read and emits output y whenever current input matches the previous one, and emits n otherwise.

6. (a) Construct a Moore machine equivalent to the following Mealy machine :

PS	Input Symbol			
	a = 0		a = 1	
	NS	o/p	NS	o/p
q_1	q_3	0	q_2	0
q_2	q_1	1	q_4	0
q_3	q_2	1	q_1	1
q_4	q_4	1	q_3	0

(b) Show using pumping lemma that the language $L = \{a^i b^i \mid i >= 1\}$ is regular or not.

7. (a) Reduce the grammar G given by

$S \rightarrow aAa;\ A \rightarrow Sb / bcc / DaA;$
$C \rightarrow abb / DD;\ E \rightarrow ac;\ D \rightarrow aDA$

into an equivalent grammar by removing useless symbols and useless productions from it.

(b) Convert the following grammar into CNF :

$S \rightarrow aAD;\ A \rightarrow aB / bAB;\ B \rightarrow b;\ D \rightarrow d$