Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (CSE-NEW/IT-NEW)/SEM-4/CS-402/2013

2013
FORMAL LANGUAGE AND AUTOMATA THEORY

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

   i) Which is true of the following ?

      a) Merger graph is directed graph

      b) Compatible graph is directed graph

      c) Both are directed

      d) None of these.

   ii) The logic of pumping lemma is a good example of

      a) The pigeon-hole principle

      b) The divide and conquer technique

      c) Recursion

      d) Iteration.

iii) a*(a + b)* is equivalent to

a) a* + b* b) a*b*

c) (ab)* d) none of these.

iv) The class of context free language is not closed under

a) Concatenation

b) Union

c) Intersection

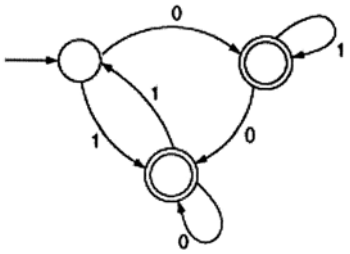
d) Repeated Concatenation.

v) Which of the following strings can be obtained by the language L = $\left\{ a^i b^{2i} \mid i \geq 1 \right\}$

a) aaabbbbbb b) aabbb

c) abbabbba d) aaaabbbabb.

vi) Which string is not accepted by the following FSA ?



a) 00111 b) 00110

c) 01010 d) 11010.

vii) Which of the following production is in CNF ?

a) $S \rightarrow aA$ b) $SA \rightarrow AS$

c) $S \rightarrow AB$ d) All of these.

viii) The solution to the equation R = Q + RP is

a) R = QP* b) R = Q*P

c) P = RQ* d) R = P.

ix) A shift register is

a) Mealy M/C

b) Turing M/C

c) Moore M/C

d) all of these.

x) Consider the following language :

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

L is

a) CFL but not regular

b) CSL but not CFL

c) Regular

d) Type 0 language but not type 1.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

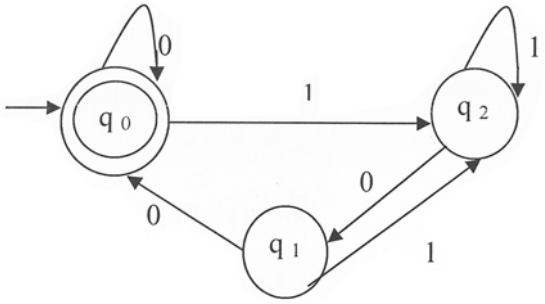
2. Design a Finite automate the accepts set of strings that every string ends with 00 over alphabet {0, 1}.

3. Let Σ = {a,b}, Prove that the Language L = {w ∈ Σ* : n_a (w) } is not regular.

4. Find the Context Free Grammar for the following language

   L = { $a^n b^{2n} c^m$: n,m > = 0}.

5. Construct the regular expression corresponding to the state diagram given below :



6. Design a Turing Machine that recognizes the language of all string of even length over the alphabet {a,b}.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Construct a DFA from the NFA given below : 6

State/Σ	I/P	
	0	1
→ Q_0	Q_0, Q_3	Q_0, Q_4
Q_3	Q_f	……
Q_4	…….	Q_f
Q_r (Final State)	Q_f	Q_f

b) Construct λ - NFA for the regular expression (0 + 1)* 1 (0 + 1) 4

c) What is regular expression ? 2

d) What will be regular expression over the alphabet {a,b}, for the language $L = (a^n b^n : n >= 4, m <= 3\}$? 3

8. a) Design a TM that accepts $\{0n1^n \mid n \geq 1\}$ 5

b) What do you mean by halting problem of a Turing machine ? 2

c) Design a TM which can multiply two positive integers. 6

d) Why a Turing machine is called linear bounded automation ? 2

9. a) State Myhill-Nerode theorem with the definition of equivalent relation and invariance. 3 + 2

b) Minimize the following machine by applying Myhill-Nerode theorem. 10

PS	NS	
	X = a	X = b
→ A	B	E
B	C	D
Ⓒ	H	I
Ⓓ	I	H
E	F	G
Ⓕ	H	I
Ⓖ	H	I
H	H	H
I	I	I

10. a) Construct CFG for the following. 3 + 2 + 3

i) Palindrome for binary numbers.

ii) $L = \{ a^n b^n c^m d^m \mid m, n > 0 \}$

iii) $L = \{ a^n b^m \mid n \neq m \}$

b) Convert the following grammar to CNF. 5

S → aA/B/C/a

A → aB/E

B → aA

C → cCD

D → abd

c) Define non-generating and non-reachable symbols with example. 2

11. a) Construct a PDA to accept L = { WW^R | W belongs to (a,b)* and W^R is reverse string of W } by empty stack and final state. 5

b) Construct an equivalent PDA for the following CFG.

$S \rightarrow aAB/bBA$

$A \rightarrow bS/a$

$B \rightarrow aS/b$

Show an ID for the string abbaaabbbab for the PDA generated with stack description. 7

c) Explain Ogden's Lemma for CFL. 3