

**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 + 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.

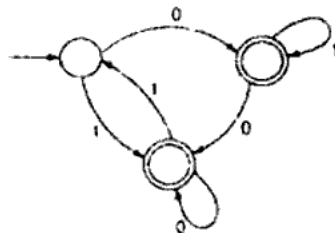
iv) The class of context free language is not closed under

- a) Concatenation  
b) Union  
c) Intersection  
d) Repeated Concatenation.

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

- a) aaabbbbbbb                      b) aabbb  
c) abhabbba                      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.  $3 \times 5 = 15$

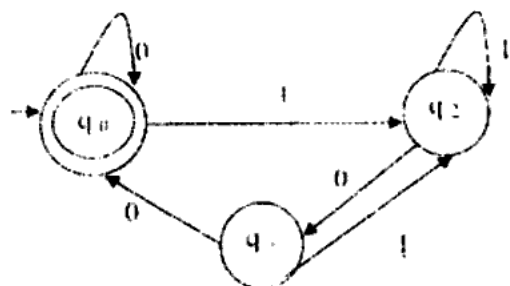
2. Design a Finite automate the accepts set of strings that every string ends with 00 over alphabet  $\{0, 1\}$ .

3. Let  $\Sigma = \{a, b\}$ . Prove that the Language  $L = \{w \in \Sigma^+ : n_a(w) \text{ is not regular}\}$ .

4. Find the Context Free Grammar for the following language

$$L = \{a^m b^n c^m : n, m \geq 0\}.$$

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.  $3 \times 15 = 45$

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

State/ $\Sigma$	I/P	
	0	1
$\rightarrow Q_0$	$Q_0, Q_3$	$Q_0, Q_4$
$Q_3$	$Q_f$	.....
$Q_4$	.....	$Q_f$
$Q_f$ (Final State)	$Q_f$	$Q_f$

b. Construct a 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  $L = \{a^n b^m : n \geq 4, m \leq 3\}$  ? 3

a. Design a TM that accepts  $\{0^n 1^n : n \geq 1\}$  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

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.

PS	NS	
	$X = a$	$X = b$
$\rightarrow A$	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 +

i) Palindrome for binary numbers.

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

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

- b) Convert the following grammar to CNF.

$S \rightarrow aA/B/C/a$

$A \rightarrow aB/E$

$B \rightarrow aA$

$C \rightarrow cCD$

$D \rightarrow abd$

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

Construct a PDA to accept  $L = \{ WWR \mid W \text{ belongs to } (a,b)^+ \text{ and } WR \text{ is reverse string of } W \}$  by empty stack and final state.

5

- 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  $abbbaabbbab$  for the PDA generated with stack description.

7

- c) Explain Ogden's Lemma for CFL.

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