



Name : .....  
Roll No. : .....  
Invigilator's Signature : .....

**CS / B.TECH (CSE) / SEM-4 / CS-401 / 2011**

**2011**

**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) Moore machine output depends on
    - a) input
    - b) input and present state
    - c) present state
    - d) none of these.
  - ii) FSM can recognize
    - a) a grammar dependent on characteristic of FSM
    - b) on CFG
    - c) any unambiguous grammar
    - d) only regular grammar.



iii) DFA has a transition function

- a)  $Q \times \Sigma$  to  $Q$                       b)  $Q \times \Sigma$  to  $2^Q$   
c) both (a) and (b)                      d) none of these.

iv) The class of CFG is not closed under

- a) concatenation  
b) intersection  
c) union  
d) repeated concatenation.

v) Consider the CFG

$$\begin{aligned} X &\rightarrow XY \\ X &\rightarrow zX / bX / a \\ Y &\rightarrow Ya / Yb / b \end{aligned}$$

Any string of terminals, which can be generated by the CFG

- a) has at least one  $b$   
b) ends with  $a$   
c) has no consecutive  $a$ 's or  $b$ 's  
d) has at least 2  $a$ 's.
- vi) A grammar that produces more than one parse tree for some sentence is said to be
- a) contiguous                      b) ambiguous  
c) unambiguous                      d) regular.



- vii) The following production rules of a regular grammar generates a language  $L$

$$S \rightarrow aS/bS/a/b$$

The regular expression for  $L$  is

- a)  $a + b$     b)  $(a + b)^*$
- c)  $(a + b)(a + b)^*$     d)  $(aa + bb)a^*b^*$
- viii) If  $Q$  is the number of states in the NFA, the equivalent DFA can have maximum number of states
- a)  $Q$     b)  $Q - 1$
- c)  $2Q - 1$     d)  $2^Q$ .
- ix) A CFG,  $S \rightarrow aS/bS/a/b$ , is equivalent to
- a)  $(a + b)^+$     b)  $(a + b)(a + b)^*$
- c)  $(a + b)^*(a + b)$     d) all of these.
- x) A Push down automaton is different from a finite automaton because of
- a) a read head
- b) a memory in the form of stack
- c) a set of states
- d) all of these.



**GROUP – B**

**( Short Answer Type Questions )**

Answer any *three* of the following.  $3 \times 5 = 15$

2. Convert the following Context-free grammar into an equivalent grammar in CNF

$$S \rightarrow 1A/0B$$

$$A \rightarrow 1AA/0S/0$$

$$B \rightarrow 0BB/1S/1$$

3. Is the following machine information lossless ? If yes, find the order of losslessness.

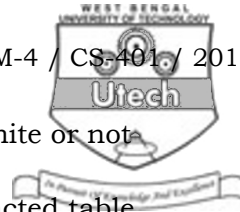
PS	NS, z	
	X = 0	X = 1
A	A, 0	B, 0
B	C, 0	D, 0
C	D, 1	C, 1
D	B, 1	A, 1

4. Let G be the grammar

$$S \rightarrow aB/ba, A \rightarrow a/aS/bAA, B \rightarrow b/bS/aBB$$

For the string *aaabbabbba* , find

- leftmost derivation
  - rightmost derivation
  - parse tree.
5. Construct a Turing machine that accepts all strings over  $\{0, 1\}$  with an even number 0's and even number of 1's.



6. Test whether the following machine is definite or not-
- by using synchronizing tree
  - by using repeated derivation of contracted table
  - if the machine is definite, what is the order of definiteness ? Justify.

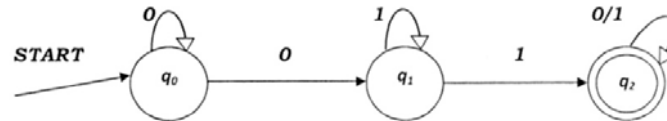
Present State	Next State	
	$a = 0$	$a = 1$
A	A	B
B	C	B
C	A	D
D	C	B

**GROUP - C**

**( Long Answer Type Questions )**

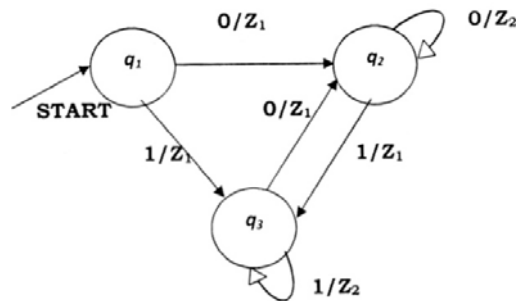
Answer any *three* of the following.  $3 \times 15 = 45$

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



6

- b) Convert Mealy Machine to Moore Machine.

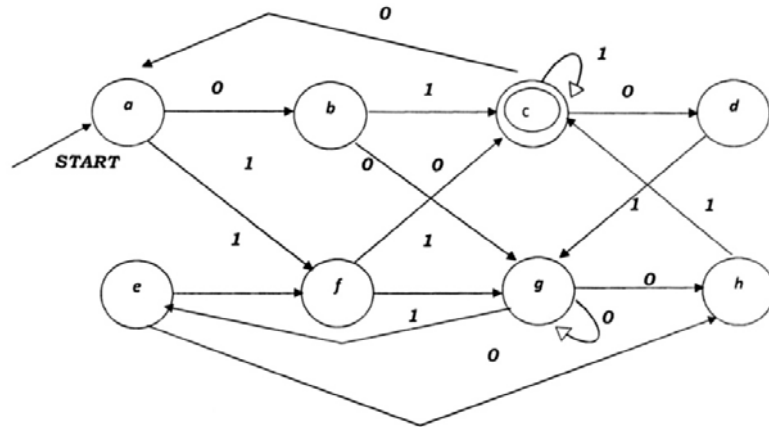


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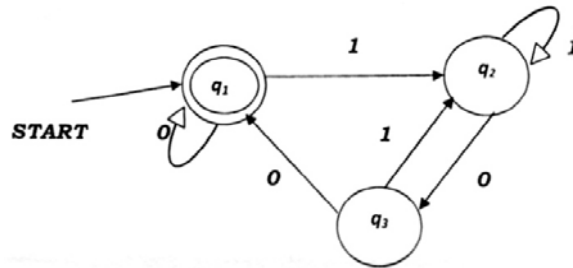
- c) What are Kleene Closure and Positive Closure ? Give example for both.  $2 + 1$



8. a) What do you mean by Disginghishable and Indistinguishable state ? 3  
 b) Use Myhill Nerode Theorem to minimize the following finite automata : 12



9. a) Give the Regular Expression for the DFA using Arden Theorem.



- b) What is Griebach Normal Form (GNF) for Context Free grammar ? 1 + 4

Convert the following grammar into GNF

$$S \rightarrow ABb/a$$

$$A \rightarrow aaA/B$$

$$B \rightarrow bAb$$

- c) Using Pumping Lemma show that  $L = \{a^n b^n : n \geq 0\}$  is not regular. 5



10. a) Construct a NFA with  $\epsilon$  or  $\lambda$  transition for  $r = (11+0)^* (00+1)^*$ . 5
- b) What is PDA ? 5
- c) Construct PDA for  $L = \{ww^R : w \text{ belongs to } (0,1)^*\}$ . 5
11. a) What do you mean by k-equivalent states ? 3
- b) Draw the Merger graph, Merger table, Compatibility graph and then minimize the following : 12

Present State	Next State, o/p			
	$i/p = 0$	$i/p = 1$	$i/p = 2$	$i/p = 3$
A	—	C, 1	E, 1	B, 1
B	E, 0	—	—	—
C	F, 0	F, 1	—	—
D	—	—	B, 1	—
E	—	F, 0	A, 0	D, 1
F	C, 0	—	B, 0	C, 1

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