Name : ………………………………………………………………………………………………………

Roll No. : ……………………………………………………………………………………………………

Invigilator's Signature : ……………………………………………………………………………….

CS/B.Tech(IT)/SEM-5/CS-512/2009-10

2009

FORMAL LANGUAGE & AUTOMATA THEORY

Time Alloted : 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 any *ten* of following : 10 × 1= 10

i) Let R_1 and R_2 be regular sets defined over alphabet $\sum$ then

a) $R_1 \cap R_2$ is not regular.

b) $R_1 \cup R_2$ is not regular.

c) $\sum \cap R_2$ is not regular.

d) R_2^* is not regular.

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

a) aaabbbbbb b) aabbb

c) abbaabbbb d) aaaabb

iii) The regular expression with all strings of 0's and 1's with atleast two consecutive 0's is

a) $1 + (10)^*$
b) $(0 + 1)^* 00 (0 + 1)^*$
c) $(0 + 1)^* 011$
d) $0^* 0^* 1^*$

iv) Which string can be generated by $S \rightarrow aS / bA$, $A \rightarrow d / ccA$?

a) aabccd
b) adabcca
c) abcca
d) abababd.

v) The regular sets are closed under

a) Union
b) Concatenation
c) Kleene closure
d) all of these.

vi) The intersection of CFL and regular language

a) is always regular
b) is always context – free
c) both (a) & (b)
d) need not to be regular.

vii) A grammar that produces more than one parse tree for some sentence is called

a) ambiguous
b) unambiguous
c) regular
d) none of these.

viii) Consider the regular expression (0 + 1) (0 + 1) .... n times. The minimum state finite automation that recognizes the language represented by this regular expression contains

a) n states
b) n + 1 states
c) n + 2 states
d) n - 1 states.

ix) The vernacular language English, if considered a formal language is a

a) regular language

b) context – free language

c) context – sensitive language

d) none of these.

x) Palindromes cannot be recognized by Finite State Machine because

a) an FSM cannot remember arbitrarily large amount of information

b) an FSM cannot fix the mid - point

c) FSM cannot find whether the second half of the string matches the first half

d) all of these.

xi) NDFA can be constructed equivalent of

a) type - 0 grammar
b) type - 1 grammar
c) type - 2 grammar
d) type - 3 grammar.

xii) Pumping lemma for CFG proves that a given language

a) belongs to CFG

b) does not belongs to CFG

c) belongs to regular grammar

d) none of these.

xiii) NDFA can be constructed equivalent of

a) only type - 1 grammar
b) only type - 2 grammar
c) only type - 3 grammar
d) all grammars.

xiv) If a machine of n states is μ definite, then

a) $\mu \leq n - 1$
b) $\mu \geq n - 1$
c) $\mu = n - 1$
d) none of these.

xv) Merger table is substitute of

a) merger graph

b) compatible graph

c) minimized machine

d) finite state machine.

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d) finite state machine.

xvi) If G = ({ S }, { a }, { S → SS}, S), the language generated by G is

a) $L (G) = \emptyset$

b) $L (G) = a^n$

c) $L (G) = a^{\emptyset}$

d) $L (G) = a^n b a^n$.

GROUP – B

(Short Answer Type Questions)

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

2. Test the machine below is definiteness or not. If yes, find the order μ. 5

PS	NS	
	x = 0	x = 1
A	A	B
B	E	B
C	E	F
D	E	F
E	A	D
F	E	B

3. a) State pumping lemma for Context Free Language.

b) Using this lemma prove that $L = \{ a^i b^j \mid j = i^2 \}$ is not Context Free Language. 2 + 3

4. a) What is ambiguous grammar ?

b) Check whether the following grammar is ambiguous :

$S \rightarrow iCtS \mid iCtSeS \mid a$

$C \rightarrow b$ 1 + 4

5. a) What are the differences between Moore machine and Mealy machines?

b) Construct a Moore machine equivalent to the Mealy machine :

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

2 + 3

6. aa) What are the differences between DFA & NFA?

bb) Construct DFA which is equivalent to given NFA.

$M = (\{ q_0, q_1, q_2, q_3 \}, \{ 0, 1 \}, \delta, q_0, \{ q_3 \})$ and δ is given in the table :

Q / Σ	0	1
q_0	q_0, q1	q_0
q_1	q_2	q_1
q_2	q_3	q_3
q_3	----	q_2

2 + 3

GROUP – C

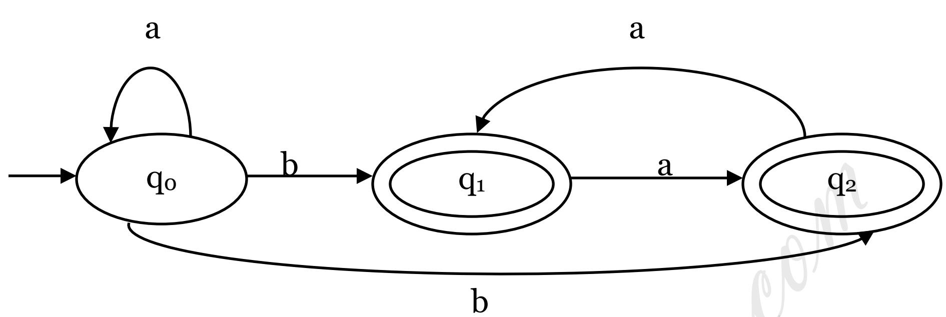
(Long Answer Type Questions)

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

7. a) State and prove Arden's Theorem.

b) Prove that $(1 + 00^* 1) + (1 + 00^* 1) (0 + 10^* 1) ^* (0 + 10^* 1) = 0^*1 (0 + 10^* 1)^*$

c) Find the regular expression for the given transition diagram :



5 + 5 + 5

8. a) What is PDA?

b) Design a PDA to accept the following language $L = (\omega\omega^R \mid \omega \in (0, 1)^*)$.

c) Construct a context free grammar generating following language :

$L = \{ a^n b^n \mid n \geq 1 \} \cup \{a^m b^{2m} \mid m \geq 1 \}$ and also construct PDA for the above derived CFG. 1 + 6 + 8

9. a)

PS	NS, z		
	I_1	I_2	I_3
A	C, 0	E, 1	---
B	C, 0	E,--	---
C	B,--	C, 0	A,--
D	B,0	C,--	E,--
E	---	E	A,--

For the incompletely specified machine shown above, find a minimum state reduced machine containing the original one.

b)

PS	NS, z	
	x = 0	x = 1
A	B,1	H, 1
B	F, 1	D, 1
C	D, 0	E, 1
D	C, 0	F, 1
E	D, 1	C, 1
F	C, 1	C, 1
G	C, 1	D, 1
H	C, 0	A, 1

Using this table

i) find the equivalence partition.

ii) find the standard form of the corresponding reduced machine.

What the minimum length sequence that distinguishes state A from state B.

8 + (3 + 3 +1)

10. a) For the grammar

$S \rightarrow aB \mid bA$

$A \rightarrow a \mid aS \mid bAA$

$B \rightarrow b \mid bS \mid aBB$

Give the left most and right most derivation for the string "aaabbabbba".

b) Design a CFG for the language

$L(G) = \{ 0^n 1^m \mid n \neq m \}$

c) Construct a regular grammar G generating the regular set by $r = 01 (0 + 1)^*$

5 + 5 + 5

11. a) Remove left recursion from guven grammar :

$A \rightarrow Ba \mid b$

$B \rightarrow Bc \mid Ad \mid e$

b) Convert the grammar into GNF :

$S \rightarrow a\ ABb \mid a$

$A \rightarrow aaA \mid B$

$B \rightarrow bAb$

c) In response to an unknown input sequence, the machine given below produces the output sequence 1110000010. Find the input sequence to the machine if it is known that is initial state is A and final state is F.

PS	NS, z	
	x = 0	x = 1
A	B, 1	C, 0
B	D, 1	B, 1
C	E, 1	B, 0
D	A, 0	E, 0
E	F, 0	D, 1
F	D, 0	A, 1
