FORMAL LANGUAGE & AUTOMATA THEORY (SEMESTER - 4)

CS / B.Tech(CSE) / SEM-4 / CS-401 / 09

1. ....
Signature of Invigilator

2. .... **Reg. No.**
Signature of the Officer-in-Charge

Roll No. of the Candidate

CS / B.Tech(CSE) / SEM-4 / CS-401 / 09

ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009

FORMAL LANGUAGE & AUTOMATA THEORY (SEMESTER - 4)

Time : 3 Hours] [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.
2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.
   b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.
3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
4. Read the instructions given inside carefully before answering.
5. You should not forget to write the corresponding question numbers while answering.
6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.
7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.
9. Rough work, if necessary is to be done in this booklet only and cross it through.

No additional sheets are to be used and no loose paper will be provided

FOR OFFICE USE / EVALUATION ONLY

Marks Obtained

	Group – A										Group – B		Group – C					
Question Number																	***Total Marks***	***Examiner's Signature***
Marks Obtained																		

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Head-Examiner / Co-Ordinator / Scrutineer

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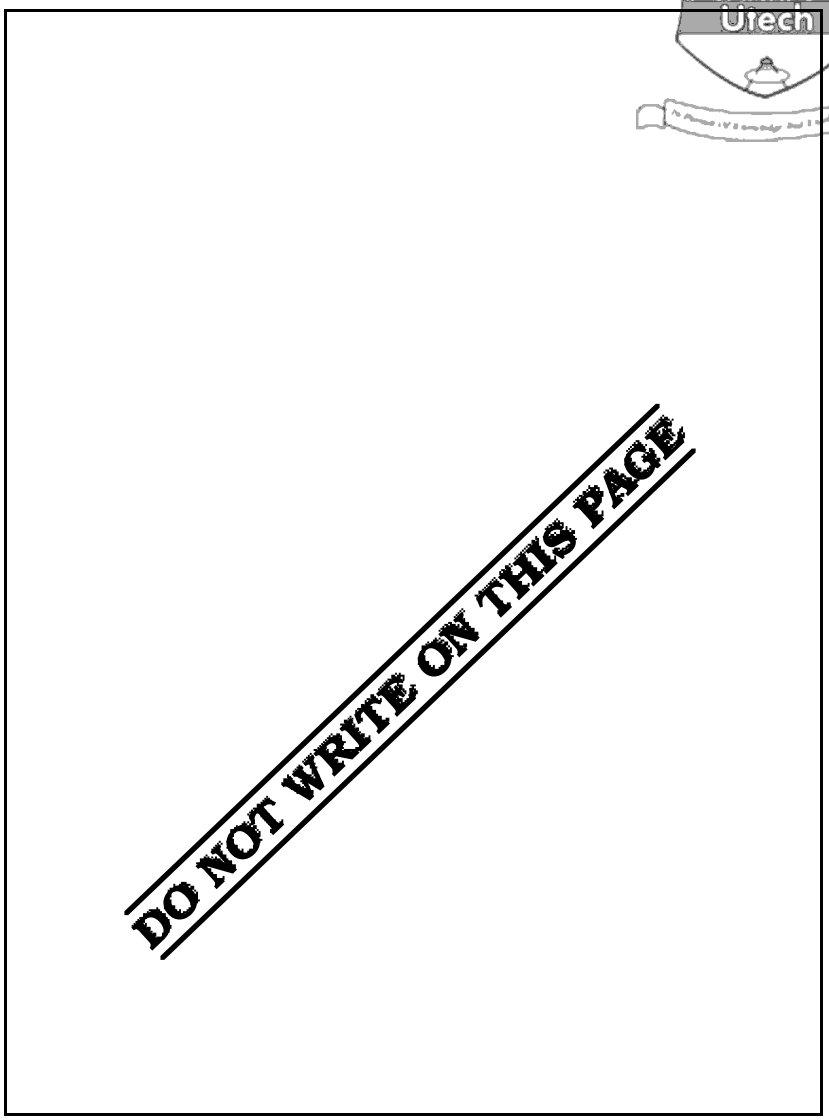
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GROUP – A

(Multiple Choice Type Questions)

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

i) $L = \{ a^n \; b^n \; c^n \;$, where $n \geq 1 \}$ is

a) regular

b) context free but not regular

c) context sensitive but not context free

d) none of these. ☐

ii) Which is true of the following ?

a) Merger graph is a directed graph

b) Compatible graph is a directed graph

c) Both are directed

d) None of these. ☐

iii) The intersection of a CFL and regular language is

a) context free

b) regular but not context free

c) neither context free nor regular

d) both regular and context free. ☐

iv) $a^* \; (a + b)^*$ is equivalent to

a) $a^* + b^*$ b) $(ab)^*$

c) $a^* \; b^*$ d) None of these. ☐

v) Which of the following productions is in CNF ?

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

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

vi) Context free language are not closed under

a) union b) complementation

c) concatenation d) star closure.

vii) Which is more suitable for an Ambiguous Grammar ?

a) All ambiguities can be removed

b) Ambiguity can be removed by setting priority

c) Only inherent ambiguity can be removed

d) There is no suitable rule for removing ambiguity.

viii) Merger table is a substitute of

a) Merger graph b) Compatible graph

c) Minimized machine d) Finite state machine.

ix) DFA converted from an NFA with n states can have maximum

a) n states b) $n!$ states

c) 2^n states d) ${}^nC_2$ states.

x) The accepting automata for the context sensitive language is

a) linear bounded automata b) finite automata

c) push-down automata d) all of these.

GROUP – B

(Short Answer Type Questions)

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

2. 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 its initial state is *A* and final state is *F*. 5

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

3. What is the basic difference between Mealy machine and Moore machine ? Construct a Mealy machine which is equivalent to the Moore machine given below : 2 + 3

PS	*NS*		*z*
	$x = 0$	$x = 1$	
q_0	q_1	q_2	1
q_1	q_3	q_2	0
q_2	q_2	q_1	1
q_3	q_0	q_3	1

4. Show that $L = \{ a^p \mid p \text{ is prime} \}$ is not regular. 5

5. Let G be the grammar $S \varnothing aB/ba$, $A \varnothing a/aS/bAA$, $B \varnothing b/bS/aBB$. For the string aaabbabbba find a. 2 + 2 + 1

   a) leftmost derivation

   b) rightmost derivation

   c) parse tree.

6. Is the following machine information lossless ? If yes, find the order of losslessness. 4 + 1

	NS, *z*	
PS	$x = 0$	$x = 1$
A	A, 0	B, 0
B	C, 0	D, 0
C	D, 1	C, 1
D	B, 1	A, 1

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 ∞ 15 = 45

7. a) State the difference between DFA and NFA. 2

   b) Design an NFA which accepts set of all binary strings containing 1100 or 1010 as substrings. 3

   c) What is regular language ? 2

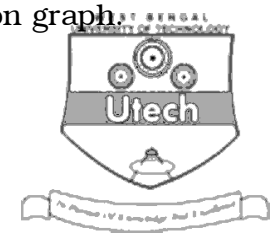
   d) Find regular expressions over $\sum = \{a, b\}$ for the languages defined as follows :

      i) $L1 = \{a^m\ b^m : m > 0\}$

      ii) $L2 = \{a^{2n}\ b^{2m+1} \mid n \geq 0,\ m\ n \geq 0\}$

      iii) $L3 = \{b^m\ a\ b^n : m > 0,\ n > 0\}$ 1 + 1 + 1

e) Find the regular expression for following transition graph. 5



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8. a) Define push-down automata. 2

b) Construct a PDA accepting the set of all strings over $\{a, b\}$ with equal number of a's and b's. 5

c) What are the non-empty transitions in an NPDA ? 2

d) Let G be a grammar $s \varnothing 0B \mid 1A$, $A \varnothing 0 \mid 0S \mid 1AA$, $B \varnothing 1 \mid 1S \mid 0BB$. For the string 00110101, find

i) leftmost derivation

ii) rightmost derivation

iii) derivation tree. 2 + 2 + 2

9. a) What are the limitations of sequential circuit ? 3

b) What do you mean by k-equivalent states ? 2

c) Minimize the following machine by partitioning the distinguishable states : 7

Present State	*i/p* = 0		*i/p* = 1	
	Next State	*o/p*	*Next State*	*o/p*
A	E	0	D	1
B	F	0	D	0
C	E	0	B	1
D	F	0	B	0
E	G	0	F	1
F	B	0	C	0
G	C	1	H	0
H	A	1	G	0

d) Give definition of lossy and lossless machine. $2 \infty 1\frac{1}{2}$

10. Draw the merger graph, merger table, compatibility graph and then minimize the following machine : 4 + 4 + 3 + 4

Present State	*Next State, o/p*		*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	--	–, 1
D	--	--	B, 1	--
E	--	F, 0	A, 0	D, –
F	C, –	--	B, 0	C, 1

11. a) Convert grammars to Greibach Normal Form (GNF).

i) $S \varnothing aSa \mid aSb \mid \square$

ii) $S \varnothing aSB \mid aSbS \mid \square$.

b) Find a reduced grammar equivalent to the grammar $S \varnothing aAa$, $A \varnothing bBB$, $B \varnothing ab$, $C \varnothing aB$.

c) Explain the concept of 2-way finite automata. 5 + 6 + 4

END