ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE - 2009

FORMAL LANGUAGE & AUTOMATA THEORY

SEMESTER - 4

Time : 3 Hours] [Full Marks : 70

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 $n \in 1 \}$ 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) $S \rightarrow aA$ b) $SA \rightarrow AS$

c) $S \rightarrow AB$ 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 × 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 $S \rightarrow aB/ba$, $A \rightarrow a/aS/bAA$, $B \rightarrow b/bS/aBB$. 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

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

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 $\Sigma = \{ a, b \}$ 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

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. $2 \times 1\frac{1}{2}$

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) $S \rightarrow aSa \mid aSb \mid \in$

ii) $S \rightarrow aSB \mid aSbS \mid \in$.

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

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

END