ENGINEERING & MANAGEMENT EXAMINATIONS, DECEMBER – 2008
FORMAL LANGUAGE AND AUTOMATA THEORY
SEMESTER - 5

Time : 3 Hours]   [Full Marks : 70

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)   any language

   b)   only context free language

   c)   only context sensitive language

   d)   only regular language.   ☐

iii)   A grammar that produces more than one parse tree for some sentence is said to be

   a)   contiguous   b)   ambiguous

   c)   unambiguous   d)   regular.   ☐

iv)   The following productions of a regular grammar generates a language L :

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

   The regular expression for L is

   a)   a + b   b)   (a + b)*

   c)   (a + b) (a + b)*   d)   (aa + bb) a*b*.   ☐

v)   Input sequence of a information lossless machine can be determined from the knowledge of

   a)   only output sequence

   b)   output sequence and initial state

   c)   output sequence, initial state and final state

   d)   initial state.   ☐

vi) Let $\Sigma = \{ 0, 1 \}$. The number of possible strings of length n that can be formed by the elements of set Σ is

   a) $n!$ b) n^2

   c) n^n d) 2^n.   ☐

vii) Which of the following are regular ?

   a)   Strings of 0's whose length is perfect square

   b)   Set of all palindromes made up of 0's and 1's

   c)   Strings of 0's whose length is prime number

   d)   Strings of odd number of 0's.   ☐

viii) Pumping Lemma is generally used for proving whether

   a)   a given grammar is regular

   b)   a given grammar is not regular

   c)   two given grammars are equivalent or not

   d)   none of these.   ☐

ix) If Q be the number of states in NDFA, then equivalent DFA can have maximum number of states

a) Q

b) $Q - 1$

c) 2^Q

d) $2^Q - 1$.

x) A PDM behaves like an FSM when the number of auxiliary memory it has is

a)   0

b)   2

c)   1

d)   none of these.

GROUP – B
(Short Answer Type Questions)

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

2. Construct a DFA which accepts the set of all binary strings that, interpreted as the binary representation of an unsigned decimal integer is divisible by 5.   5

3. a) State pumping Lemma for regular language.

   b) Using this Lemma prove that $L = \{ a^n b^n \mid n \geq 1 \}$ is not regular. $2 + 3$

4. Consider the following context free grammar :

$G = (V, \Sigma, P, S)$

where V, Σ, P, S are in their usual meaning.

P consists of the following production rules :

   $S \rightarrow aAbB$

   $A \rightarrow aA \mid a$

   $B \rightarrow bB \mid b$

Find a grammar in Chomsky normal form equivalent of the grammar G.   5

5. a) Show that the following grammar is ambiguous :

$S \rightarrow a \mid abSb \mid aAb$

$A \rightarrow bS \mid a\,AA\,b$ 3

b) Define DFA.   2

6. a) What is ID of PDA ?   2

b) Construct a context free grammar that generates the language
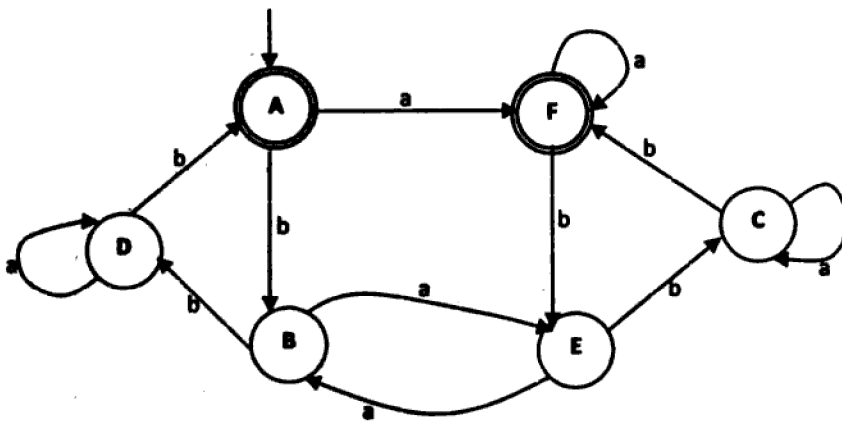
$L = \{\, wcw^r \mid w \in (\,a,\,b\,)^* \,\}$ 3

GROUP – C

(Long Answer Type Questions)

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

7. a) What do you mean by k-equivalent ? Why any two final states are 0-equivalent and any two non-final states are 0-equivalent ?

b) Construct the minimum state equivalent DFA for the following DFA.

c) Find a grammar generating $L = \{\, a^n b^n c^j \mid n \geq 1, j \geq 0 \,\}$ $(2 + 2) + 6 + 5$

8. a) What is information lossless machine ?

    b) Consider the machine shown in the following table :

Present State	Nest State	
	$x = 0$	$x = 1$
A	A, 1	C, 1
B	E, 0	B, 1
C	D, 0	A, 0
D	C, 0	B, 0
E	B, 1	A, 0

    i) Is this machine information lossless of finite order ? If yes, find the order μ.

    ii) The machine produced the output sequence $Z = 110001100101$. What is the corresponding input sequence if the initial state is A and final state is B ?   3 + (5 + 7)

9. a) State and discuss Myhill-Nerode theorem.

    b) Write the DFG for the language

        $L = \{ 0^i 1^j 2^k \mid i = j \text{ or } j = k \}$.

    c) Prove that CFLs are not closed under intersection and complement operation.
                                                                        5 + 5 + 5

10. a) Define push down automation (PDA).

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

    c) Construct a PDA, A equivalent to the following context-free grammar
        $S \rightarrow OBB$, $B \rightarrow OS/IS/O$. Test whether 010^4 is in $N(A)$.   2 + 5 + 8

11. a) Design a finite automata for the *RE*

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

b) Construct a minimum state automata equivalent to a given automata *M* defined below :

States ＼ Σ	a	b
→ q_0	q_0	q_3
q_1	q_2	q_5
q_2	q_3	q_4
q_3	q_0	q_5
q_4	q_0	q_6
q_5	q_1	q_4
(q_6)	q_1	q_3

5 + 10

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END