ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2008
FORMAL LANGUAGE AND AUTOMATA THEORY
SEMESTER – 4

Time : 3 Hours] [Full Marks : 70

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : 10 × 1 = 10

i) Which of the following regular expressions over { 0, 1 } denotes the set of all strings not containing 100 as a sub-string ?

a) 0*(1*0)* b) 0*1010*

c) 0*1*01* d) 0*(10+1) *.

ii) DFA has

a) single final state

b) more than one initial states

c) unique path (for a set of inputs) to the final state

d) all of these.

iii) Which of the following is regular ?

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

b) Strings of all palindromes made up of 0's & 1's

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

d) Strings of odd number of zeroes.

iv) The logic of pumping lemma is a good example of

a) the pigeon-hole principle b) the divide & conquer technique

c) recursion d) iteration.

v) The class of context free language is not closed under

a) concatenation b) union

c) intersection d) repeated concatenation. ☐

vi) The grammar G = ({S}, {0,1}, P,S) where P={S→0S1, S→0S, S→S1, S→0} is a

a) recursively enumerable language

b) regular language

c) context sensitive language

d) context free language. ☐

vii) If *S* is the number of states in NDFA then equivalent DFA can have maximum of

a) S states b) S – 1 state

c) 2^S states d) $2^S - 1$ states. ☐

viii) If L1 is the set of languages accepted by a NPDA and L2 is the set of context free languages, then

a) L1=L2 b) L1⊆L2

c) L2⊆L1 d) None of these. ☐

ix) What is the highest type number to the grammar given by the following production rules

S → Aa, A → c | Ba, B→abc

a) zero b) one

c) two d) three. ☐

x) Given an arbitrary NDFA with *n* states, the maximum number of states in an equivalent minimized DFA is at least

a) n^0 b) 2^n

c) n ! d) None of these. ☐

GROUP – B

(Short Answer Type Questions)

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

2. a) What do you mean by a sub-tree of a derivation tree ?

   b) Consider G whose productions are S → aAS/a, A → SbA/SS/ba. Show that S⟶ aabbaa by constructing a derivation tree, by right most derivation, whose yield is aabbaa. 2 + 3

3. Convert the Mealy Machine (given below) to a Moore Machine. 5

Present State	Next State	i/p=0	Next state	i/p=1
	State	Output	State	Output
Q_1	Q_2	1	Q_1	0
Q_2	Q_3	0	Q_4	1
Q_3	Q_1	0	Q_4	0
Q_4	Q_3	1	Q_2	1

4. Reduce the following grammars to GNF : 5

   S → A0, A → 0B, B → 0A, B → 1

5. The set L = $\{a^i b^j c^k$ /where i, j, k are integer and i, j, k ≥ 1$\}$. Is L regular ? Justify your answer. 1 + 4

6. Minimize the following machine by determining the set of equivalent states. 5

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

GROUP – C

(Long Answer Type Questions)

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

7. a) State & discuss Myhill-Nerode theorem. 5

b) Write the CFG for the language

$L = \{ 0^i 1^j 2^k \mid i=j \text{ or } j=k \}$. 5

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

8. a) $E \rightarrow E+E \mid E^*E \mid a$. Prove that the CFG with this production rule is ambiguous. Remove the ambiguity from this grammar. 2 + 3

b) $S \rightarrow AB; A \rightarrow a, B \rightarrow C/b, C \rightarrow D; D \rightarrow E, E \rightarrow a.$

remove the unit production.

$L = \{a^n b^n \mid n \geq 0\}$. Find a CFG to generate L^2. 3 + 2

c) Design a PDA which accepts the language.

$L = \{ W \varepsilon (a,b)^* \mid W$ has equal no. of a & b$\}$. 5

9. a) A long sequence of input pulses enters a two-input, two-output synchronous sequential circuit, which is required to produce an output pulse Z=1, whenever a sequence 010101 occurs. Overlapping sequences are accepted. Draw the state transition diagram. 6

b) Find minimum state reduced machine containing the following incompletely specified machine. 9

PS	NZ, 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, 0	A, –

10. a) Show that the following FSM is information lossless of finite order :

PS	NZ, Z	
	x=0	x=1
A	C, 0	D, 1
B	D, 0	C, 1
C	A, 0	B, 0
D	C, 1	D, 1

Also find its order of information losslessness. 7

b) Find the minimal inverse machine of the FSM in problem (a). 8

11. a) What do you mean by Inverse machine ? Write the definition of a lossless machine. What do you mean by Halting problem of a Turing machine ? Why a Turing machine is called linear bounded Automata ? 2 + 2 + 2 + 2

b) Consider the Turing machine's description is given in table below. Draw the computation sequence of the input string 00. 7

Present state	Tape symbol :: b	Tape symbol :: 0	Tape symbol :: 1
Q_1	$1Lq_2$	$0Rq_1$	–
Q_2	bRq_3	$0Lq_2$	$1LQq_2$
Q_3	–	bRq_4	bRq_5
Q_4	$0Rq_5$	$0Rq_4$	$1Rq_4$
Q_5	$0Lq_2$	–	–

END