



**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) $0^*1010^*$   | <input type="checkbox"/> |
| c) $0^*1^*01^*$  | d) $0^*(10+1)^*$ | <input type="checkbox"/> |

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 | <input type="checkbox"/> |
| c) recursion                 | d) iteration.                     | <input type="checkbox"/> |





**GROUP - B**

**( Short Answer Type Questions )**

Answer any three of the following.

3 x 5 = 15

2. a) What do you mean by a sub-tree of a derivation tree ?  
 b) Consider G whose productions are  $S \rightarrow aAS/a$ ,  $A \rightarrow SbA/SS/ba$ . Show that  $S \rightarrow aabbaa$  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 <sub>1</sub>	Q <sub>2</sub>	1	Q <sub>1</sub>	0
Q <sub>2</sub>	Q <sub>3</sub>	0	Q <sub>4</sub>	1
Q <sub>3</sub>	Q <sub>1</sub>	0	Q <sub>4</sub>	0
Q <sub>4</sub>	Q <sub>3</sub>	1	Q <sub>2</sub>	1

4. Reduce the following grammars to GNF :

$$S \rightarrow A0, A \rightarrow 0B, B \rightarrow 0A, B \rightarrow 1$$

5

5. The set  $L = \{a^i b^j c^k / \text{where } i, j, k \text{ are integer and } i, j, k \geq 1\}$ . 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)  $E \rightarrow E+E | E^*E | a$ . 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.

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

c) Design a PDA which accepts the language.

$L = \{W \varepsilon (a,b)^* | W \text{ has equal no. of } a \text{ \& } b\}$ . 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 <sub>1</sub>	1Lq <sub>2</sub>	0Rq <sub>1</sub>	-
Q <sub>2</sub>	bRq <sub>3</sub>	0Lq <sub>2</sub>	1LQq <sub>2</sub>
Q <sub>3</sub>	-	bRq <sub>4</sub>	bRq <sub>5</sub>
Q <sub>4</sub>	0Rq <sub>5</sub>	0Rq <sub>4</sub>	1Rq <sub>4</sub>
Q <sub>5</sub>	0Lq <sub>2</sub>	-	-

END