MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : CS-402

FORMAL LANGUAGE AND AUTOMATA THEORY

Time Allotted : 3 Hours | *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

   i) A context free grammar is not closed under

   a) Product b) Union

   c) Complementation d) Kleen star.

   ii) Context sensitive grammar can be recognized by

   a) deterministic push down machine

   b) non-deterministic push down machine

   c) FSM

   d) linearly bounded memory machine.

iii) $A = (a + b)^* a$ and $B = b(a + b)^*$ then A intersection B will be

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

c) $a(a + b)^* b$ d) $b(a + b)^* a$.

iv) Which of the following is most general phase - structured grammar ?

a) Regular b) Context sensitive

c) PDA d) none of these.

v) The string 1101 does not belong to the set represented by

a) $110^*(0 + 1)$

b) $1(0 + 1)^* 101$

c) $(10)^* (01)^* (00 + 11)^*$

d) $[00 + (11)^* 0]^*$.

vi) Pumping lemma is generally used for

a) a given grammar is regular

b) a given grammar is not regular

c) whether two regular expressions are equivalent or not

d) none of these.

vii) The basic limitation of FSM is that

a) it cannot remember arbitrary large amount of information

b) it some times fail to recognize grammar that are regular

c) it some times fail to recognizes grammar that are not regular

d) all of these.

viii) Recursive languages are

a) closed under insertion

b) recursively enumeration

c) closed under complementation

d) all of these.

ix) *k*-level equivalence is possible between two finite automata

a) if all equivalence above *k*-level exist between them

b) if all level equivalence up to $k - 1$ level already exist

c) if both contain at least *k* number of states

d) if both contain exactly *k* number of states.

x) An automata is a/an ..... device.

a) acceptor only b) acceptor/rejector

c) rejector only d) generating.

xi) Which of the following is correct ?

a) Language can be derived from the FA

b) Regular expressions can be derived from the FA

c) FA can be derived from the language

d) both (a) & (c).

GROUP – B

(Short Answer Type Questions)

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

2. Design a two-input two-output sequence detector which generates an output '1' every time the sequence 1010 is detected. And for all other cases output '0' is generated. Overlapping sequences are also counted. Draw only state table and state diagram.

3. Convert the following NFA into an equivalent DFA :

PS	*NS*	
	$a = 0$	$a = 1$
$\rightarrow q_0$	$q_0 \cdot q_1$	$q_0 \cdot q_2$
q_1	q_3	–
q_2	–	q_3
(q_3)	q_3	q_3

4. Define DFA. Derive the DFA for the regular language $0(0+1)^*1$ for the symbols $\sum = \{0, 1\}$. 2 + 3

5. Construct a minimum state automaton from the transition table given below :

PS	$x = 0$	$x = 1$
q_0	q_1	q_2
q_1	q_2	q_3
q_2	q_2	q_4
q_3	q_3	q_3
q_4	q_4	q_4
q_5	q_5	q_4

q_3, q_4, q_5 are final states.

6. Find the string which is applied on state '*D*' producing output string 10011110 and final state '*D*' for the machine given below :

PS	NS, o/p	
	$x = 0$	$x = 1$
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

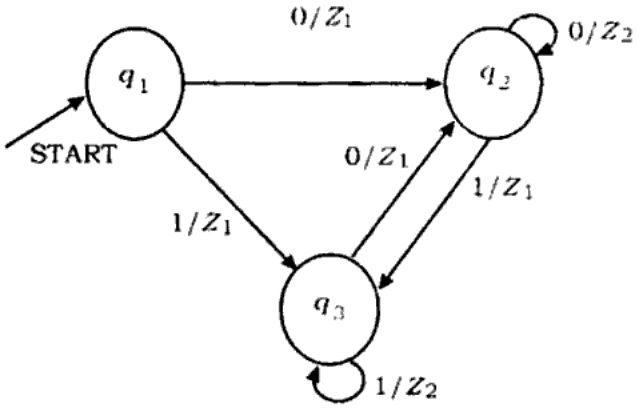
GROUP – C

(Long Answer Type Questions)

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

7. a) Construct a regular grammar *G* generating the regular set represented by $P = a^* b (a + b)^*$.

   b) Convert the following Mealy machine to Moore machine.



   c) What is Klenne's star ? Give example. What is positive closure ? Give example. 5 + 6 + (2 + 2)

8. a) Construct an equivalent PDA for the following CFG :

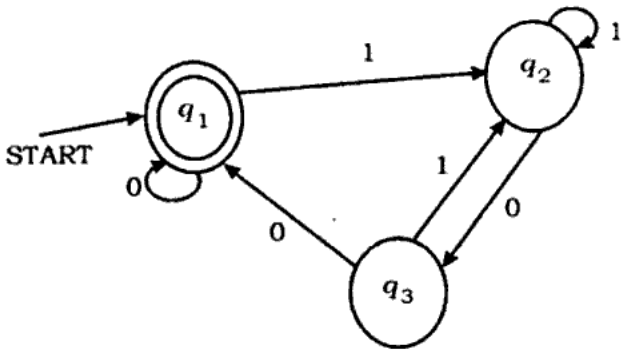
   S → aAB/bBA

   A → bS/a

   B → aS/b

   Show an ID for the string abbaaabbbab for the PDA generated with stack description.

b) Give the regular expression for the DFA using Arden theorem.



c) Convert the following grammar into GNF :

$S \rightarrow ABb/a$

$A \rightarrow aaA/B$

$B \rightarrow bAb.$ 7 + 5 + 3

9. a) Let G be the grammar $S \rightarrow aB|ba$, $B \rightarrow b|bS|aBB$. For the string aaabbabbba find :

i) leftmost derivation

ii) rightmost derivation

iii) parse tree.

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

c) Design an NFA which accepts set of all binary strings containing 1100 or 1010. (2 + 2 + 2) + 4 + 5

10. a) What do you mean by distinguishable and indistinguishable states ?

b) Draw the Merger graph, Merger table, compatibility graph and then minimize the following :

Present State	Next State, *o/p*			
	Input = 0	Input = 1	Input = 2	Input = 3
A	–	*C*, 1	*E*, 1	*B*, 1
B	*E*, 0	–	–	–
C	*F*, 0	*F*, 1	–	–
D	–	–	*B*, 1	–
E	–	*F*, 0	*A*, 0	*D*, 1
F	*C*, 0	–	*B*, 0	*C*, 1

3 + 12

11. a) Design a TM that accepts $\{ 0^n 1^n | n >= 1 \}$.

b) What do you mean by halting problem of a Turing machine ?

c) Explain Ogden's Lemma for CFL.

d) Construct CFG for the following :

i) Palindrome for binary numbers

ii) $L = \{ a^n b^n c^m d^m | m, n > 0 \}$.

5 + 2 + 3 + (3 + 2)