FORMAL LANGUAGE & AUTOMATA THEORY
(CSBS 3103)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Finite state machine can recognize
(a) RL (b) REL (c) CFL (d) CSL.

(ii) Moore Machine is an application of
(a) Finite automata without input (b) Finite automata with output
(c) Non Finite automata with output (d) None of the above.

(iii) Regular expression a / b denotes the set
(a) {a} (b) {∈ , a, b } (c) {a,b} (d) {ab}

(iv) The logic of pumping lemma is a good example of
(a) the pigeon-hole principle (b) the Divide and Conquer technique
(c) recursion (d) iteration.

(v) Regular Expression For All Strings Starts With ab and ends with b defined over {a,b}
(a) ab(a+b)b (b) ab(a+b)* b
(c) ab* b (d) None of the above

(vi) The set $\{a^n b^n \mid n>=1\}$ is generated by the CFG
(a) S → aSb | ab (b) S → aSb | ab | ε
(c) S → aaSbb | ab (d) S → aaSbb | aabb | ab

(vii) A Push Down Machine will behave like a Finite State Machine if the stack memory size is
(a) 0 (b) 1 (c) 2 (d) 3.

(viii) Which of the following does not have left recursions?
(a) Chomsky Normal Form (b) Greibach Normal Form
(c) Backus Naur Form (d) All of the above.

(ix) The language recognized by Turing machine is:
(a) CFL (b) CSL (c) REL (d) RL

(x) Turing machine consist of
(a) Input tape (b) Blank symbol
(c) Tape head (d) All of these.

Fill in the blanks with the correct word

(xi) Limitation of PDA can overcome by_____.

(xii) A pushdown automata is _____if there is at most one transition to each configuration.

(xiii) A Turing machine with several tapes in known as _____.

(xiv) _____ technique can be used to prove that a language is non-regular.

(xv) If L1 and L2 are regular languages, then L1.L2 is _____.

Group - B

2. (a) Design a DFA over $\sum$ ={a,b} such that every string accepted must start with aa or bb. *[(CO1)(Create/HOCQ)]*

(b) Convert the following NFA into equivalent DFA where q_0 is initial state and q_2 is final state.

PS	Next State	
	X=0	X=1
q_0	q_0	q_1
q_1	q_1,q_2	q_1
q_2	q_2	q_1,q_2

[(CO1)(Apply/IOCQ)]

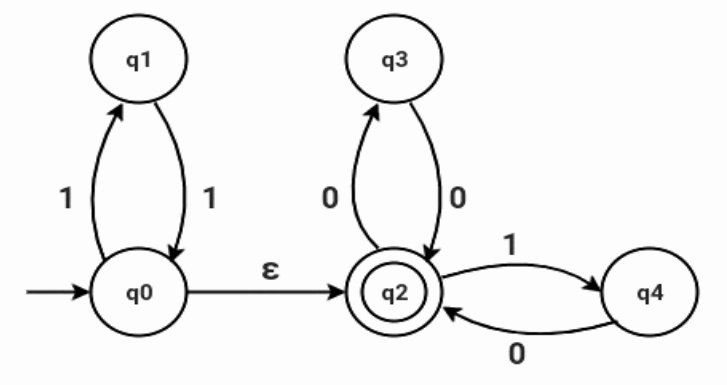
5 + 7 = 12

3. (a) Consider the following Mealy machine as shown below. Convert it into equivalent Moore machine.

PS	Next State, O/P	
	X=a	X=b
q_1	q_1,1	q_2,0
q_2	q4,1	q_4,1
q_3	q_2,1	q_3,1
q_4	q_3,0	q_1,1

[(CO1) (Apply/IOCQ)]

(b) Convert the following Epsilon-NFA into NFA using Epsilon closure:



[(CO1) (Apply/IOCQ)]

6 + 6 = 12

Group - C

4. (a) State Pumping Lemma. Show that the language L={ ww | w ∈ {a,b}*} is not Regular using Pumping Lemma. *[(CO3)(Understand /Apply/IOCQ)]*

   (b) Draw Finite Automata Transition Diagram of the following Regular Expression:
   (i) $(ab)^* + (a+ab)^*b^*(a+b)^*$ (ii) $[a+ba(a+b)]^*a(ba)^*b^*$. *[(CO3)(Create/HOCQ)]*

(3 + 3) + (3 + 3) = 12

5. (a) Convert the following Regular grammar to finite automata:

   $S \rightarrow 001S \mid 10A$
   $A \rightarrow 101A \mid 011.$ *[(CO3)(Apply/IOCQ)]*

   (b) Convert the following Regular Grammar to Regular Expression:

   $S \rightarrow 011A \mid 101B$
   $A \rightarrow 110A \mid 00$
   $B \rightarrow 11B \mid S$ *[(CO3)(Apply/IOCQ)]*

   (c) Find the Regular Expression over $\sum = \{a,b\}$ such that $|w_a| = 1 \pmod 3$. *[(CO3) (Apply/IOCQ)]*

4 + 4 + 4 = 12

Group - D

6. (a) Construct a PDA accepting all palindromes over $\sum = \{a,b\}$. *[(CO5) (Create/HOCQ)]*

   (b) Define nPDA. Explain with suitable example. *[(CO5)(Remember/LOCQ)]*

8 + 4 = 12

7. (a) Define Chomsky's Normal Form (CNF) and Greibach Normal Form(GNF) with an example. *[(CO4)(Understand/LOCQ)]*

   (b) Convert the following Context Free Grammar (CFG) to Chomsky's Normal Form (CNF):

   $S \rightarrow aAbB$
   $A \rightarrow aA \mid a$
   $B \rightarrow bB \mid b$ *[(CO4)(Apply/IOCQ)]*

(3 + 3) + 6 = 12

Group - E

8. (a) How Turing Machine (TM) can be used as unary to binary converter. *[(CO6)(Analyse/IOCQ)]*

   (b) Design a Turing Machine that accepts the language $L = \{a^n b^n c^n \mid n>=1\}$. *[(CO6)(Create/HOCQ)]*

6 + 6 = 12

9. (a) Define decidable and semi-decidable and undecidable problems with an example. *[(CO6)(Understand/LOCQ)]*

   (b) Differentiate between Non-deterministic Turing Machine and Multi tape Turing Machine. *[(CO6)(Analyze/IOCQ)]*

(c) Give the application of Turing Machine. *[(CO6)(Remember/LOCQ)]*

6 + 4 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	16.66	55.21	28.12