TE (Comp.) (Semester – V) (RC) Examination, November/December 2015
AUTOMATA LANGUAGES & COMPUTATION

Duration : 3 Hours | Total Marks : 100

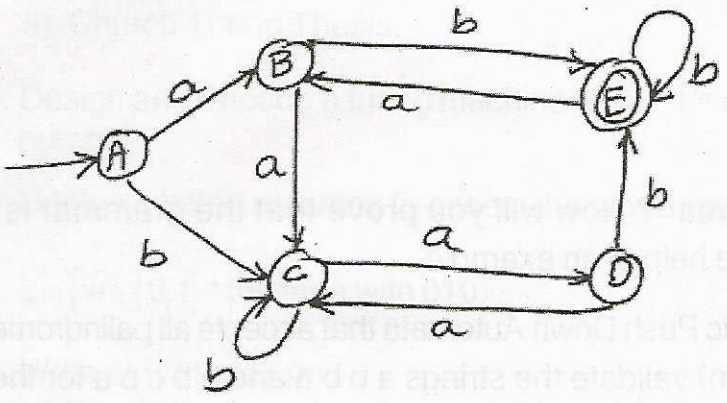
Instructions : *1) Assume data **wherever** required.*
*2) Answer **any 5** questions with atleast **one** from **each** Module.*

MODULE – I

1. a) State Kleens Theorem. Prove Part 1 of Kleens theorem **6**

   b) Construct a Mealy Machine to add two binary numbers. Convert the resulting Mealy Machine to equivalent Moore machine. **8**

   c) Minimize the following deterministic finite Automata using table filling algorithm. **6**



2. a) Obtain regular expressions for the following languages :

   i) $L=\{a^n b^m \mid n \geq 4, m \leq 3\}$

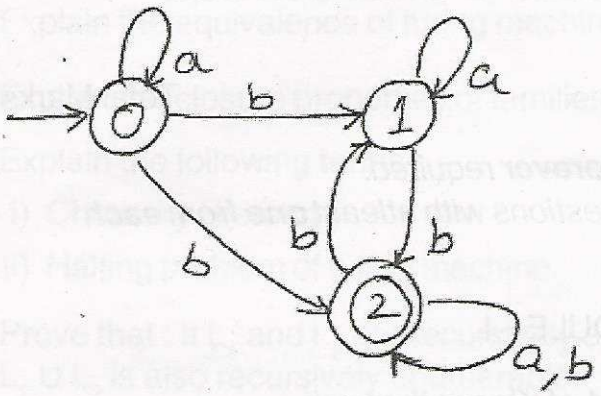
   ii) $L = \{w \mid n_a(w) \bmod 3 = 0 \text{ and } w \in \{a,b\}^*\}$. **6**

   b) Prove that the languages :

   i) $L=\{a^{n!} \mid n \geq 0\}$ is not regular

   ii) $L=\{w \mid n_a(w) < n_b(w) \text{ and } w \in \{a,b\}^*\}$ is not regular. **6**

c) Convert the following Non-deterministic Finite Automata (NFA) to Deterministic Finite Automata (DFA). 6



d) Explain Homomorphism using examples. 2

MODULE – II

3. a) Convert the given grammar to Grcibach Normal Form (GNF)

$S \rightarrow A\ B\ b/a$

$A \rightarrow a\ a\ A$

$B \rightarrow b\ A\ b.$ 6

b) What is ambiguous grammar ? How will you prove that the grammar is ambiguous ? Show with the help of an example. 6

c) Construct a non deterministic Push Down Automata that accepts all palindrome strings (odd as well as even) validate the strings a b b a and a b c b a for the same. 8

4. a) Design a Deterministic Push Down Automata (DPDA) to recognize the language $L=\left\{ 0^n 1^m 0^n \mid n,m>0 \right\}$ validate the string 00100. 6

b) State Pumping Lemma for context Free Languages. Prove that the language : $L=\left\{ a^n b^{2n} c^n \mid n \geq 0 \right\}$ is not context free language. 4

c) Convert the following grammar into Grcibach Normal From (GNF) and hence draw a Push Down Automata (PDA) for the same.

$E \rightarrow E/E \mid E*E \mid T$

$T \rightarrow (E) \mid a$. 6

d) Construct context Free Grammar for the following language

$L=\{a^i b^j \mid i \geq 2j\}$. 4

MODULE – III

5. a) Design a Non Deterministic Turing Machine to accept numbers that are multiples of 2 or 3 in unary format. 4

b) Design a turing machine to compute the function f(x) = m × n where m and n are positive integers. Initially, the tape contains string $1^m 01^n 0$. 10

c) Write short notes on :

i) Non-Deterministic Turing Machine

ii) Church Turing Thesis. 6

6. a) Design and Encode a turing machine to find 1's complement of a given binary number. 8

b) Design a turing machine to accept the language

$L=\{w \in \{0,1\}^* \mid w \text{ ends with } 010\}$. 6

c) Write short notes on :

i) Multitape Multihead turing machine

ii) Recursively Enumerable language. 6

MODULE – IV

7. a) What are context sensitive Languages ? Determine Context Sensitive Grammar for language

$L=\{a^n b^n c^n \mid n \geq 1\}$. 8

b) Explain the following terms :
   i) Linear Bounded Automata
   ii) Rice Theorem. 6

c) Explain the equivalence of turing machine and type O grammar. 6

8. a) Explain the closure properties of families of languages. 6

b) Explain the following terms :
   i) Chomsky Hierarchy
   ii) Halting problem of turing machine. 6

c) Prove that : If L_1 and L_2 are recursively enumerable languages over Σ, then $L_1 \cup L_2$ is also recursively enumerable. 8
