21/5116

COMP 5 – 2 (RC)

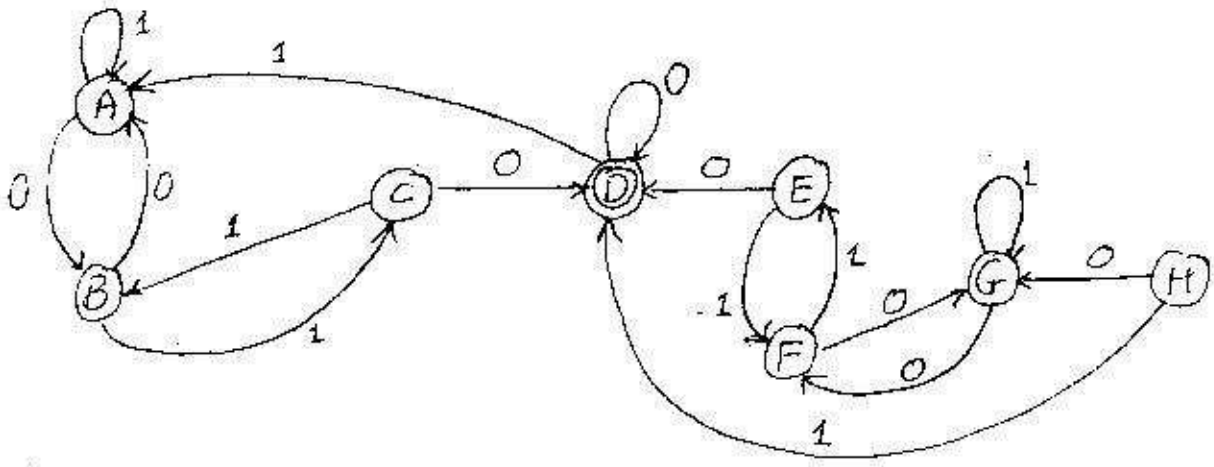
T.E. (Comp.) (Semester – V) (RC) Examination, May/June 2016
AUTOMATA LANGUAGES AND COMPUTATION

Duration : 3 Hours | Total Marks : 100

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

MODULE – 1

1. a) Minimize the following Deterministic Finite Automata using table filling algorithm. **10**



b) Determine Finite Automata for the following language :

$L = \{w \mid n_a(w) \geq 1 \text{ and } n_b(w) = 2 \text{ and } w \in \{a,b\}^*\}$. **6**

c) Explain extended transition function for NFA and hence determine $\delta^*(q_0, 0111)$ for the NFA $M = (\{q_0, q_1, q_2, q_3\}, \{0, 1\}, q_0, \{q_3\}, \delta)$.

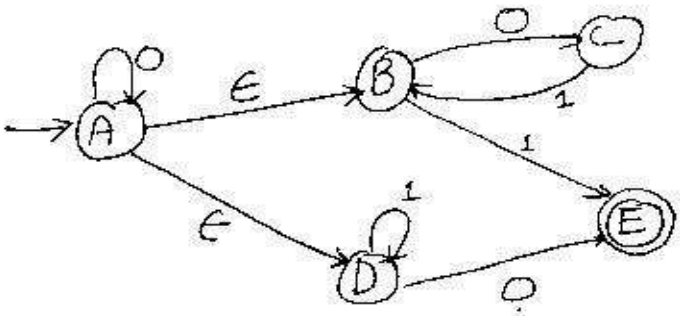
Where $\delta(q_0, 0) = q_1$, $\delta(q_0, 1) = \{q_0, q_1\}$, $\delta(q_1, 0) = q_2$

$\delta(q_1, 1) = q_2$, $\delta(q_3, 0) = \phi$, $\delta(q_3, 1) = \phi$. **4**

2. a) State Pumping Lemma for regular languages and hence prove that the language $L = \{a^n b^n \mid n \geq 1\}$ is not context free language. 6

b) Determine a Mealy machine for binary adder. 4

c) Convert the following ϵ - NFA to NFA. 6



d) Obtain DFA for the following strings :

i) Strings of a's and b's ending with ab or ba.

ii) Strings beginning with ab or ending with ab. 4

MODULE – 2

3. a) What is Greibach Normal Form ? Convert the following grammar into Greibach Normal Form :

$G = (\{A, S, B\}, \{a, b\}, S, P = \{S \rightarrow AB, A \rightarrow BS \mid b, BSA \mid a\})$. 8

b) Determine Context Free Grammar (CFG) for the following languages :

i) $L = \{a^n b^n \mid n > 0\}$

ii) $L = \{a^i b^j c^k \mid i = j + k\}$. 6

c) Design Push Down Automata corresponding to the Context Free Grammar whose productions are as follows :

$S \rightarrow S + T$

$S \rightarrow T$

$T \rightarrow T * a$

$T \rightarrow a$. 6

4. a) Prove that the language :

   i) $L = \{ww \mid w \in \{a, b\}^*\}$ is not context free language.

   ii) $L = \{a^n b^m \mid n = m^2\}$ is not context free language. 6

   b) Construct Non Deterministic Push Down Automata (NPDA) for the language $L = \{a^i b^j c^k \mid i, j, k \geq 0 \text{ and } i = j + k\}$ validate the string aaabbc. 8

   c) Prove that : "If L_1 and L_2 are context free languages then $L_1 \cup L_2$ and $L_1.L_2$ are also context free languages". 6

MODULE – 3

5. a) Design a Turing machine that computes the function $f(x) = m - n$ where m and n are both positive integer numbers. If $m \leq n$ then it outputs 0. Assume Turing machine uses unary notation. 8

   b) Give encoding function for a Universal Turing Machine. 6

   c) Explain the following terms :

   i) Recursively Enumerable Language.

   ii) Multitape Turing Machine. 6

6. a) Design a turing machine that computes $f(x) = n \bmod 2$ where n is a positive number. 6

   b) Design a turing machine that accepts the following language $L = \{ww^R \mid w \in \{a, b\}^* \text{ and } |w| > 0\}$. 8

   c) Explain the variations of turing machine. 6

MODULE – 4

7. a) Explain the relationship among different classes of languages in Chomsky hierarchy. 4

   b) Construct a context sensitive grammar for the following language. $L = \{a^n b^n c^n \mid n \geq 1\}$ and validate the string aa bb cc. 6

8. a) Construct unrestricted grammar to generate {SS | S∈ {a, b}*}. **8**

   b) Explain the following terms :

      i) Full Trio

      ii) Linear Bounded Automata

      iii) Rice Theorem. **12**