COMP 5 – 2 (RC)

T.E. (COMP) (RC) Semester – V Examination, May 2010
AUTOMATA LANGUAGE AND COMPUTATION

Duration: 3 Hours | Total Marks: 100

Instructions: *1) Answer **five** questions by selecting atleast **one** from **each** Module.*
*2) Make necessary assumptions **if required**.*

MODULE – 1

1. a) Obtain a regular expression to each of the following languages over $\Sigma = \{a, b\}^*$ **6**
   i) To accept the words with two or more letters but beginning and ending with the same letter.
   ii) To accept a language consisting of string's of a's and b's with alternate a's and b's.

   b) Define : **4**
   i) Deterministic finite automata
   ii) Moore machine.

   c) Prove part 2 of Kleene's theorem given by the following statement. **6**
   "The language accepted by finite Automata is regular".

   d) A deterministic finite automata with states 1-4 and input alphabet $\Sigma = \{a, b\}$ has following transition table. **4**

q	$\delta(q, a)$	$\delta(q, b)$
1	{2}	{4}
2	{3}	{2}
3	{3}	{2}
4	{4}	{4}

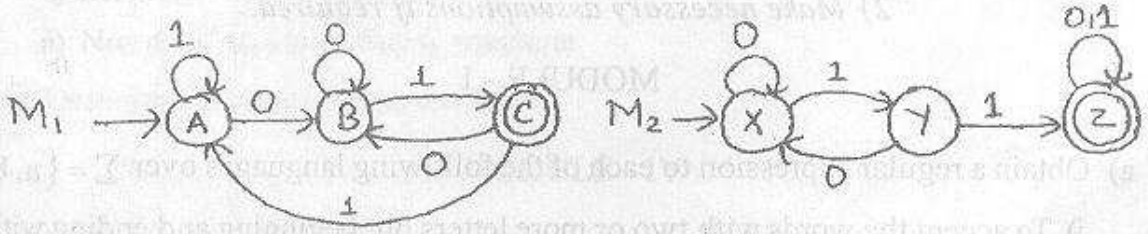
   i) Draw transition diagram for above table.
   ii) Calculate $\delta^*(1, abaaba)$.

P.T.O.

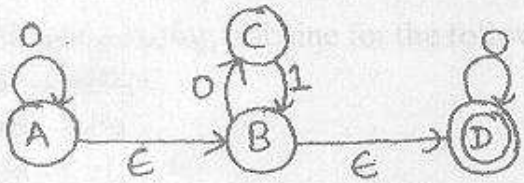
2. a) Let M_1 and M_2 given below be finite Automata's recognizing the languages L_1 and L_2 respectively. Draw finite Automata recognizing the following languages : 5

   i) $L_1 \cup L_2$

   ii) $L_1 - L_2$

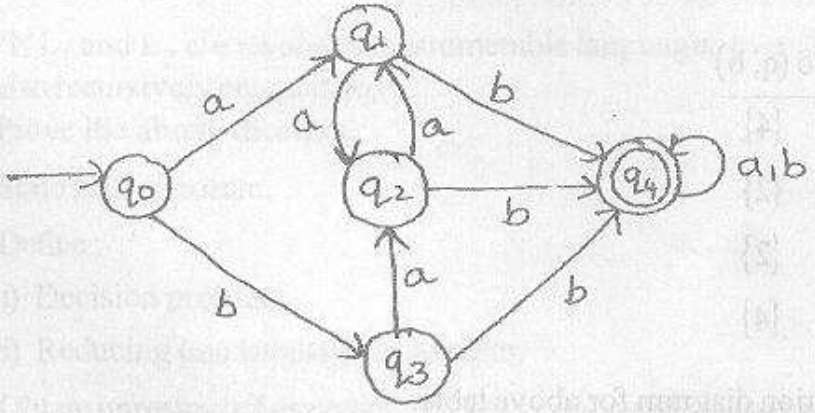


b) Convert the following $\in$-NFA to NFA. 5



c) Prove by pumping lemma. $L = \{a^i b^j / i > j\}$ is not regular. 5

d) Minimize the following deterministic finite automata. 5



MODULE – II

3. a) What is a context free grammar ? Show that the following language is not context free language $L = \{ ww / w \in \{a, b\}^* \}$. 6

b) Eliminate useless symbols in the Grammar G = (V, T, P, S) where V = {S, A, B, C, D, E} T = {a, b, d} and P is given by the productions. 4

P = { S → aA|bB
A → aA|a
B → bB
D → ab|Ea
E → aC|d
}

c) Find an equivalent LL(1) grammar from the following : 4

$S \rightarrow S_1\$$
$S_1 \rightarrow aAb|aAA|aB|bbA$
$A \rightarrow aAb|ab$
$B \rightarrow bBa|ba$

d) Construct a bottom up PDA for the following : 6

$S \rightarrow S + T$
$S \rightarrow T$
$T \rightarrow T * a$
$T \rightarrow a$

4. a) State pumping lemma for a context free language. 3

b) Construct a Push Down Automata to accept the language. 6

$L = \{a^n b^{2n} / n \geq 1\}$

Explain the behaviour of PDA with the help of a string.

c) Define :

i) Chomsky normal form ii) Push Down Automata. 5

d) Prove that if L_1 and L_2 are context free languages then language $L_1 \cup L_2$ is also context free language. 6

MODULE – III

5. a) Define Turing machine. 2

b) Construct a Turing machine that creates a copy of its input string to the right of the input but with a blank separating the copy from the original. 8

c) State and explain church hypothesis. 4

d) Give the encoding function for a "Tu" universal Turing machine. 6

6. a) Explain how to construct a composite Turing machine. 4

   b) Construct a Turing machine that computes the function $f(x) = m - n$ where $m \geq n$, m and n are both positive integer numbers. Assume that Turing machine uses unary notation. 6

   c) Define : 6

      i) Multitape Turing machine

      ii) Non deterministics Turing machine.

   d) Describe Universal Turing machine. 4

MODULE – IV

7. a) Define : 4

      i) Unrestricted grammar

      ii) Context sensitive grammar.

   b) Simulate Turing machine for the following unrestricted grammar : 6

      $S \rightarrow aBS|\in$

      $aB \rightarrow Ba$

      $Ba \rightarrow aB$

      $B \rightarrow b$

   c) Obtain a context sensitive grammar for : 5

      $\{a^i b^i c^i / n \geq 1\}$

   d) Explain the relationships among different class of languages in chomsky hierarchy. 5

8. a) "If L_1 and L_2 are recursively enumerable languages over $\sum$, then $L_1 \cup L_2$ is also recursively enumerable". Prove the above theorem. 8

   b) State Rice theorem. 2

   c) Define : 4

      i) Decision problem

      ii) Reducing one language to another.

   d) Obtain unrestricted grammar generating following language : 6

      $L = \{a^i | i \text{ is a positive power of } 2\}$.