COMP 5 – 2 (RC)

T.E. (Comp.) Semester – V Examination, Nov./Dec. 2009
AUTOMATA LANGUAGES 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 – I

1. a) Prove by mathematical induction that every u, v $\in \Sigma^+$ $(uv)^R = v^R u^R$. 6
   b) Construct an $\in$-NFA equivalent to following regular expression.
   (a + b)* ababb (a + b)*. 4
   c) Prove the following statement :
   Let L be the set accepted by non deterministic finite automata then there exists a deterministic finite automata that accepts L. 6
   d) Define the following : 4
   1) Non deterministic finite automata.
   2) Extended transitions function δ^* for non deterministic finite automata.

2. a) State pumping lemma for regular sets show that $\{a^{n!} \mid n \geq 0\}$ is not regular. 6
   b) Minimize the DFA given by the following transition table : 8

State	0	1
→A	B	F
B	G	C
(C)	A	C
D	C	G
E	H	F
F	C	G
G	G	E
H	G	C.

where A is the start state and C is the accepting state for the deterministic finite automata.

   c) Explain closure properties of regular sets. 4
   d) State MyHill Nerode theorem. 2

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MODULE – II

3. a) Give context free grammars for the following : 4

i) $L = \{x \in \{0, 1\} / n_0(x) - n_1(x)\}$.

ii) $L = (011 + 1)^* (0 + 1)^*$.

b) Define Push Down automata. 2

c) Convert following context free grammar to Chomsky normal form : 8

$S \rightarrow AACD$

$A \rightarrow aAb | \in$

$C \rightarrow aC | a$

$D \rightarrow aDa | bDb | \in$.

d) Construct a Push Down Automata for the following grammar : 6

$S \rightarrow aABC$

$A \rightarrow aB | a$

$B \rightarrow bA | b$

$C \rightarrow a$.

4. a) What is an ambiguous grammar ? Is the following grammar ambiguous ? 5

$S \rightarrow aB | bA$

$A \rightarrow as | bAA | a$

$B \rightarrow bS | aBB | b$.

b) What do you mean by Greibach Normal Form ? 2

c) Write the rules for obtaining context free grammar corresponding to a given Push Down Automata. 8

Convert the following PDA to CFG using above rules.

1) $\delta(q_0, 0, z_0) = (q_0, xz_0)$

2) $\delta(q_0, 0, x) = (q_0, xx)$

3) $\delta(q_0, 1, x) = (q_1, \in)$

4) $\delta(q_1, 1, x) = (q_1, \in)$

5) $\delta(q_1, \in, x) = (q_1, \in)$

6) $\delta(q_1, \in, z_0) = (q_1, \in)$.

d) Construct a top Down Push Down Automata for the following $s \rightarrow (s)s | \in$. 5

MODULE – III

5. a) Construct a Turing machine for accepting $L = \{0^n 1^n | n \geq 1\}$. 6

   b) Explain the variations of Turing machine in brief. 6

   c) Define : 4

      i) Acceptance by a Turing machine

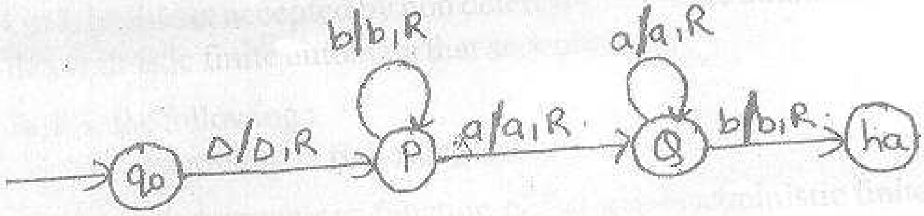
      ii) Characteristics function of a set.

   d) Explain how a partial function is computed using Turing machine. 4

6. a) Construct a Turing machine to compute the function $f(x) = x + y$ where x and y are positive integers. Assume Turing machine to use unary notation. 6

   b) Give the encoding function for an universal Turing machine. 8

      Encode the following Turing machine using above function.



   c) Define : 4

      i) Turing machine

      ii) Church Turing thesis.

   d) Why is a Turing machine said to be a language acceptor ? 2

MODULE – IV

7. a) Construct a phrase structure grammar for the set of all strings containing a's followed by same number of b's and followed by same number of c's. 6

   b) Define : 6

      i) Linear Bounded Automata.

      ii) Context Sensitive Grammars.

      iii) Abstract Families of Languages.

   c) Enumerate and explain closure properties of context free languages. 6

   d) Define decision problem. 2

8. a) Obtain a generalised sequential machine that maps
$L_1 = \{0^n1^n|n \geq 1\}$ to $L_2 = \{a^{2n}b|n \geq 0\}$. 6

b) State Rice theorem. 2

c) Obtain Turing machine for an unrestricted grammar given below. 6

$s \rightarrow aBs/\in$

$aB \rightarrow Ba$

$Ba \rightarrow aB$

$B \rightarrow b$

d) If L_1 and L_2 are recursively enumerable language over $\sum$ then $L_1 \cap L_2$ is also recursively enumerable. 6
Prove the above statement.