(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2754	Roll No.										

B.Tech.

(SEM. VII) ODD SEMESTER THEORY EXAMINATION 2012-13

THEORY OF AUTOMATA AND FORMAL LANGUAGES

Time : 3 Hours *Total Marks : 100*

Note : (i) *Attempt **all** questions.*

(ii) *All questions carry equal marks.*

(iii) *Notations/Symbols/Abbreviations used have usual meaning.*

1. Attempt any **two** parts of the following :

(a) Construct a minimum state automata equivalent to a FA whose transitions are given as follows :

Present State	Next State Input a	Input b
$\rightarrow q_0$	q_1	q_2
q_1	q_3	q_8
q_2	q_4	q_3
q_3	q_5	q_3
q_4	q_4	q_6
q_5	q_8	q_6
q_6	q_7	q_4
q_7	q_6	q_5
q_8	q_8	q_7

Given that q_4, q_5 and q_8 are final states.

(b) Design finite automata (DFA) over $\Sigma = \{0, 1\}$ with minimum number of states which accepts all the strings that end with 11 and contain 101 as substring.

(c) (i) Discuss the Chomsky hierarchy of the languages.

(ii) Write the regular expression for the language of all strings of 0's and 1's in which do not contain substring 000.

2. Attempt any **two** parts of the following :

(a) (i) Let r_1 and r_2 be regular. Simplify the following regular expression :

$$r_1(r^*_1 r_1 + r^*_1) + r^*_1 + (r_1 + r_2 + r_1 r_2 + r_2 r_1)^*$$

(ii) Prove that every language defined by a regular expression is also accepted by some finite automata.

(b) Obtain the regular expression for the following finite automata having q_0 as final state :

Present State	Next State Input a	Next State Input b
$\rightarrow q_0$	q_3	q_1
q_1	q_2	q_0
q_2	q_1	q_3
q_3	q_0	q_2
q_4	q_5	q_4
q_5	q_4	q_3

(c) (i) If L and M are regular languages then L-M is also regular language. Prove.

(ii) State the pumping lemma for regular expressions. Use the pumping lemma to prove that the language L is not regular. L is defined as follows :

$$L = \{(01)^n \mid n \text{ is prime number}\}.$$

3. Attempt any **two** parts of the following :

(a) (i) The set of context free languages is closed under intersection operation. Prove the statement or give counter example.

(ii) Determine whether following grammar is ambiguous or not ?

$$S \rightarrow ictS \mid ictSeS \mid a.$$

(b) Simplify the following context free grammar G to an equivalent context free grammar that do not have any useless symbol, null production or unit production :

$S \rightarrow A \mid B \mid C$

$A \rightarrow aAa \mid B$

$B \rightarrow bB \mid bb$

$C \rightarrow aCaa \mid D$

$D \rightarrow baD \mid abD \mid aa$

S is the start symbol.

(c) (i) Give an algorithm to decide whether language generated by a given CFG is finite.

(ii) Convert the following grammar into Greibach Normal Form (GNF).

$S \rightarrow ABb \mid a$

$A \rightarrow aaA$

$B \rightarrow bAb$

4. Attempt any **two** parts of the following :

(a) What is a Push Down Automata (PDA) ? Construct a PDA which accepts the language L given by $L = \{0^n 1^{2n} \mid n$ is non-negative integer$\}$.

(b) (i) Prove that if a PDA M_1 accepts language L by final state then there exist a PDA M_2 which accepts L by empty stack.

(ii) Construct a Push Down Automata which accepts the language generated by the following context free grammar having S as start symbol :

$$S \to aSA \mid a$$
$$A \to bB$$
$$B \to b$$

(c) Obtain a context free grammar that generates the language accepted by the PDA M with following transitions :

$\delta(q_0, 1, Z_0) = \{(q_0, XZ_0)\}$

$\delta(q_0, 1, X) = \{(q_0, XX)\}$

$\delta(q_0, 0, X) = \{(q_0, X)\}$

$\delta(q_0, \in, X) = \{(q_1, \in)\}$

$\delta(q_1, \in, X) = \{(q_1, \in)\}$

$\delta(q_1, 0, X) = \{(q_1, XX)\}$

$\delta(q_1, 0, Z_0) = \{(q_1, Z_0)\}$

Given that q_0 is start state and q_1 is final state.

5. Attempt any **two** parts of the following :

(a) Define Turing machine. Design a Turing machine that accepts the language L over {a, b} defined as follows :

$$L = \{ww \mid w \in (a + b)^*\}.$$

(b) (i) Prove that recursively enumerable languages are closed under intersection operation.

(ii) What do you understand by undecidable problem ? Prove that Halting problem of Turing machine is undecidable.

(c) (i) State post correspondence problem (PCP). Write the steps to construct a PCP instance, given an instance of Modified Post Correspondence Problem (MPCP).

(ii) Write short notes on various variants of Turing Machine.