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

PAPER ID : 2754 Roll No. | | | | | | | | | |

B. Tech.

(SEM. VII) THEORY EXAMINATION 2011-12

THEORY OF AUTOMATA AND FORMAL LANGUAGES

Time : 3 Hours *Total Marks : 100*

Note :– (1) Attempt **all** questions.

(2) All questions carry equal marks.

(3) Notations/Symbols/Abbreviations used have usual meaning.

(4) Make suitable assumptions, wherever required.

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

(a) Define Nondeterministic finite automata (NFA). Design deterministic finite automata (DFA) over $\Sigma = \{a, b\}$ with minimum number of states which accepts all the strings that contains **babb** as substring.

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

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

Given that q_3 and q_4 are final states.

(c) State and prove Myhill-Nerode Theorem.

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

(a) 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.

$$L = \{0^{2n}1^{3n} \mid n \text{ is nonnegative integers}\}$$

(b) Obtain the regular expression for the following finite automata having q_3 as final state :

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

(c) (i) Define Moore machine and Mealy machine. Illustrate the procedure to transform a given Moore machine to equivalent Mealy machine.

(ii) Prove that regular languages are closed under Intersection operation.

(iii) Find the regular expression for the set of all strings of **0**'s and **1**'s in which every three are at least two occurrences of **0** between any two occurrence of **1**.

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

(a) 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 :

$$S \rightarrow aA \mid aBB$$

$$A \rightarrow aaA \mid \in$$

$$B \rightarrow bB \mid bbC$$

$$C \rightarrow B$$

S is the start symbol.

(b) What do you understand by ambiguous grammar ? Show that the following grammar is ambiguous :

$$S \rightarrow S + S \mid S * S \mid (S) \mid a$$

Write an equivalent unambiguous context free grammar which generates the same language.

(c) Convert the following grammar into Greibach Normal Form (GNF) :

$$S \rightarrow AA \mid 0$$

$$A \rightarrow SS \mid 1$$

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

(a) What do you understand by Instantaneous Description of a Push Down Automata (PDA) ? Construct a deterministic PDA which accepts all those strings over **{a, b}** which have equal number of **a's** and **b's**.

(b) Prove that context free languages are closed under union and star-closure.

(c) Consider the PDA $M = (\{q_0, q_1\}, \{a, b\}, \{A, Z_0\}, \delta, q_0, Z_0, \{q_1\})$ where δ is given as follows :

$\delta(q_0, a, Z_0) = \{(q_0, AZ_0)\}$

$\delta(q_0, b, A) = \{(q_0, AA)\}$

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

Obtain the context free grammar that generates the same language which is accepted by PDA **M**.

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

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

$$L = \{a^n b^n c^n \mid n \text{ is positive integer}\}.$$

(b) Differentiate between recursive language and recursively enumerable language. Prove that if a language **L** and complement of **L** both are recursively enumerable then **L** is recursive.

(c) Write short note on Universal Turing Machine.