**Printed Pages—4**                                    **EIT072**

(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 :

EIT072/KIH-26394                      1                      *[Turn Over*

| Present State | Next State | |
|---|---|---|
| | Input a | Input b |
| →$q_0$ | $q_1$ | $q_2$ |
| $q_1$ | $q_4$ | $q_3$ |
| $q_2$ | $q_4$ | $q_3$ |
| $q_3$ | $q_5$ | $q_6$ |
| $q_4$ | $q_7$ | $q_6$ |
| $q_5$ | $q_3$ | $q_6$ |
| $q_6$ | $q_6$ | $q_6$ |
| $q_7$ | $q_4$ | $q_6$ |

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 |
| →$q_0$ | $q_2$ | $q_1$ |
| $q_1$ | $q_2$ | $q_3$ |
| $q_2$ | $q_3$ | $q_1$ |
| $q_3$ | $q_3$ | $q_3$ |

(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 $\delta$ 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.