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

PAPER ID : 0112

B.Tech.
(SEMESTER-IV) THEORY EXAMINATION, 2011-12
THEORY OF AUTOMATA & FORMAL LANGUAGES

Time : 3 Hours / Total Marks : 100

Note : Attempt all Section as directed.

Section – A

1. Attempt all questions. All questions carry equal marks : 2 × 10 = 20
   (a) Define deterministic finite automaton.
   (b) State Myhill-Nerode theorem.
   (c) Find a regular expression corresponding to the language of all strings over the alphabet {0, 1} that contains at least two 0’s.
   (d) Differentiate between Mealy machine and Moore machine.
   (e) Show that the context-free gramma G given by productions S → SBS/a, B → b, is ambiguous.
   (f) What do you mean by inherent ambiguous CFL?
   (g) Compare PDA with FA.
   (h) What do you mean by instantaneous description of PDA?
   (i) When a language is said to be recursive or recursively enumerable?
   (j) What are the ways of representations of TMs?

Section – B

2. Attempt any three parts. 3 × 10 = 30
   (a) Design a Mealy machine that accepts binary string divisible by 3.
   (b) Construct an NFA without E-mores corresponding to the following NFA.
(c) Show that the language \( \{ 0^n 1^n 2^n \mid n \geq 1 \} \) is not a context free language.

(d) Construct PDA by empty stack which accepts the following:

\( \{ a^m b^m c^n \mid m, n \geq 1 \} \)

(e) For \( \Sigma = \{a, b\} \) design a TM that accepts \( L = \{a^n b^n \mid n \geq 1 \} \).

**Section – C**

Attempt all questions. \( 5 \times 10 = 50 \)

3. Prove that if a language \( L \) is accepted by an NFA then there is a DFA that accepts \( L \).

**OR**

Prove that if \( L \) is accepted by an NFA with \( \epsilon \)-transitions, then \( L \) is accepted by an NFA without \( \epsilon \)-transitions.

4. Find the regular expression corresponding to the following Finite Automaton:

![Finite Automaton Diagram]

Show that \( L = \{ w w \mid w \in \{a, b\}^* \} \) is not regular.

5. Construct a PDA \( M \) equivalent to the grammar with the following productions:

\[
S \rightarrow aAA \\
A \rightarrow bS | aS | a
\]

Also check whether the string \( abaaaaa \) is in \( N(M) \) or not.

**OR**

Design 2-stack PDA for language \( L = \{a^n b^n c^n \mid n \geq 0 \} \).

6. Convert the following grammar to GNF:

\[
S \rightarrow ABA \\
A \rightarrow aA | \epsilon \\
B \rightarrow bB | \epsilon
\]

**OR**

Prove that if \( L_1 \) and \( L_2 \) are two CFLs then \( L_1 \cap L_2 \) may or may not be CFL.

7. Write short notes on any two of the following:

(a) Universal TM
(b) Halting Problem
(c) Church’s Thesis