**DHARMSINH DESAI UNIVERSITY, NADIAD**
**FACULTY OF TECHNOLOGY**
**B.TECH. SEMESTER VI [CE\IT]**

**SUBJECT: (CT614) THEORY OF AUTOMATA AND FORMAL LANGUAGES**

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| **Examination** | **: Third Sessional** | **Seat No.** | **: _____** |
| **Date** | **: 02/04/2013** | **Day** | **: Tuesday** |
| **Time** | **: 12 to 1.15** | **Max. Marks** | **: 36** |

**INSTRUCTIONS:**
1. Figures to the right indicate maximum marks for that question.
2. The symbols used carry their usual meanings.
3. Assume suitable data, if required & mention them clearly.
4. Draw neat sketches wherever necessary.

**Q.1 Do as directed.**

(a) Define: Acceptance by PDA. **[2]**

(b) Eliminate left recursion problem from the given grammar. **[2]**
$S \rightarrow S_1\$ \quad S1 \rightarrow S_1A \mid \Lambda \quad A \rightarrow Aa \mid b$

(c) Describe Chomsky hierarchy for languages. **[2]**

(d) State true or false and Justify. **[2]**
1. Turing machine can accept Regular language.
2. 'C' language is not a CFL.

(e) Does multi-tapes increase the power of a TM compared to single tape TM? Justify your answer. **[2]**

(f) Define Context Sensitive Grammar and Phrase Structure Grammar. **[2]**

**Q.2** Attempt ***Any Two*** from the following questions. **[12]**

(a) Construct a Top down PDA for {x belongs to {a,b}* | x is a non Palindrome}

(b) Design a PDA for the language L= $\{a^ib^jc^k \mid i,j,k >= 1 \& i+j = k\}$.

(c) Using Pumping Lemma prove that $\{a^ib^jc^k \mid i< j< k\}$ is not a context free language.

**Q.3** (a) Define Encoding function of UTM. Construct TM that accept $L=\{a^nb^n \mid n>=0\}$and encode TM. **[6]**

(b) Construct **Insert(a)** TM which changes the tape content 'x**y**' to x**a**y. Where **x** belongs to $(\sum \cup \{\Delta\})^*$, **y** belongs to $\sum^*$ and **a** belongs to $\sum \cup \{\Delta\}$. **[6]**

**OR**

**Q.3** (a) Construct a TM that computes Reverse function of the input string **[6]**

(b) Discuss Non Deterministic Turing Machine. Construct and Explain a single tape / Multi tape version of 'Execute' 'Sub Turing Machine' with suitable example. **[6]**

**Let $L = \{a^i b^j c^k | i, j, k \geq 1 \text{ and } i + j = k\}$**

a. Find a PDA (which accepts via final state) that recognizes $L$.

b. Find a PDA (which accepts via empty stack) that recognizes $L$.

**Solution**

a. Hint: Push $a$'s and $b$'s into the stack and match them with each$c$ and clear.

The PDA $M = (\{q_0, q_1, q_2, q_3\}, \{a, b, c\}, \{a, b, \$\}, \delta, q_0, \$, \{q3\})$

Transitions are:

$\delta(q_0, a, \$)$ contains $(q_0, a\ \$)$

$\delta(q_0, a, a)$ contains $(q_0, aa)$

$\delta(q_0, b, a)$ contains $(q_1, ba)$

$\delta(q_1, b, b)$ contains $(q_1, bb)$

$\delta(q_1, c, b)$ contains $(q_2, \varepsilon)$

$\delta(q_2, c, a)$ contains $(q_2, \varepsilon)$

$\delta(q_2, c, b)$ contains $(q_2, \varepsilon)$

$\delta(q_2, \varepsilon, \$)$ contains $(q_3, \varepsilon)$

b. The machine $M$ above is the required PDA, $q_3$ is the final state and all the transitions remain the same as for (i). This machine accepts $L$ via both by empty stack and final state. Note that this is a DPDA.