Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech (CSE)/SEM-1/PGCS-105B/2011-12

2011
THEORY OF COMPUTATION

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions. 5 × 14 = 70

1. a) Construct a DFA accepting all strings w over { 0, 1 } such that the number of 1's in w is 3 mod 4. 4

   b) Construct a transition system which can accept strings over the alphabet a, b containing either cat or rat. 4

   c) Construct a minimum state automaton equivalent to the DFA described by Figure 1. 6

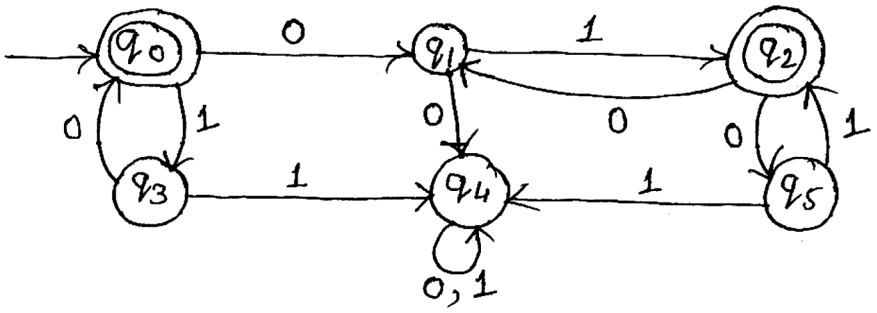

Figure 1

2. a) Show that the set of all non-palindromes over $\{a, b\}$ is a context-free language. 4

b) Construct a grammar to generate

$\{(ab)^n \mid n \geq 1\} \cup \{(ba)^n \mid n \geq 1\}$. 4

c) Find the regular expression corresponding to Figure 2. 6

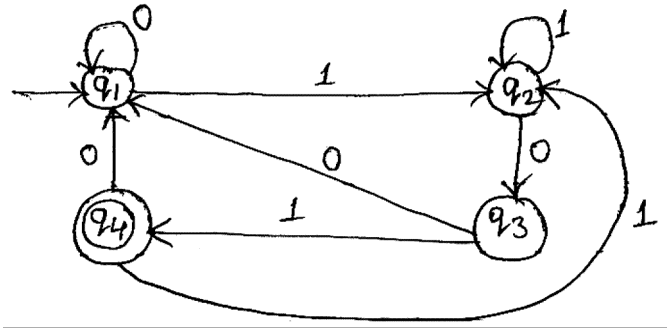

Figure 2

3. a) Design an FA for the RE 10 + (0 + 11) 0 ∗ 1. 6

b) Prove

(1 + 00∗1) + (1 + 00∗1) (0 + 10∗1) ∗ (0 + 10∗1) = 0∗1 (0 + 10∗1) ∗. 4

c) Is $L = \{a^{2n} \mid n \geq 1\}$ regular ? 4

4. a) Write the CFG for the language $L = \{0^i\, 1^j\, 2^k \mid i = j \text{ or } j = k\}$. 4

b) Reduce the following grammar to GNF : 6

$S \to AB; A \to BS \mid b, B \to SA \mid a.$

c) Prove that CFLs are not closed under intersection and complement operation. 4

5. a) Construct a PDA, A accepting the set of all strings over { a, b } with equal number of *a*'s and *b*'s. 5

b) Construct a PDA *A* equivalent to the following :

CFG : $S \to OBB, B \to OS \mid 1S \mid O$. Test whether $O10^4$ is in $N(A)$. 3 + 3

c) Using the Pumping Lemma prove that $L = \{a^P \mid P \text{ is a prime}\}$ is not regular. 3

6. a) Construct a Turing machine that enumerates $\{O^n\, 1^n \mid n \geq 1\}$. 6

b) Construct a Turing machine that can accept the strings over { 0, 1} containing even number of 1's. 4

c) Construct a TM that accepts the language $01^* + 10^*$. 4

7. a) State and prove Pumping Lemma for regular language. 6

b) Construct a TM that can accept the set of all even palindromes over { 0, 1 }. 4

c) Design a TM that converts a binary string into its equivalent unary string. 4