CS-73

BACHELOR IN COMPUTER APPLICATIONS

Term-End Examination

December, 2007

CS-73 : THEORY OF COMPUTER SCIENCE

Time : 3 hours *Maximum Marks : 75*

Note : *Question number 1 is* ***compulsory****. Attempt any* ***three*** *questions from the rest.*

1. (a) Tabulate the Chomsky hierarchy of grammars with examples. 6

(b) Consider the two regular expressions $r_1 = 0^* + 1^*$ and $r_2 = 01^* + 10^* + 1^*0 + (0^*1)^*$.

(i) Find a string corresponding to r_1 but not to r_2.

(ii) Find a string corresponding to r_2 but not to r_1.

(iii) Find a string corresponding to both r_1 and r_2.

(iv) Find a string corresponding to neither r_1 nor r_2. 8

(c) Differentiate between NP-hard and NP-complete problems. What are the steps in proving that a particular problem is NP-complete ? 5

(d) Define regular set. Using Pumping Lemma show that the language $L = \left\{ 0^{i^2} \,\middle|\, i \text{ is an integer}, i \geq 1 \right\}$ is not regular. 5

(e) Prove that if L_1 and L_2 are context free languages, then the languages $L_1 \cup L_2$, $L_1 L_2$ and L_1^* are also context free languages. 6

2. (a) Let $M = (\{q_1, q_2, q_3\}, \{0, 1\}, \delta, \{q_1\}, \{q_3\})$ is a NDFA where δ is given

$\delta(q_1, 0) = \{q_2, q_3\}$

$\delta(q_1, 1) = \{q_1\}$

$\delta(q_2, 0) = \{q_1, q_2\}$

$\delta(q_2, 1) = \{\phi\}$

$\delta(q_3, 0) = \{q_2\}$

$\delta(q_3, 1) = \{q_1, q_2\}$

(i) Construct an equivalent DFA and draw the transition diagram.

(ii) Check whether the string '011010' is accepted by DFA and NFA. 7+3

(b) Give a detailed description of ambiguity in context-free grammar. 5

3. (a) Define Push Down Automata (PDA). Find PDA for the language given below : 8

$L = \{a^n b^m c^{m+n} : n, m \geq 0\}$

(b) Let G be the grammar

$S \rightarrow 0B \mid 1A$

$A \rightarrow 0 \mid 0S \mid 1AA$

$B \rightarrow 1 \mid 1S \mid 0BB$

for the string '00110101'.

Find

(i) LMD

(ii) RMD

(iii) Derivation Tree 7

4. (a) Define Turing Machine. Find the turing machine that computes the following function,

$f(n, m) = n * m$

Here the function f is $f : N \times N \rightarrow N$. *2+8*

(b) State and give the proof of Post correspondence problem. *5*

5. (a) Prove that the universal language L_u is recursively enumerable. *7*

(b) Define Primitive Recursive Function. Show that the following function is Primitive Recursive : *2+6*

$$f(n, m) = \begin{cases} n - m & \text{if } n \geq m \\ 0 & \text{otherwise} \end{cases}$$