

# BACHELOR IN COMPUTER APPLICATIONS

## Term-End Examination

June, 2007

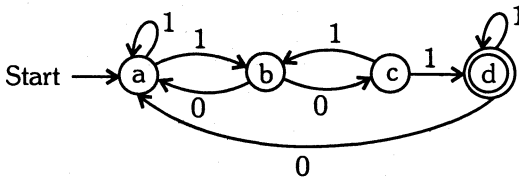
### CS-73 (S) : THEORY OF COMPUTER SCIENCE

Time : 3 hours

Maximum Marks : 75

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

1. (a) What is a NP-hard problem ? Explain how the NP-hardness of the problem can be established. 6
- (b) Using parse tree show that the grammar  $S \rightarrow S + S \mid S * S \mid a$  is ambiguous.  
Use  $a + a * a$  as the string. 4
- (c) Describe Universal Turing Machine. 5
- (d) Find the minimum state finite automaton equivalent to the following transition diagram : 7



- (e) List three applications of finite automata. 3
- (f) Design a Turing Machine which accepts the language  

$$L = \{ 0^n, n \mid n \geq 1 \}$$
 5
2. (a) Construct left linear and right linear grammars for the language  $1^*(0(0+1))^*$  7
- (b) State pumping lemma for regular sets/expressions and prove that the language  

$$L = \{ a^p \mid p \text{ is prime} \}$$
 is not regular. 8
3. (a) Explain Chomsky Hierarchy of grammars. 6
- (b) Define the following with suitable examples : 9
- (i) Primitive recursive function
- (ii) Growth rate of functions
- (iii) Kleene Closure
4. (a) Write a short note on Post Correspondence Problem (PCP). 5
- (b) Prove the following : 5
- (i) Complement of a recursive language is recursive.
- (ii) Union of two recursive languages is recursive.
- (c) Describe the operation of a Turing Machine which uses a two-way infinite tape. 5

5. (a) Design the Push Down Automata (PDA) which accepts the language

$$L = \{ w c w^T \mid w \in (a, b)^* \} \quad 8$$

- (b) When can a problem be termed as “undecidable” ?  
Explain with an example. 4
- (c) What is meant by time complexity and space complexity of a problem ? 3

