

BACHELOR IN COMPUTER APPLICATIONS

Term-End Examination

June, 2008

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) Draw finite automata corresponding to the following regular expressions :
- (i) $(ab + cd) e$ 2
- (ii) $(b + c) a^*$ 2
- (b) Convert the following NFA to DFA : 4

State	Input	
	a	b
q_0	q_0, q_1	q_2
q_1	q_0	q_1
q_2	—	q_0, q_1

- (c) Design a Turing machine over $\{a, b\}$ which accepts all the strings of type $a^n b^n$ where $n \geq 1$ i.e.

$$L(M) = \{a^n b^n \mid n \geq 1\} \quad 5$$

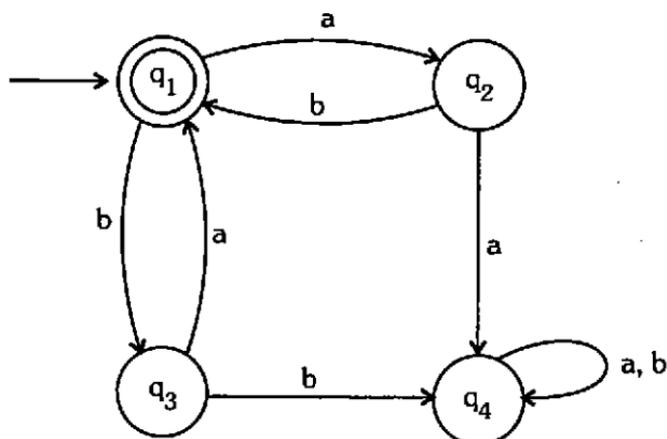
(d) If language L is recursive, show that \bar{L} is also recursive. 4

(e) Describe the following asymptotic notations :
 Θ, Ω . 6

(f) Describe polynomial time reduction and how it is related to NP completeness. 5

(g) State two undecidable problems. 2

2. (a) Find the regular expression corresponding to the following Finite automata : 4



(b) Give a push down automaton corresponding to the following context free language : 4

$$S \rightarrow AB, A \rightarrow BS \mid b, B \rightarrow SA \mid a$$

(c) State pumping lemma for regular sets and prove that the language $L = \{a^p \mid p \text{ is prime}\}$ is not regular. 5

(d) Describe the type 0 and type 1 languages in the Chomsky's classification. 2

3. (a) Design a Turing machine over $\{a, b\}$ which accepts all the strings ending with $bbba$. 5
- (b) Describe halting problem of Turing machines. 5
- (c) Describe the concept of Universal Turing machine. 5
4. (a) Describe three initial functions used to define the primitive recursive functions. Show that the following function is primitive recursive : 6
- $f : \mathbb{N} \times \mathbb{N} \rightarrow \mathbb{N}$ defined by $f(m, n) = m + n$ where \mathbb{N} denotes the set of whole numbers.
- (b) Describe the working of multihead Turing machine. 5
- (c) Describe Post Correspondence problem. 4
5. (a) Describe how finite automata can be used to search information on world wide web. 5
- (b) Describe the role of Turing machine as a computer for positive integers. Design a Turing machine which computes the sum of two positive integers m and n , $m, n \geq 1$. 4
- (c) State Rice's theorem and describe the concept of functional properties. 4
- (d) Briefly describe NP-hard problem. 2

