53 (CS 502) THCM

2015

THEORY OF COMPUTATION

Paper : CS 502

Full Marks : 100

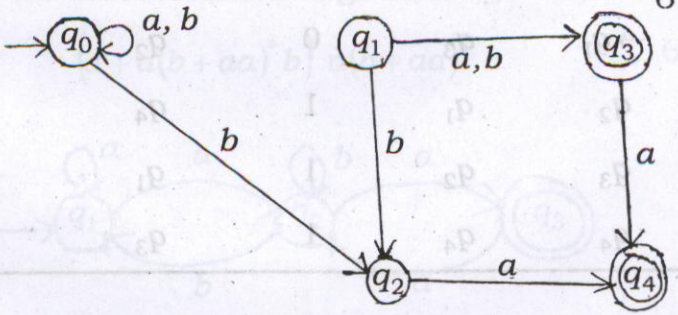
Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions out of seven.*

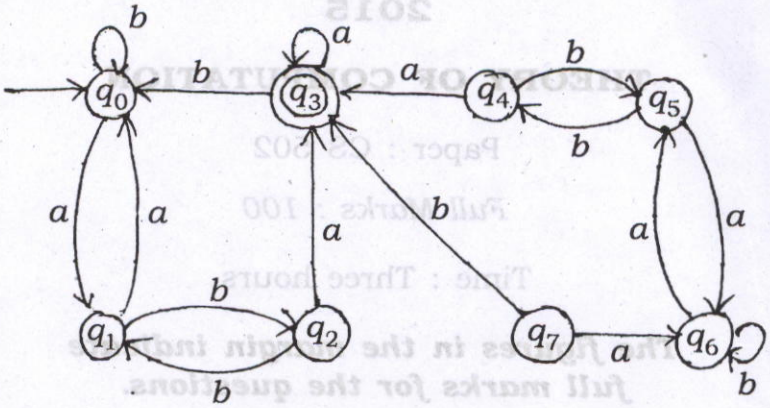
1. *(a)* Construct a DFA accepting all strings over $\{a,b\}$ ending in ab. 4

(b) Construct a DFA equivalent to the NDFA M whose transition diagram is given by 6



Contd.

(c) Construct a minimum state automaton equivalent to the DFA described by the figure below : 10



2. (a) Construct a Moore machine equivalent to the Mealy machine given by 5

Present State	Next State			
	Input $a = 0$		Input $a = 1$	
	State	Output	State	Output
$\rightarrow q_1$	q_3	0	q_2	0
q_2	q_1	1	q_4	0
q_3	q_2	1	q_1	1
q_4	q_4	1	q_3	0

(b) Given a grammar $G = (\{S, c\}, \{a, b\}, P, S)$ where P consists of $S \to aCa, C \to aCa \mid b$. Find $L(G)$. 3

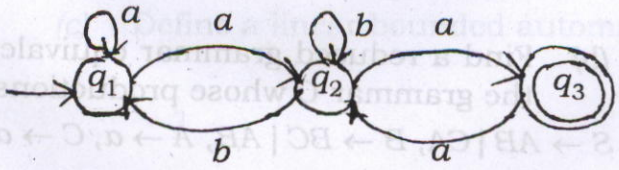
(c) Let L be the set of all palindromes over $\{a, b\}$. Construct a grammar G generating L. 4

(d) Show the Chomsky classification of grammar and define each type with examples. 8

3. (a) Use regular expressions and prove that

$$(1+00*1)+(1+00*1)(0+10*1)*(0+10*1) = 0*1(0+10*1)^*$$ 4

(b) Consider the transition system given in the figure below. Prove that the strings recognized are $(a + a(b+aa)^* b)^* a(b+aa)^* a$ 6



(c) Construct a DFA with reduced states equivalent to the regular expression

$10+(0+11)0^*1$ 10

4. (a) Define pumping lemma for regular sets. Using pumping lemma, show that 3+5=8

$L=\{0^i1^i \mid i \geq 1\}$ is not regular.

(b) Construct a regular grammar G generating the regular set represented by $P=a^*b(a+b)^*$ 6

(c) Give the formal definition of a derivation tree in context free grammar. Define leftmost and rightmost derivation. 4+2=6

5. (a) What do you mean by ambiguity in a context free grammar ? If G is the grammar $S \rightarrow sbs \mid a$, show that G is ambiguous. 2+5=7

(b) Find a reduced grammar equivalent to the grammar G whose productions are

$S \rightarrow AB \mid CA,\ B \rightarrow BC \mid AB,\ A \rightarrow a,\ C \rightarrow aB \mid b$ 5

(c) When is a grammar G said to be in Chomsky Normal Form (CNF) ? Reduce the following grammar G to CNF. G is defined by the productions

$$S \to aAD$$
$$A \to aB \mid bAB$$
$$B \to b$$
$$D \to d$$

3+5=8

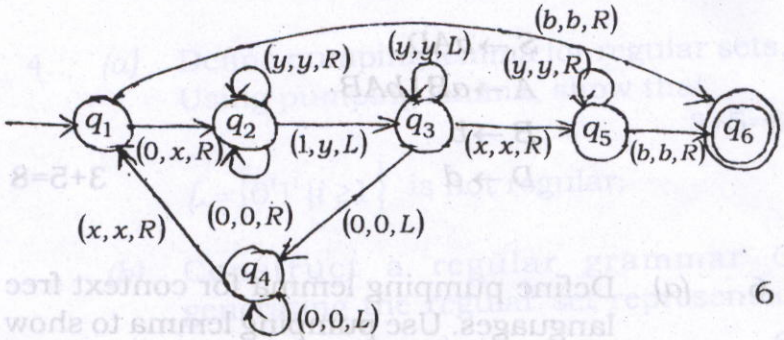
6. (a) Define pumping lemma for context free languages. Use pumping lemma to show that

$$L = \{a^n b^n c^n \mid n \geq 1\}$$ is not context free. 3+5=8

(b) What do you mean by pushdown automata (PDA) ? Construct a pda A accepting $L = \{wcw^T \mid w \in \{a,b\}^*\}$ by final state. 4+5=9

(c) Define a linear bounded automata. 3

7. *(a)* M is a Turing machine represented by the transition system given below. Obtain the computation sequence of M for processing the input string 0011.



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(b) Consider the Turing Machine M described by the transition table given below. Describe the processing of (a) 011 (b) 0011 (c) 001 using IDS.

Which of the above strings are accepted by M ? 6

Present State	Tape Symbol				
	0	1	x	y	b
$\rightarrow q_1$	xRq_2				bRq_5
q_2	$0Rq_2$	yLq_3		yRq_2	
q_3	$0Lq_4$		xRq_5	yLq_3	
q_4	$0Lq_4$		xRq_1		
q_5				$yxRq_5$	bRq_6
(q_6)					

(c) Design a Turing Machine to recognize all strings consisting of an even number of 1's. 6

(d) What do you mean by a recursive language ? 2
