

III B.Tech I Semester Regular Examinations, November 2006
THEORY OF COMPUTATION
 (Common to Computer Science & Engineering and Computer Science &
 Systems Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
 All Questions carry equal marks

1. For the following state transition table draw the state transition diagram. Find its equivalent machine. For the string abbaaab test whether both give same result or not. q_0 is the initial state and q_3 is the final state. [16]

q / Σ	0	1
q_0	q_1	q_2
q_1	q_1	$q_1 q_3$
q_2	ϕ	ϕ
q_3	$q_0 q_3$	q_3

2. (a) Define NFA- ϵ transitions and write the differences between NFA- and ordinary NFA.
 (b) Find NFA without ϵ for the following Figure 2b [4+4+8]

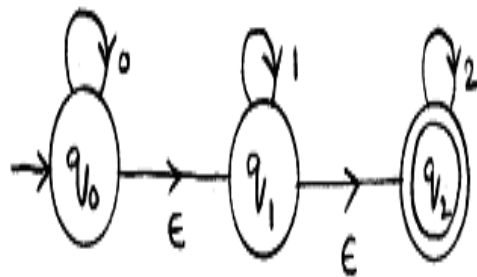


Figure 2b

- (c) Construct state transition table for the following Moore machine. Figure 2c

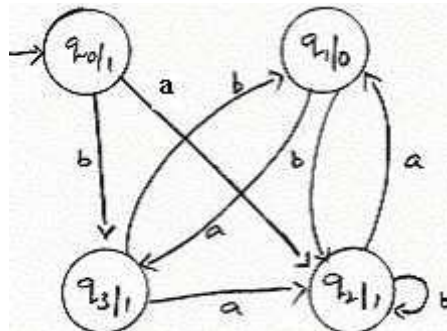


Figure 2c

3. (a) List the closure properties of regular sets and explain any two of them.
 (b) State and explain Arden's theorem with a suitable example.

- (c) Construct FA for regular expression $0^*1 + 10$. [6+6+4]
4. (a) Construct finite automata recognizing the following grammar.
 $A_0 \rightarrow aA_1$
 $A_1 \rightarrow bA_1/bA_0 / a$
- (b) Describe the language generated by the grammar
 $S \rightarrow aAB, A \rightarrow bBb, B \rightarrow A/\wedge$
 Give the rigorous definition for a derivation tree and give an example. [8+8]
5. (a) Construct Push Down Automata equivalent to the grammar and verify the result for aabaaa.
 $S \rightarrow aAA$
 $A \rightarrow aS/bS/a$
- (b) Prove or explain that if L is a Context Free Language then there exists an equivalent Push Down Automata. [8+8]
6. Construct Turing machine to accept following language and give its state transition table and diagram. Check the machine by tracing a suitable instance.
 $L = \{ a^n b^n a^n b^n / n \geq 1 \}$. [16]
7. Construct LR(0) items for the grammar given, find its equivalent DFA. Check the parsing by taking a suitable derived string. λ is null.
 $E \rightarrow T E'$
 $E' \rightarrow + T E' | \lambda$
 $T \rightarrow F T'$
 $T' \rightarrow * F T' | \lambda$
 $F \rightarrow i d$ [8+8]
8. Write short notes on any three of the following.
- (a) NP hard problems
 (b) Reducability
 (c) PCP
 (d) UTM. [16]

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1. (a) Let $R = \{(1, 2), (2, 2), (2, 3)\}$ be a relation on the set $\{1, 2, 3\}$, Find R^* .
- (b) Develop a Deterministic Finite Automation accepting the language given over the alphabet $\{0, 1\}$. $L = \{\text{the set of all strings such that every block of five consecutive contain at least two o's}\}$
- (c) Give mathematical definition of NFA and state main differences between NFA and DFA. [4+8+4]
2. (a) Construct the Moore machine for Figure 2a Melay machine.

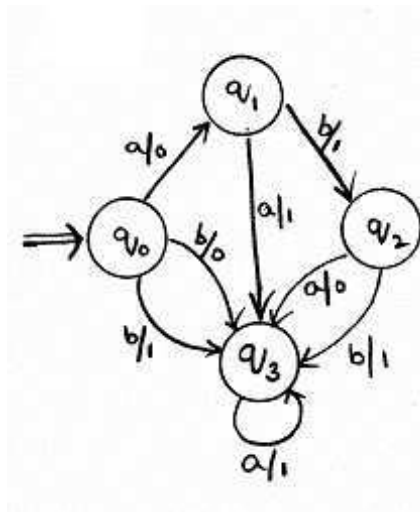


Figure 2a

- (b) Minimise the Finite automation given Figure 2b below and show both given and reduced are equivalent. [6+10]

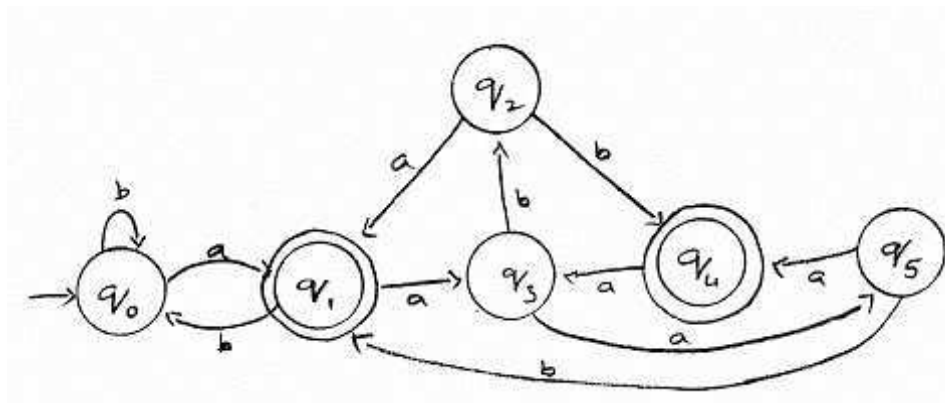


Figure 2b

3. (a) Construct a FA accepting all strings over $\{a, b\}$ ending in aba or aaba.
(b) Show that $L = \{\omega\omega/\omega \in \{a, b\}^*\}$ is not regular. State and explain the theorem used. [8+8]
4. (a) Construct a regular grammar G generating the regular set represented by $a^*b(a+b)^*$.
(b) Give the CFG to generating the following sets
The set of all strings of balanced parenthesis [8+8]
5. (a) Construct PDA for the grammar
 $S \rightarrow aA$
 $A \rightarrow aABC/bB/a$
 $B \rightarrow b$
 $C \rightarrow c$

(b) Convert the following to CNF
 $S \rightarrow 0S0/1S1/A$
 $A \rightarrow 2B3$
 $B \rightarrow 2B3/3$. [8+8]
6. (a) Give formal definition of Turing Machine and explain the concept behind saying “Turing Machine is more powerful than the digital computer”.
(b) Design Turing Machines for the following:
i. To compliment a given binary number.
ii. To compute $f(x,y) = x+y$ for x and y positive integers represented in Unary. [4+12]
7. (a) Discuss different languages and their corresponding machines.
(b) Write the design procedure of shift reduce parser by taking a suitable example. [8+8]
8. Explain briefly
(a) NP hard and NP complete problems.
(b) Modified post correspondence problem.
(c) UTM. [16]

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1. Define NFA mathematically. Explain its significance and function. Convert the given Finite automaton into Deterministic. Explain the method used. Taking suitable example prove both accept the same string. Figure 1 [16]

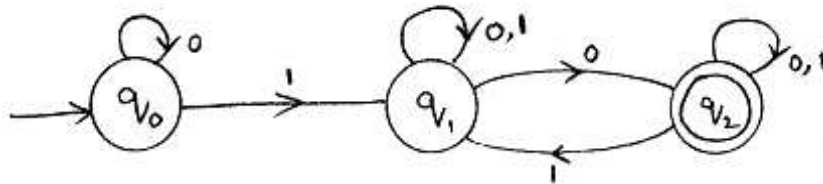


Figure 1

2. (a) Construct state Transition Table for the Moore machine given in Figure 2a below.

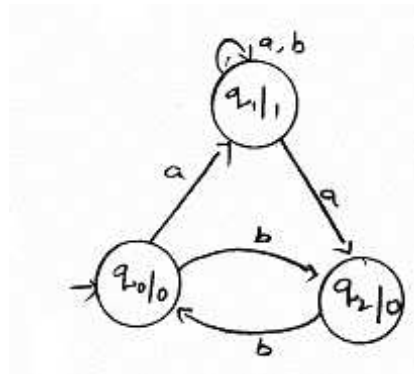


Figure 2a

- (b) Construct Moore machine for the Melay machine in Figure 2b

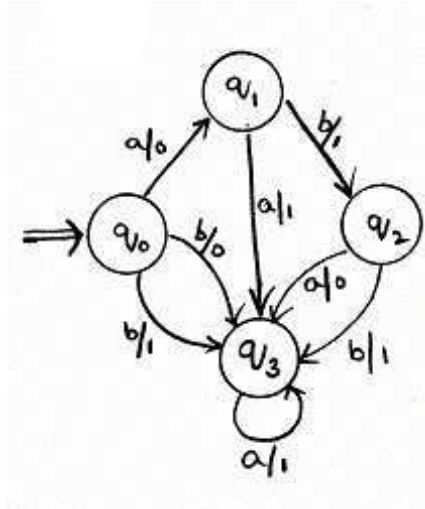


Figure 2b

(c) Construct a minimum automation equivalent to a given automation. [4+6+6]

α	A	b	Output
q_0	q_1	q_2	0
q_1	q_2	q_3	0
q_2	q_3	q_4	1
q_3	q_4	q_4	0
q_4	q_0	q_0	0

3. (a) State and explain pumping Lemma.
 (b) Prove $L = \{ww^R/w \in (a/b)\}$ is not regular.
 (c) Construct FA which accepts the regular expression $10+(0+11)0^*1$. [6+6+4]
4. (a) Find the regular grammar for the following automata. Figure 4a

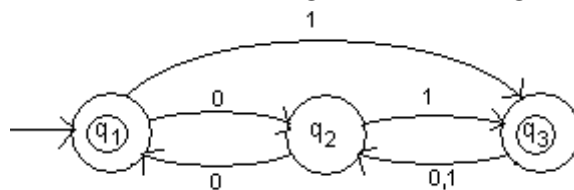


Figure 4a

- (b) Prove that the grammar is ambiguous
- $S \rightarrow aSb/SS/ \in$
 - $S \rightarrow aB/aaB, A \rightarrow a/Aa, B \rightarrow b$
- [8+8]
5. (a) Convert the following grammar to CNF
- $$\begin{aligned}
 S &\rightarrow AB \\
 A &\rightarrow a \\
 B &\rightarrow C/b \\
 C &\rightarrow a
 \end{aligned}$$
- (b) Design a PDA to accept the language.
- $$L = \{a^n b^m c^m a^n / m, n, \geq 1\}$$
- [8+8]

6. (a) Explain how a “RAM computer” can be simulated using Turing Machine.
(b) Design a Turing machine to multiply two integers. Taking this as a block given the block diagram to find factorial of an integer. [6+10]
7. (a) Discuss the Chomsky Hierarchy of languages.
(b) For the grammar shown below construct the sets of LR(0) items.
 $S' \rightarrow S\$$
 $S \rightarrow a S b \mid a b$ [6+10]
8. (a) Is concept of universal gates like Nor and Nand and the universal Turing machine same. Explain the UTM in detail.
(b) What is modified version PCP? Show or explain that if the PCP is decidable then modified PCP is also decidable. [8+8]

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1. (a) With the help of schematic diagram explain the function of DFA. What are the reasons to say it is Deterministic.
- (b) Construct DFA equivalent to the NFA
 $M = (\{p, q, r, s\}, \{0, 1\}, S, P, \{s\})$ and is δ given by [8+8]

	0	1
p	$\{p, q\}$	$\{p\}$
q	$\{r\}$	$\{r\}$
r	s	-
s	s	s

2. (a) Construct the Moore machine for Figure 2a Melay machine.

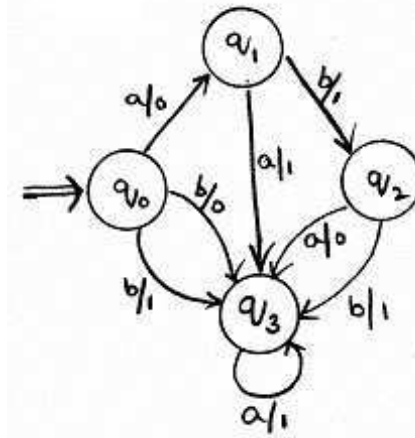


Figure 2a

- (b) Minimise the Finite automation given Figure 2b below and show both given and reduced are equivalent. [6+10]

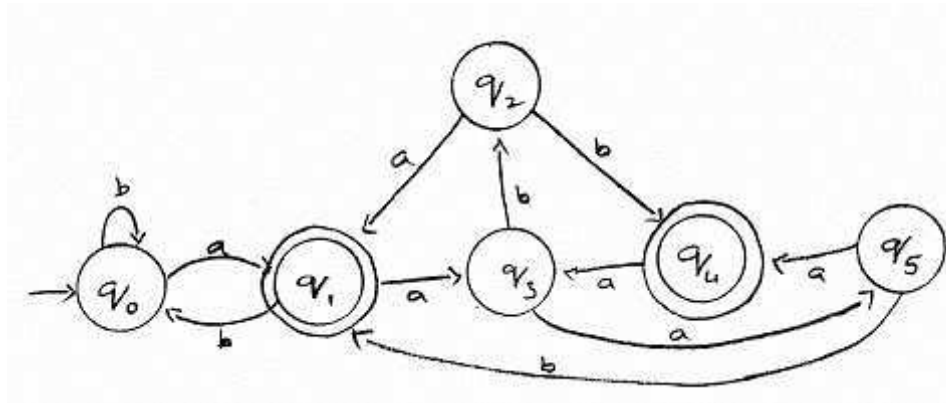


Figure 2b

3. (a) Construct the NFA for the regular expression $r = 0^*1((0+1)0^*1)^*(\epsilon+(0+1)(00)^*)+0(00)^*$
- (b) Consider the FA and construct regular expressions that is accepted by it. [8+8]

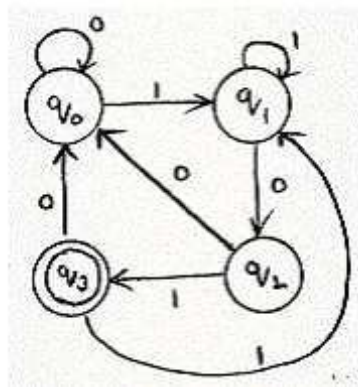


Figure 3

4. (a) Construct finite automata recognizing the following grammar.
 $A_0 \rightarrow aA_1$
 $A_1 \rightarrow bA_1/bA_0/a$
- (b) Describe the language generated by the grammar
 $S \rightarrow aAB, A \rightarrow bBb, B \rightarrow A/\epsilon$
 Give the rigorous definition for a derivation tree and give an example. [8+8]
5. (a) Construct PDA to accept the strings generated by following CFG
 $S \rightarrow aABC$
 $A \rightarrow aB/C$
 $B \rightarrow bA/b$
 $C \rightarrow a$.
- (b) Prove that for every PDA with final state there will be an equivalent PDA with empty stack. [8+8]
6. (a) Write short notes on “Modifications of Turing Machines.”
- (b) Design a Turing Machine to recognize the language. $L = \{ a^n b^n c^n / n \geq 1 \}$.

[6+10]

7. (a) Discuss different languages and their corresponding machines.
(b) Write the design procedure of shift reduce parser by taking a suitable example.

[8+8]

8. Write short notes on

- (a) Halting problem of Turing Machine.
(b) PCP and modified PC problems.

[16]
