BTS-IV-04-18-0728 Reg. No.

A

B.Tech. Degree IV Semester Examination April 2018

CS 15- 1404 AUTOMATA LANGUAGES AND COMPUTATIONS

(2015 Scheme)

Time : 3 Hours Maximum Marks : 60

PART A

(Answer *ALL* questions)

(10 × 2 = 20)

I. (a) Define deterministic finite automata. Give an example. What is its application?

(b) Define Moore and Mealy machines.

(c) What are regular expressions? Write regular expressions for

(i) Binary strings made of 5 bits and not ending with '01'.

(ii) Strings from $\sum=\{a,b\}$ containing only three a's and zero or more b's.

(d) Draw NFA for the following regular expressions.

(i) $(0+1)^* 00(0+1)^*$.

(ii) $0^* 1^* 0^*$.

(e) Define context free grammar. Explain its two normal forms with an example for each.

(f) Simplify the following CFG.

$S \rightarrow a\ ABd \mid aBC$

$A \rightarrow aA \mid E$

$B \rightarrow aBC \mid b$

$C \rightarrow cC \mid B \mid c$

S→aBC
B→aBC|b
C→cC|aBC|b|c

(g) Explain Chomsky Hierarchy.

(h) What is meant by Halting problem of Turing Machine?

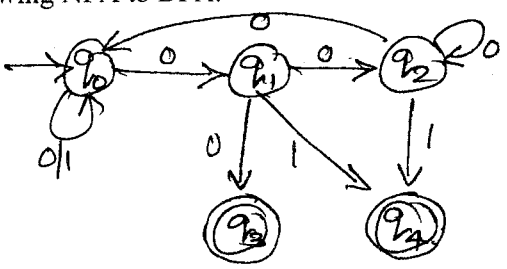
(i) Discuss the closure properties of regular sets.

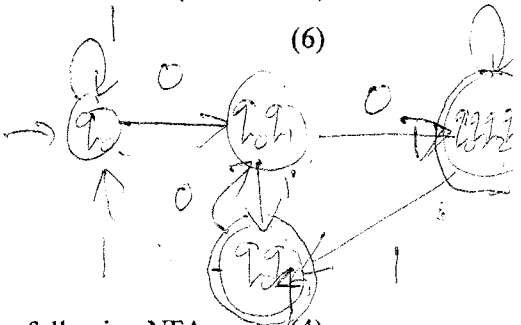
(j) Explain the model of a Push down Automata.

PART B

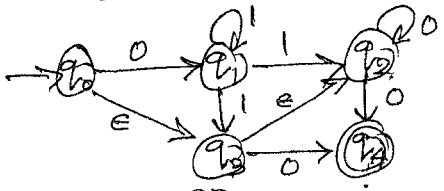
(4 × 10 = 40)

II. (a) Convert the following NFA to DFA. (6)

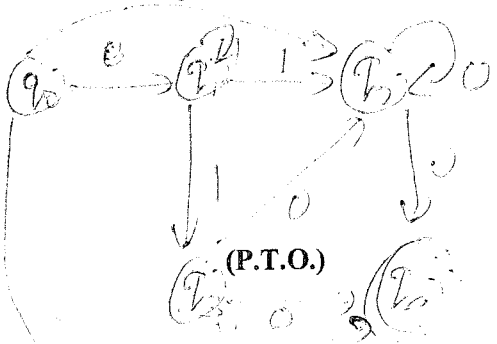




(b) What is meant by epsilon closure? Eliminate epsilon from the following NFA and draw the NFA without epsilon. (4)

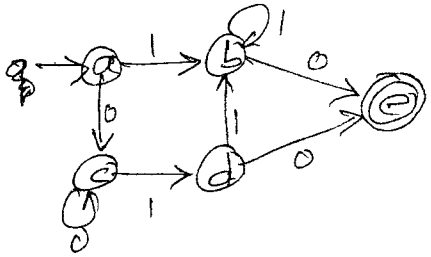


OR



(P.T.O.)

III. (a) Minimize the following DFA. (5)



(b) Design a Moore Machine to calculate the residue mod 4 of a binary string treated as a binary integer. (5)

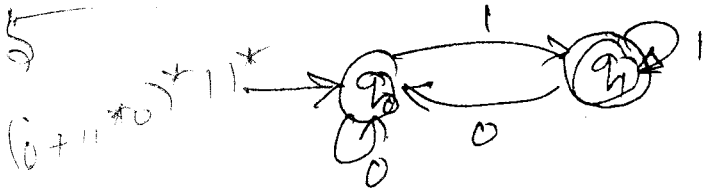
IV. (a) State and prove the pumping lemma for regular sets. (5)

(b) Show that the Language (5)

$L = \{a^{n^2} \mid n \geq 1\}$ is not regular.

OR

V. (a) Using Ardens Theorem, find the regular expression for the following DFA. (5)



(b) Prove that for every regular expression 'r' there is an equivalent NFA 'M'. (5)

VI. (a) Define a Push Down Automata. Design a PDA to accept the language (7)
$L = \{0^n 1^n \mid n \geq 1\}$.

(b) Consider the grammar (3)

$S \rightarrow AB \mid C$

$A \rightarrow aAb \mid ab$

$B \rightarrow cBd \mid cd$

$C \rightarrow aCd \mid aDd$

$D \rightarrow bDc \mid bc$

Find the left most derivation and parse tree for the string 'aabbccdd'.

OR

VII. (a) Convert the following CFG to Chomsky normal form (4)

$S \rightarrow abB \mid abA \mid a$

$B \rightarrow Bb \mid b$

$A \rightarrow aA \mid a$

(b) Explain the three methods used to simplify context free grammars. (4)

(c) What is an ambiguous grammar? Give an example. (2)

VIII. (a) Explain the model of Turing machine. (3)

(b) Design a Turing machine to accept the language (7)
$L = \{a^n b^n c^n \mid n \geq 1\}$.

OR

IX. (a) Explain what you mean by: (3)

(i) Multi-track Turing machines.

(ii) Multi-tape Turing machines.

(iii) Universal Turing machines.

(b) What do you mean by recursive and recursively enumerable languages? (3)

(c) Design a Turing machine to accept the Language $r = 00(0+1)^*$. (4)

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