

C.U.SHAH UNIVERSITY

Summer Examination-2019

Subject Name : Theory of Computation

Subject Code : 4TE06TOC1

Branch: B.Tech (CE)

Semester : 6

Date: 29/04/2019

Time: 10:30 To 01:30

Marks : 70

Instructions:

- (1) Use of Programmable calculator & any other electronic instrument is prohibited.
- (2) Instructions written on main answer book are strictly to be obeyed.
- (3) Draw neat diagrams and figures (if necessary) at right places.
- (4) Assume suitable data if needed.

Q-1 Attempt the following questions: (14)

- a) Find regular expression corresponding to the language of all strings that begins or end with 00 or 11 over $\{0, 1\}^*$.
- b) List out applications of Theory of Computation.
- c) Show that the statement $p \vee q \vee r \vee s$ and $(\neg p \wedge \neg q \wedge \neg r) \rightarrow s$ are equivalent.
- d) Differentiate Deterministic Finite Automata with Non-Deterministic Finite Automata.
- e) Number of states requires accepting string ends with 101.
(i) 3 (ii) 2 (iii) 4 (iv) can't be represented
- f) Give definition of Regular Grammar.
- g) State Arden's Theorem.
- h) Which of the following is most powerful?
(i) Non-Deterministic Finite Automata
(ii) Deterministic Finite Automata
(iii) Deterministic Pushdown Automata
(iv) Non-Deterministic Pushdown Automata
- i) The logic of a pumping lemma is a good example of
(i) The pigeon hole principal
(ii) Divide and Conquer Method
(iii) Iteration
(iv) Recursion
- j) How many strings of length less than 4 contains the language described by the regular expression $(x+y)^*y(a+ab)^*$?
(i) 7 (ii) 10 (iii) 12 (iv) 11
- k) Regular expressions are closed under
(i) Union (ii) Intersection
(iii) Kleen star (iv) All of the mentioned
- l) Given the language $L = \{ab, aa, baa\}$, which of the following strings are in L^* ?
1) abaabaabaa, 2) aaaabaaaa, 3) baaaaabaaaab, 4) baaaaabaa



- (i) 1, 2, and 3
 - (ii) 2, 3, and 4
 - (iii) 1, 2, and 4
 - (iv) 1, 3, and 4
- m) Describe the language corresponding to given regular expression:
 $(1+01)^*(0+01)^*$
- n) The number of eight-bit strings beginning with either 111 or 101 is ____.
- (i) 64
 - (ii) 128
 - (iii) 265
 - (iv) None of the above

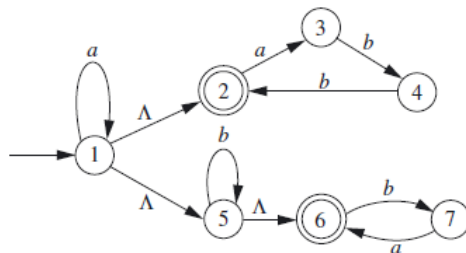
Attempt any four questions from Q-2 to Q-8

Q-2 Attempt all questions (14)

- (a) What is a finite automaton? For each of the following regular expressions, draw an FA recognizing the corresponding language:
- i) $(111 + 000)^* 0$
 - ii) $(0 + 1)^* (01 + 110)$
 - iii) $0 + 10^* + 01^*0$
- (b) Using Principle of Mathematical Induction, prove that for every $n \geq 1$,
 $7 + 13 + 19 + \dots + (6n + 1) = n(3n + 4)$

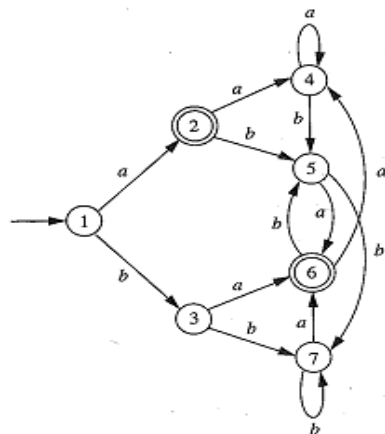
Q-3 Attempt all questions (14)

- (a) Draw Finite Automata (FA) for following languages:
- $L1 = \{x \mid 11 \text{ is not a substring of } x, x \in \{0,1\}^*\}$
 $L2 = \{x \mid x \text{ ends with } 10, x \in \{0,1\}^*\}$
- Find FA accepting languages (i) $L2 - L1$ and (ii) $L1 \cap L2$
- (b) For given NFA- λ , draw an NFA and using subset construction method also draw an FA accepting the same language.

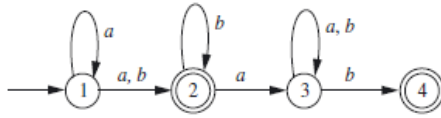


Q-4 Attempt all questions (04)

- (a) For given FA, find a minimum-state FA recognizing the same language:



- (b) Give definition of context-free grammar. Find context-free grammars generating each of these languages: (07)
- (i) $\{a^i b^j c^k \mid i = j + k\}$
(ii) $\{a^i b^j c^k \mid i = j \text{ or } i = k\}$
- (c) Find regular expression corresponding to given FA. (03)



Q-5 Attempt all questions

- (a) For each of these regular expressions over $\{0, 1\}$, draw an NFA recognizing the corresponding language. (04)
- (i) $(0 + 1)(01)^*(011)^*$
(ii) $(0+1)^*(011 + 01010)(0 + 1)^*$
- (b) Using pumping lemma show that the language $L = \{ww \mid w \in \{0, 1\}^*\}$ is not regular. (03)
- (c) Convert a given CFG (Context free grammar) to Chomsky Normal Form (CNF) (07)

$S \rightarrow AACD$
 $A \rightarrow aAb \mid \Lambda$
 $C \rightarrow aC \mid a$
 $D \rightarrow aDa \mid bDb \mid \Lambda$

Q-6 Attempt all questions

- (a) Design and draw a deterministic PDA accepting strings of the language $L = \{x \in \{a, b\}^* \mid n_a(x) > n_b(x)\}$. Trace it for the string “aababaab” (14)
- (b) Show that the following CFGs are ambiguous and find an equivalent unambiguous grammar.
- (i) $S \rightarrow a \mid Sa \mid bSS \mid SSb \mid SbS$
(ii) $S \rightarrow ABA \quad A \rightarrow aA \mid \Lambda \quad B \rightarrow bB \mid \Lambda$

Q-7 Attempt all questions

- (a) Define Turing Machine. Draw a Turing Machine(TM) to accept Palindromes over $\{a,b\}$. (Even as well as Odd length Palindromes) (14)
- (b) Explain following terms:
- (i) Basic complexity classes
(ii) Equivalence Relation
(iii) P and NP Completeness

Q-8 Attempt all questions

- (a) Write a short note on (14)
- (i) Universal Turing Machine
(ii) Halting Problem
- (b) Explain unbounded minimalization and μ -recursive functions.

