INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Date: .....*FN / AN* Time: *60 min* Full marks: - No. of students: -

Autumn Semester Quiz 1, 2017 Dept: *Computer Science & Engineering* Sub No: CS60005

M.Tech (Core) Sub Name: ***Foundations of Computing Science***

Instructions: ***Answer all questions. Write all your answers ONLY in the spaces provided.***

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1. Write the correct option in the provided space:

   (a) The ***automata*** for recognizing regular languages are:

   iv

   i. Deterministic Finite Automata
   ii. Non-deterministic Finite Automata
   iii. Regular Expressions
   iv. Both (i) and (ii)

   (b) Which of the given languages are regular?

   L1 : The set of all strings over {a,b} containing more a's than b's

   L2 : The set of strings over {0,1} that have an equal number of 0's and 1's; and having an alternating pattern of 0's and 1's.

   L3 : The set of strings over {0,1} than have an equal number of 0's and 1's in any pattern.

   L4 : The set of all strings over {0,1}

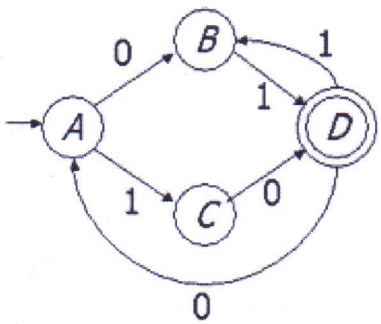
   L5 : $\{0^m 0^n (0^{m+n}) \mid m \geq 1 \; and \; n \geq 2\}$

   L6 : $\{0^m 1^n (0^{m+n}) \mid m \geq 1 \; and \; n \geq 2\}$

   L7 : $\{0^m 10^n (0^{m+n}) \mid m \geq 1 \; and \; n \geq 2\}$

   L2 , L4 , L5

   (c) For the automaton, identify in the list, which of the strings the automaton accepts:

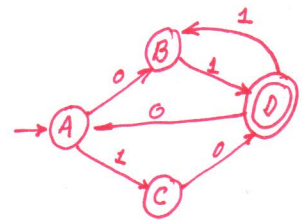


   i. 01010
   ii. 1100111
   iii. 100
   iv. 0010110

   (i) ONLY

   (d) Which of the following regular expressions defines the same language as the finite automaton above? Hint: each of the correct choices uses component expressions. Some of these components are; the ways to get from A to D without going through D, from D to itself without going through D, from A to itself without going through A, etc.

i. ((01+10)(11)*0)*(01+10)(11)*
ii. ((01+10)(11)*0)*(01+10)
iii. ((01+10)0)*(01+10)(11)*
iv. (01+10)(11+(01+10)0)*



(i)

(e) Given a language, what would you do to achieve the following (briefly in at most one sentence):

i. To prove the language is regular

Draw a DFA/NFA for the language OR Write a regular expression for it.

ii. To prove the language is not-regular

Assuming the language is regular, use contradiction with the Pumping Lemma.

(f) Given an NFA that recognizes L, what would you do to transform the NFA for L into an NFA for $\overline{L}$

NFA for L $\Rightarrow$ DFA for L $\Rightarrow$ Flip final and non-final states in the DFA.

2. Answer only True/False.

(a) DFAs and NFAs are equivalent in their power to recognize a regular language. True

(b) All regular languages can be recognized using a finite amount of memory. True

(c) Given an NFA that recognizes L, to build an NFA to recognize the reverse of L, that is L^r containing every string of L in reverse, it suffices to swap the initial and final states and reverse all edges. False

(d) All regular languages are decidable. (That is the question *Does* $w \in L$, *when it is known that L is regular, is computable)* True.