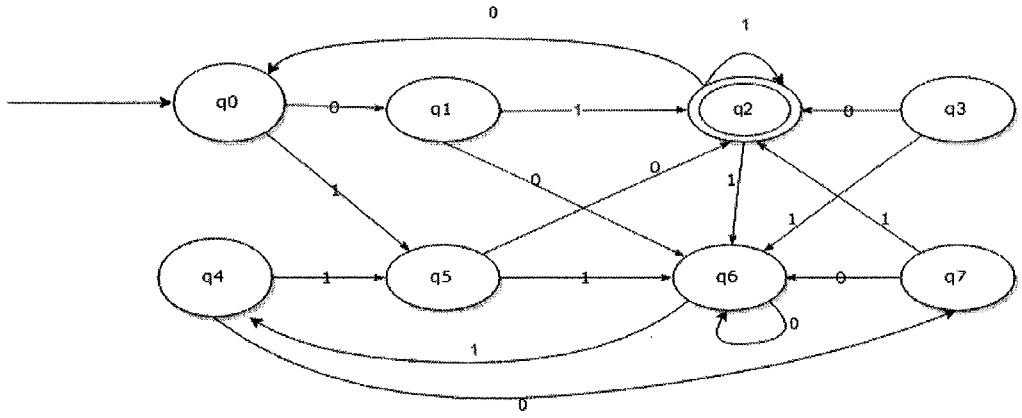
B.E COMPUTER SCIENCE AND ENGINEERING 3rd YEAR 1st SEMESTER EXAMINATION 2019

Formal Languages and Automata Theory

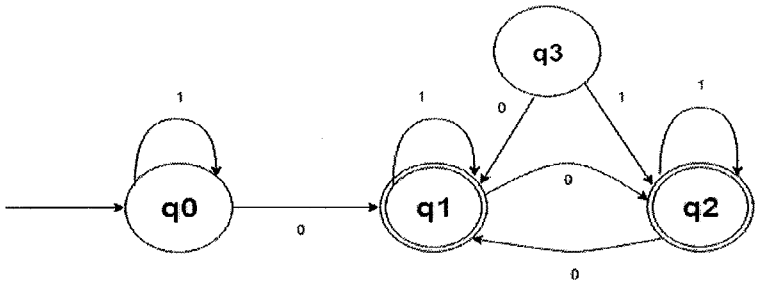
Time: 3 hours | Full Marks: 100

Answer All Questions

1.a) The transition diagram of a DFA is given below. Form the table of distinguishabilities for this automaton and give the transition diagram of the minimum state equivalent DFA.



b) Consider the following finite state automaton:



The language accepted by this automaton is given by the regular expression

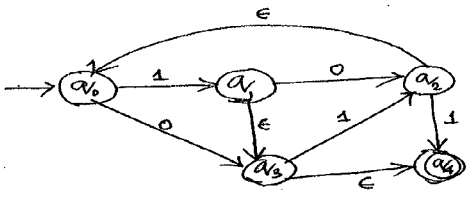
i) $1^*01^*01^*01^*$ ii) $(0+1)^*$

iii) $1^*0(0+1)^*$ iv) $1^*01^*01^*$

Justify your answer briefly.

OR

1.b) Convert the following ϵ-NFA to an equivalent DFA



18+7

2 State the Pumping lemma for regular languages. Prove that L = $\{w \in \Sigma^* \mid n_0(w) < n_1(w)\}$ is not regular, where n_0 and n_1 denote the numbers of 0's and 1's in w respectively and $\Sigma=\{0,1\}$.

5+10

3.a) How would you decide if a Regular language is empty, finite or infinite ?
b) Suppose h is the homomorphism from the alphabet {0,1,2} to the alphabet {a,b} defined by: h(0) = a; h(1)=ab; h(2)=ba. Suppose L is the language {ababa}, that is, the language consisting of only the one string ababa. What is $h^{-1}(L)$?

5+5

4.a) Design a Push Down Automat (PDA) to accept $L=\{a^n b^{m+n} c^m \mid m,n \geq 1\}$.
b) Prove that for every parse tree, there is a unique leftmost derivation and vice-versa.

7+8

5. State Pumping lemma for Context Free Languages (CFLs). Using Pumping lemma, prove that L= {ww | w in $\{0,1\}^*$} is not Context Free. Prove that CFLs are not closed under intersection.

5+6+4

6) Design a Turing Machine (TM) to decide if two binary positive integers A and B, represented in Unary, are equal, A>B or A<B.
Hints: In unary representation, each integer is represented with a string of as many 1's as the value of the integer. A 0 may be used as a separator between the two integers, placed over the tape of the TM as input. The TM, in each left to right scan, puts crosses on a pair of 1's on the two opposite side of the separator 0. In this process, if it finds no more 1's to cross out in the left side of the separator 0 then:
i) if no more 1 is found to cross out in the right side of the separator 0 then A=B
ii) if any 1 is left to cross out in the right side of the separator 0 then A<B
Otherwise, if after putting cross on a 1 in the left side of the separator 0, no matching 1 is found to cross out in the right side then A>B.

Or

6) Define a Universal Turing Machine (UTM). Discuss how a UTM can be implemented with a multi tape Turing Machine. State Halting Problem for Turing Machines. Prove undecidability of Halting Problem.

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