Fall 2017

SABANCI UNIVERSITY
Faculty of Engineering and Natural Sciences
CS 302 Automata Theory

Final Examination

Closed (Book+Notes+All Electronic Devices)

Duration : 150 minutes

Q1	
Q2	
Q3	
Q4	
Total	

Question 1 (*25* points)

(a) *(8 pts)* State the full definition of a ***nondeterministic finite automaton*** *(NFA)*, ***A = (Q, Σ, δ , s, F)*** including the *extended transition function* ***δE*** and the condition for a string ***u∈Σ**** to be accepted by ***A*** *(in your definition the domain and range of the transition functions* ***δ*** *and* ***δE*** *should be explicitly and clearly specified)*.

(b) *(5pts)* Construct an *NFA* ***A*** with at most ***3*** states that accepts the *regular expression* ***E*** = ***(1+0)*.1.(1+0)*** interpreted as a language.

(c) *(6 pts)* Construct a *DFA* ***B*** that accepts the language ***E*** in part ***(b)***.

(d) *(6 pts)* Construct a *minimal state DFA* ***C*** that accepts the language ***E*** in part ***(b)***.

Question 2 (*25* points)

(a) *(9 pts)* Specify, clearly and with all the details, a *context-free grammar (CFG)*, ***G = (V, T, R, S)*** that generates the set of *all* ***regular expressions*** over some finite set $\boldsymbol{\Sigma}$.

(b) *(8 pts)* Write down a regular expression ***E*** over the set ***{0,1}*** corresponding to the language ***L*** where for each string ***u*** in ***L*** , ***010*** OR ***101*** is *substring* of ***u***.

(c) *(8 pts)* Sketch an ***NFA*** that accepts the language ***L*** in part ***(b)*** above .

Question 3 (*25 points)*

(a) *(7 pts)* State clearly the *definition* of a *PDA* ***P*** accepting a language ***L*** by *final state* ***(L(P))*** ; and by *empty stack* ***(N(P))*** .

(b) *(10 pts)* Compute a *PDA* ***P*** that accepts the language

$L = (\omega \in (0+1)^* \mid \#1\text{s} = \#0\text{s in } \omega)$

(c) *(8 pts)* Is your ***PDA*** a deterministic ***PDA (DPDA)*** ? If not try to modify it so that it is a ***DPDA***.

Question 4 (*25* points)

Consider the language $\boldsymbol{L = (\omega \in \{a,b,c\}^* /\ \omega = a^{k+1}b^k c^{k-1}\ ;\ k > 0\ )}$

(a) *(15 pts)* Choosing a appropriate $\boldsymbol{\omega \in L}$ *(if you do not show explicitly your choice of* $\boldsymbol{\omega}$ *you get NO credit !)* and using the *pumping lemma* show that $\boldsymbol{L}$ is NOT a *context-free language*.

(b) *(10 pts)* Compute a ***2***-tape *NDTM* TM ***M*** that decides $\boldsymbol{L = (\omega \in \Sigma /\ \omega = uvu\ ,\ u,v \in \Sigma^*,\ u \neq e)}$