

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Date: 09-02-2018

Time: 60 min

Full marks: 30

No. of students: 11

Spring Semester Class Test 1, 2017/18

Dept: *Comp. Sc & Engg.*

Sub No: CS60060

M.Tech (Elective)

Sub Name: **Formal Systems**

Instructions: *Answer all questions.*

1. For each of the following, indicate True/False. For those that are false, indicate a word which distinguishes the LHS from the RHS: [4 x 2 marks]

Statement	True/False	Word
$(E_1+E_2).F^\omega \equiv E_1.F^\omega + E_2.F^\omega$		
$E.(F_1+F_2)^\omega \equiv E.F_1^\omega + E.F_2^\omega$		
$E.(F.F^*)^\omega \equiv E.F^\omega$		
$(E*.F)^\omega \equiv E*.F^\omega$		

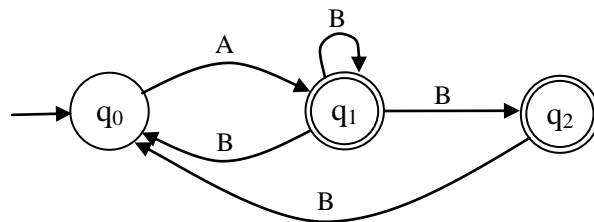
Where E, E_1, E_2, F, F_1, F_2 are arbitrary regular expressions with $\epsilon \notin \mathcal{L}(F) \cup \mathcal{L}(F_1) \cup \mathcal{L}(F_2)$.

2. Complete the following statements: [1+1+2 marks]

- a. A linear time property P is a liveness property whenever $\text{pref}(P) =$ _____
- b. A linear time property P is a safety property iff $\text{closure}(P) =$ _____
- c. The expansion law for the Until operator of LTL states that :

$\varphi_1 \mathbf{U} \varphi_2 \equiv$ _____

3. Draw the NBA for the following GNBA, where $F = \{q_1, q_2\}$. [6 marks]



4. Draw the GNBA for the LTL property $\varphi = (a \wedge \neg b) \mathbf{U} ((\neg a) \mathbf{U} b)$. Clearly specify the elementary sets of formulas, the set of sets of final states, the initial states, and the labels on the transitions of the GNBA. [12 marks]