



COMSATS UNIVERSITY ISLAMABAD (CUI)

DEPARTMENT OF COMPUTER SCIENCE

TERMINAL EXAMINATION SPRING-2024

Class: B.S.(C.S.) - 4th Semester

Subject: CSC312-Theory of Automata

Instructor: Taimur Shahzad

Dated: 5th June, 2024

Time Allowed: 180 Minutes

Maximum Marks: 50

- All questions are self-explanatory and require no further explanations during exam time.
- Make sure that you have signed the attendance sheet before leaving the examination room.
- Attempt all questions.

Question No.01:

[Marks= 5+5]

- Differentiate between Kleen Star Closure and Positive Closure with a suitable example.
- Whether Halting Problem is Decidable or Undecidable? Justify your answer by proving it.

Question No.02: Give pushdown automata that recognizes the following languages. Give both a drawing and 6-tuple specification for each PDA:

[Marks= 5+5]

- $L_1 = \{a^i b^j c^k \mid i, j, k \geq 0 \text{ and } i + j = k\}$.
- $L_2 = \{ab^n acab^n a \mid n \geq 0\}$.

Question No.03: Design a Finite Automata and Language of given Regular Expressions. [Marks= 2+2+2+2+2]

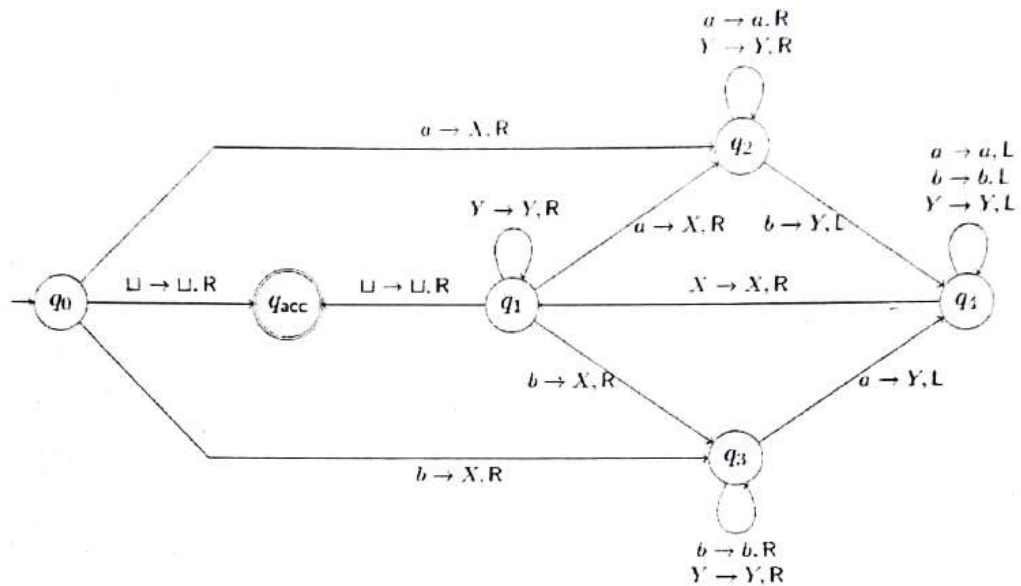
- $E_1 = a(a+b)^*$
- $E_2 = (a(a+b)^*b) + (b(a+b)^*a)$
- $E_3 = (a(a+b)^*a) + (b(a+b)^*b) + a + b + \epsilon$
- $E_4 = (a+b)^*a(a+b)^*$
- $E_5 = (a+b)^*a$

Question No.04: Let $T = \{0, 1, (,), \cup, *, \emptyset, \epsilon\}$. We may think of T as the set of symbols used by regular expressions over the alphabet $\{0, 1\}$; the only difference is that we use ϵ for symbol ϵ , to avoid potential confusion in what follows.

[Marks= 3+3+4]

- Your task is to design a CFG G with set of terminals T that generates exactly the regular expressions with alphabet $\{0, 1\}$.
- Using your CFG G , give a derivation and the corresponding parse tree for the string $(0 \cup (10)^*1)^*$.
- Your task is to design a CFG G with set of terminals T that generates exactly the regular expressions with alphabet $\{0, 1\}$.

Question No.05: Consider the following Turing Machine M with input alphabet $\Sigma = \{a, b\}$. The reject state q_{rej} is not shown, and if from a state there is no transition on some symbol then: [Marks= 3+3+4]



As per our convention, we assume it goes to the reject state.

- Give the formal definition of M as a tuple.
- Describe each step of the computation of M on the input **baabab** as a sequence of instantaneous descriptions.
- Describe the language recognized by M . Give an informal argument that outlines the intuition behind the algorithm used by M justifies your answer.

Best of Luck