National University of Computer & Emerging Sciences, Karachi
Spring-2022 CS-Department
Mid-II Exam
22nd of April, 09:30 am – 10:30 am

Course Code: CS3005	Course Name: Theory of Automata
Instructor Name: Mr. Musawar Ali, Ms. Bakhtawar Abbasi	
Student Roll No:	

Instructions:

- Return the question paper.
- Attempting of the question in the given order is highly encouraged.
- Read each question completely before answering it. There are **4 questions on 2 pages.**
- In case of any ambiguity, you may make assumption. But your assumption should not contradict any statement in the question paper.
- **Show full steps and provide appropriate reasons wherever possible to get full credit.**

Time: 60 minutes. **Max Marks: 35 points**

Question 1: DFA Minimization and Kleen's Theorem. (CLO2) **(4+4+4) Points**

a. Minimize the DFA using any method of your choice mentioned in **Figure1**.
b. Find the concatenation of **DFA2** mentioned in **Figure2** and **DFA3** mentioned in **Figure3** using Kleen's Theorem. The resultant **DFA** should be **DFA2.DFA3**.
c. Draw the **DFA** for RE $((a+b)a)^* + \lambda$ and find the closure of resultant **DFA**.

Question 2: Properties of Regular Languages. (CLO2) **(2+2) Points**

a. Find the reverse of **DFA2** mentioned in **Figure2.**
b. Find the union of **DFA2** mentioned in **Figure2** and **DFA3** mentioned **Figure3.**

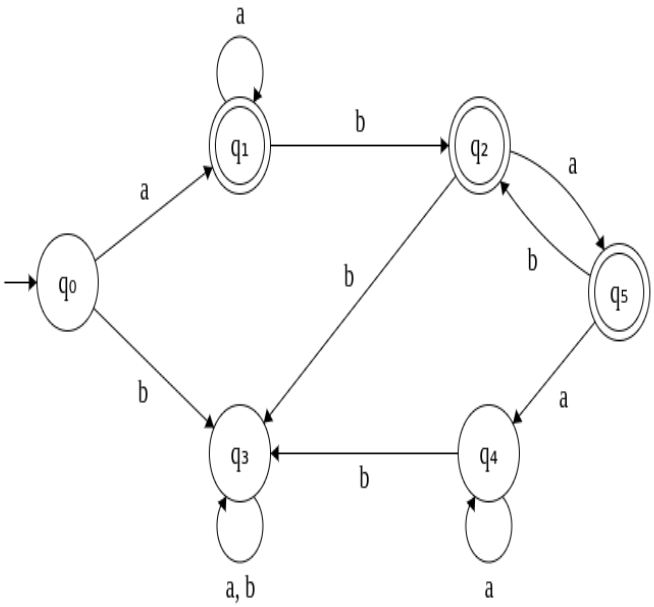


Figure1: DFA 1

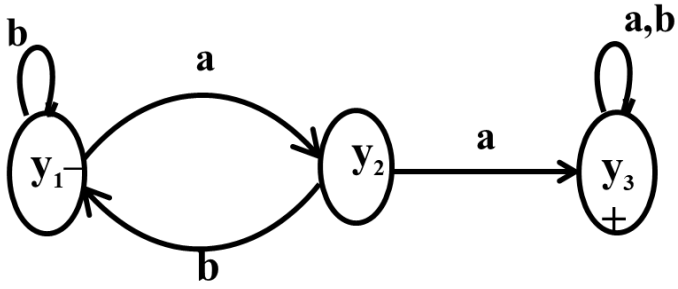


Figure2: DFA 2

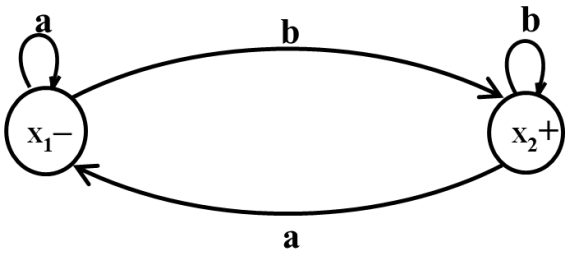


Figure3: DFA 3

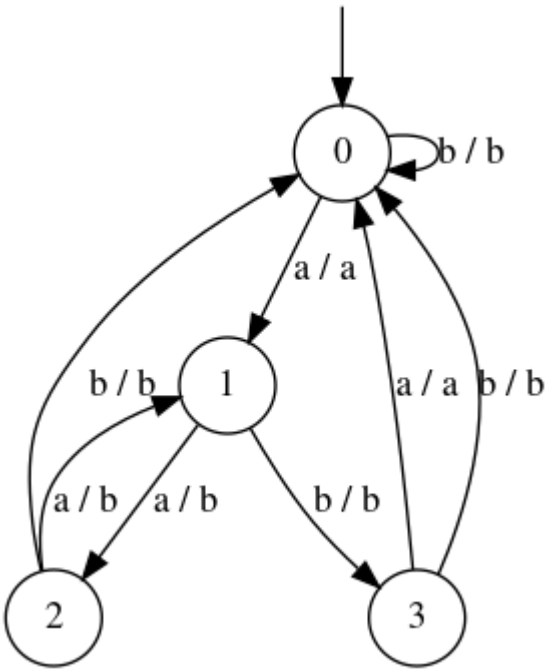
Question 3: **Pumping Lemma, CFG and RG. (CL03)** **(4+9+3) Points**

a. Apply Pumping Lemma on languages **L1** and **L3** to prove that these are not regular languages.
b. Write down the CFG/RG for the languages **L1**, **L2** and **L3**.
c. Draw the derivation trees for word **abbc** from CFG/RG of **L1, abab** from CFG/RG of **L2** and **aabbbbbbbbbb** from CFG/RG of **L3.**

(i) $L1 = \{a^n b^{n+m} c^m : n, m \geq 0\}$ **(ii)** $L2 = \{(ab)^{2n} : n \geq 0\}$ **(iii) L3 =** $\{a^n b^{2n+6} : n \geq 0\}$

Question 4: **Moore and Mealy Machine. (CLO4)** **3 Points**

Convert the following mealy machine in equivalent Moore machine.



Good Luck