Final Assessment Test (FAT) - APRIL/MAY 2023

Programme	B.Tech		
Course Title	THEORY OF COMPUTATION	Semester	Winter Semester 2022-23
		Course Code	BCSE304L
Faculty Name	Prof. SURESHKUMAR WI	Slot	D2+TD2
Time	3 Hours	Class Nbr	CH2022235000710
		Max. Marks	100

PART-A (10 X 10 Marks)
Answer All questions
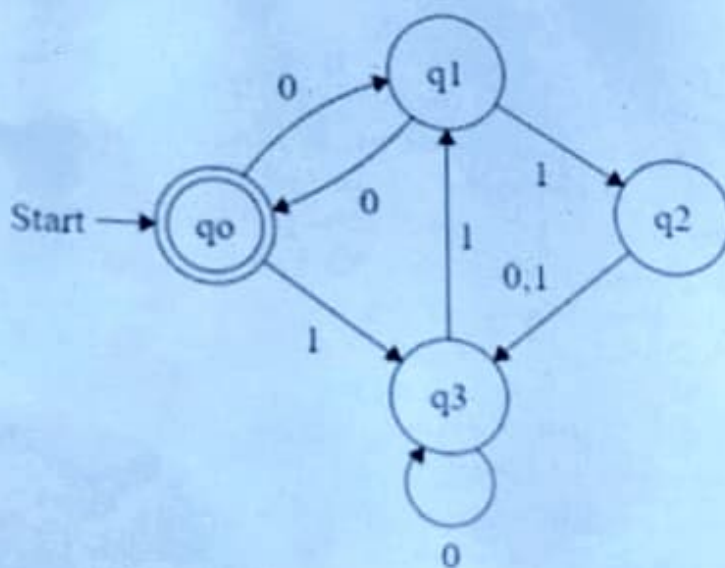
01. Construct an equivalent non-deterministic finite automaton without null moves for the automaton ({q0, q1, q2, q3, q4}, {a, b} U ε, δ, q0, {q4}) given below. **[10]**
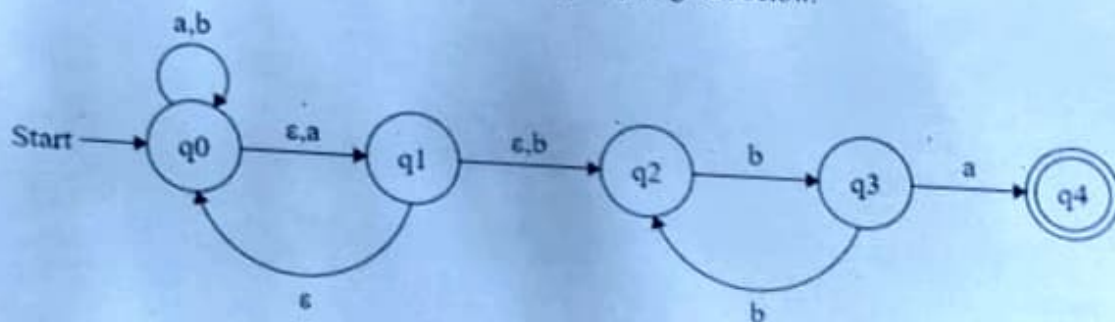
02. Construct the regular expression that generates all the strings accepted by the automaton ({q0, q1, q2, q3}, {0,1}, δ, q0, {q0}) given below. Give the stepwise solution. **[10]**
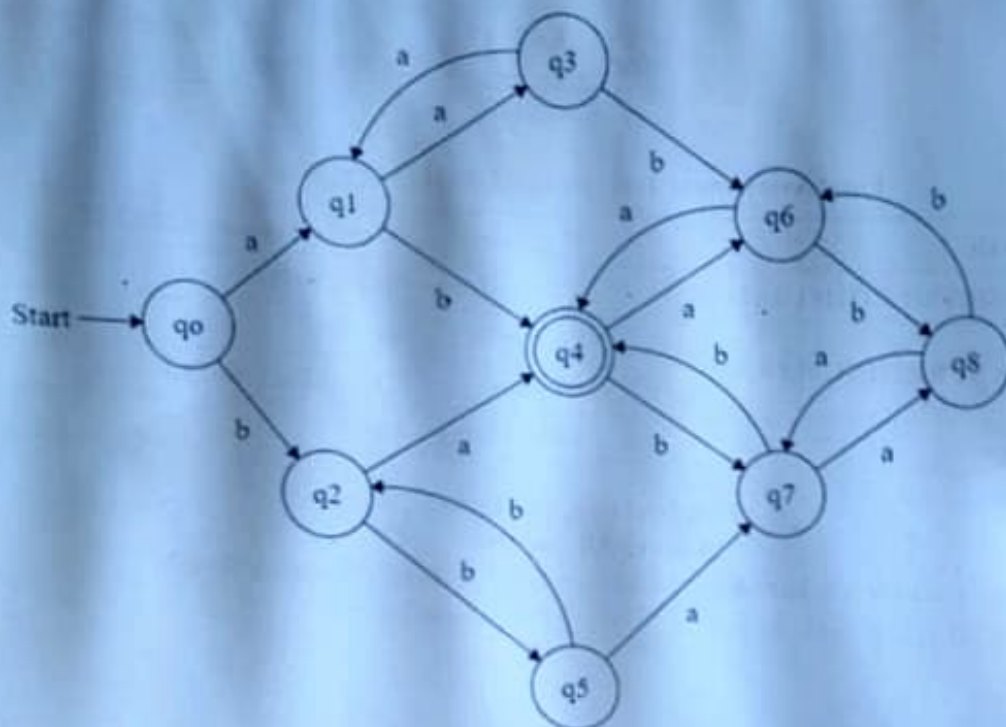

03. Consider the language, $L = \{e^3 a^n b^p e^2 e^m \mid$ either $n > p$ or $p > m$, where $n, p, m > 0\}$
   a. Construct a context-free grammar G1 for the given language. (5 marks) **[10]**
   b. Convert G1 into Chomsky Normal Form (CNF). (5 marks)

04. Construct a minimized Deterministic Finite Automaton for the automaton given below. **[10]**

05. Prove whether the following languages are Context-Free or not. [10]
   a) $L = \{a^i b^j \mid j = 2*i-2 \text{ and } i > 1\}$ (5 marks)
   b) $L = \{a^n b^m \mid m = 2^n, n > 0\}$ (5 marks)

06. Given the following Context Free Grammar, $G1 = (\{S, P, Q, X, Y\}, \{0,1\}, P, S)$ with the set of productions P, [10]

   $S \rightarrow YP \mid XQ$
   $P \rightarrow XS \mid YPP \mid 0$
   $Q \rightarrow YS \mid XQQ \mid 1$
   $X \rightarrow 0$
   $Y \rightarrow 1$

   Convert the above given CFG G1 in a suitable form and validate the string "01110" using Cocke Younger Kazami (CYK) parsing technique and comment on the result.

07. Children's day celebration was conducted in a school. The school conducted Treasure Hunt [10] where chocolates are the treasure to be found. Father, mother and child will play as one team. The winner will be chosen based on the chocolates collected. Each team should surrender the chocolates to the judge in the following fashion. First, the father should surrender the chocolates, then the mother and finally the child. The team is considered a winner if the number of chocolate collected by the father is more than that of the child.
   a) Define the context-free language L for the above problem. (2 Marks)
   b) Design a Pushdown Automaton (PDA) that accepts L. (6 Marks)
   c) Justify the PDA design accepts the strings in L. (2 Marks)

08. In a school sports day event, a gymnastic event is planned to be conducted. The participants for [10] the event are the students of class 6th, 7th, 9th and 11th standard. The Physical Education Department has to form a team where 6th and 9th standard students' strengths will be equal and 7th and 11th standard students' strengths will be equal. The students should be arranged in an order of 6th standard students coming first followed by 7th standard students followed by 9th standard students and finally 11th standard students. For the given scenario, identify the type of grammar in Chomsky Hierarchy and provide a machine to validate the condition.

09. A music app categorizes songs into three genres namely classical, pop and country. The app **[10]** subscribers can download songs after selecting songs in a specific pattern. First, classical songs should be selected, then pop songs and finally country songs should be selected. The selected songs will be downloaded only if the number of classical songs selected are equal to the number of pop and country songs selected together.

The subscribers can select the songs in many ways subject to the above restrictions.

For example:

(i) 3 classical, 2 pop and 1 country songs

(ii) 7 classical, 3 pop and 4 country songs, etc

are some selection patterns where the subscribers can download the selected songs

a) Express 'all the selection patterns where the subscribers can download the selected songs' as a language L. (2 marks)

b) Design a Turing Machine M that will recognise language L. (6 marks)

c) Justify that the Turing Machine M accepts the song selection pattern defined in L. (2 marks)

10. State whether the instances of the Post Correspondence Problem have a solution. The following **[10]** are the instances with $\Sigma = \{a, b\}$

List A	List B
b	ba
baa	aab
ba	bab
bba	b
bba	ba