VIT

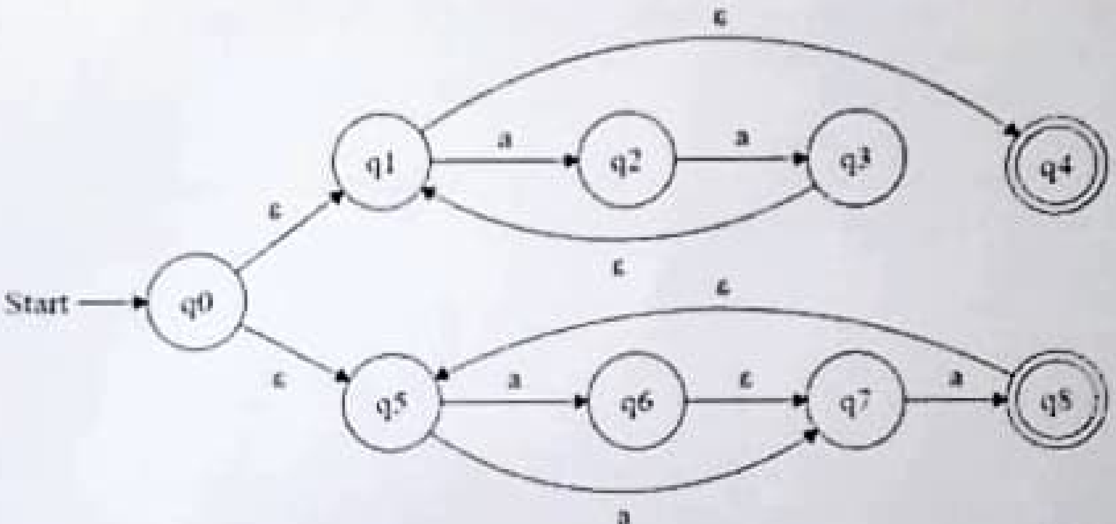
Reg. No. :

Final Assessment Test (FAT) - APRIL/MAY 2023

Programme	B.Tech	Semester	Winter Semester 2022-23
Course Title	THEORY OF COMPUTATION	Course Code	BCSE304L
Faculty Name	Prof. X Anita	Slot	D1+TD1
		Class Nbr	CH2022235000690
Time	3 Hours	Max. Marks	100

Section A (10 X 10 Marks)
Answer All questions

01. Convert the finite automaton ({q0, q1, q2, q3, q4, q5, q6, q7, q8}, {a} U ε, δ, q0, {q4, q8}) to a non-deterministic finite automaton without NULL moves. [10]



02. a) Design a regular expression for the language containing the set of all strings in $\Sigma = \{0,1\}^*$ having no more than three 0's. (3 Marks) [10]

b) Design a non-deterministic finite automaton that accepts all strings generated by the regular expression in question 2(a). (3 Marks)

c) Construct an equivalent grammar for the NFA designed in question 2(b). (4 Marks)

03. A fruit juice shop owner instructs his employees to buy apples, bananas, kiwis, and watermelons from a wholesale market and also instructs them to arrange fruits in the bag such that the watermelons are at the bottom and on top of the watermelons the apples are placed, over the apples, the kiwis are placed, and finally, over the kiwis, the bananas are placed to protect from smashing. The number of bananas bought should be thrice that of watermelons and the number of apples should be twice the count of kiwis. The owner wants to check whether the arrangement and count made by the employees are the same using a machine. [10]

a) Determine the Context-Free Language, L (2 Marks)

b) Design a Push-Down Automata accept L in question 3(a). (8 Marks)

Q4 [10]

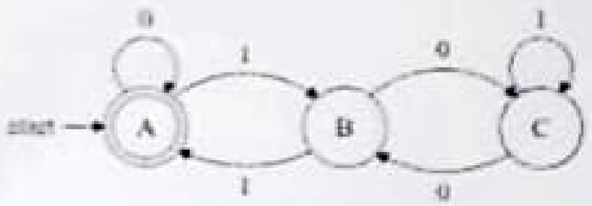


Figure 1: M1

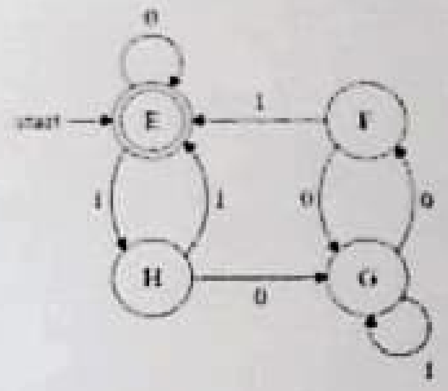


Figure 2: M2

a) Using the equivalence method test whether the two given finite automata M1 & M2 are equal or not. (5 Marks)

b) Identify the Regular Expression for machine M1, and show the process. (5 Marks)

Q5. Prove that the following languages are regular or not. **[10]**

a) $L = \{W \mid W \in \{a,b\}^*$ and $|w|_a = 2, |w|_b = 2\}$ (5 marks)

b) $L = \{0^i 1^j 2^{i+j} \mid i,j \geq 0\}$ (5 marks)

NOTE: $|w|_a$ means the number of a's in the word w. $|w|_b$ means the number of b's in the word w.

Q6. Given the following Context Free Grammar. $G1 = (\{S, T, X, Y, Z\}, \{0,1\}, P, S)$ with the set of productions P. **[10]**

$S \rightarrow 1 S 1 \mid T \mid Z$

$T \rightarrow 1 X 1 \mid X$

$X \rightarrow 0 X 0 \mid 1$

$Y \rightarrow 0 Y 0 \mid 1 Y 1 \mid \epsilon$

Derive an equivalent grammar G2 in Greibach Normal Form.

Q7. $L = \{a^i b^j c^{k+i}\, zz\, d^n e^m f^p \mid i,k > 0,\ j > 2,\ n,m > 0,\ p = 2+m\}$ **[10]**

a) Write down the Context Free Grammar G1 for the above-given language L. (6 marks)

b) Take a sample string which gets accepted to the language, and validate the string using the identified grammar G1 through Left Most Derivation (LMD). (4 marks)

Q8. Design a Turing machine acceptor to validate the string for the language $L = L1 \cup L2$ where **[10]**

$L1 = \{WxW^c \mid W \in \{0,1\}^*$ and W^c is the complement of w\}.

$L2 = \{W \mid W \in \{a,b\}^+$ and $|W|_a = |W|_b\}$.

NOTE: W is 010 then, W^c is 101.

$|W|_a$ is the number of a's in W

$|W|_b$ is the number of b's in W

Q9. Design a Turing machine for the language. **[10]**

$L = \{W \mid W \in \{a,b\}^+$ W is a palindrome\}.

The Turing machine should write the output as 'X' for the even length palindrome; if the string is of odd length and the middle symbol is 'a' output 'Y' else output 'Z' on the tape.

10. State whether the instances of the Post Correspondence Problem have a solution. The following are the instances with $\Sigma = \{0,1\}$ [10]

List A	List B
01	101
100	00
110	1
0	01
001	11

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