

Reg. No.:

Name :



VIT

Vellore Institute of Technology
(Deemed to be University under section 3 of U.G.A. Act, 1956)

Continuous Assessment Test I – September 2023

Programme	: B.Tech (CSE) and its Specialization	Semester	: Fall Semester
Course Title	: Theory of Computation	Code	: BCSE304L
		Class Nbr(s)	: CH2023240100678 CH2023240100680 CH2023240100679
Faculty (s)	: Dr.T.Benil Dr. Jannath Nisha Dr. R. Rathna	Slot	: G1+TG1
Time	: 9.00 AM to 10.30 AM	Max. Marks	: 50 marks

Answer all the Questions

1. i) Prove that the sum of the first n positive integers is given by the formula using inductive proof. (7 marks)

$$1 + 2 + 3 + \dots + n = \frac{n(n+1)}{2} \text{ for } n \geq 1$$

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- ii) Consider a binary tree data structure where each node can have zero, one, or two children. Justify what type of induction and explain? (3 marks)
2. i) Imagine you are developing a social media platform, and you need to implement a username validation system. Usernames on your platform must adhere to certain rules:
- a) Usernames can consist of letters (both uppercase and lowercase), digits, and underscores.
 - b) Usernames must start with a letter.
 - c) Usernames can be at most 20 characters long.

Design an NFA that recognizes valid usernames according to the specified rules. Provide a detailed explanation of the states, transitions, and acceptance criteria in your NFA. Additionally, explain how the NFA processes a username input and determines whether it's valid or not. The NFA should accept valid usernames and reject invalid ones. (10 marks)

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- ii) Convert the obtained NFA into DFA (5 marks)

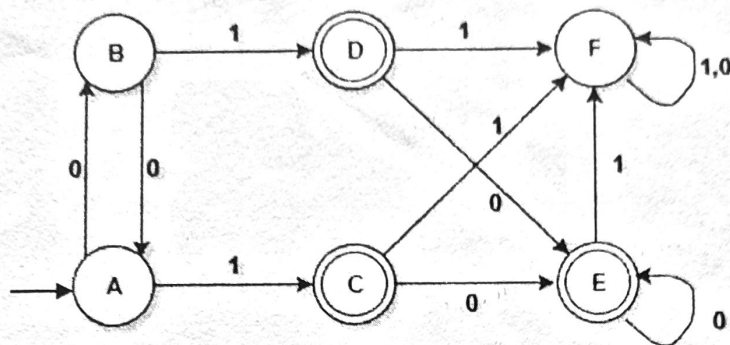
3.

i) Design an ϵ – NFA (Nondeterministic finite automaton) to recognize the language L, containing only binary strings of non-zero length whose bits sum to a multiple of 3.

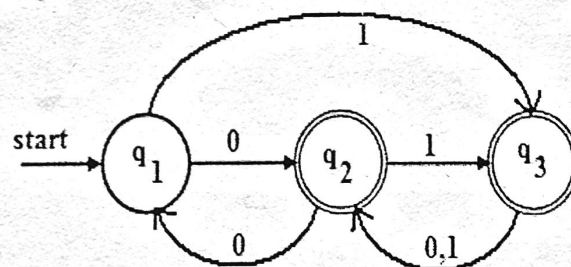
(5 marks)

ii) Explain the Myhill-Nerode theorem and demonstrate how to minimize a given DFA and detail the process of identifying equivalent states and creating a minimized DFA.(10 marks)

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4 Find the Regular expression for the set of all strings denoted by $R_{12}^{(2)}$ from the DFA given below.



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