

BACHELOR OF TECHNOLOGY (CBCS - 2023)
B. Tech. Sem-IV Information Technology : WINTER: 2025
SUBJECT: FORMAL LANGUAGES & AUTOMATA THEORY

Day : Tuesday
Date : 25/11/2025

W-29315-2025

Time : 10:00 AM-01:00 PM
Max. Marks : 60

NB :

1. Assume suitable data, if necessary.
2. Draw neat labelled diagrams WHEREVER necessary.
3. Figures to the right indicate FULL marks for the question.
4. All questions are COMPULSORY.

Q. 1 Design a NFA that accepts strings with an even number of a's over the alphabet {a, b}. (10)
Explain process stepwise.

OR

Q. 1 Design a DFA that accepts all BINARY strings representing numbers divisible by 3. (10)

Q. 2 Prove using algebraic identities that the regular expression: (10)

$$(a + b)^* a (a + b)^*$$

is equivalent to the set of all strings over {a, b} that contain at least one 'a'.

OR

Q. 2 Why is the pumping lemma a necessary but not sufficient condition for regularity? Provide (10)
an example of a language that passes the pumping lemma but is not regular (if such exists).

Q-3 Define ambiguous grammar. Give an example of an ambiguous grammar and show two (10)
different parse trees for the same string.

OR

Q. 3 Compare Type-2 (CFL) and Type-3 (Regular) grammars. Discuss their expressive powers (10)
and differences in terms of recognizers.

Q. 4 Design a PDA to accept the language $L = \{ a^n b^n \mid n \geq 0 \}$ by empty stack. Explain the (10)
transitions.

OR

Q. 4 List the limitations of PDA. Give examples of languages that cannot be accepted by any (10)
PDA.

Q. 5 Design a TM to decide whether the number of a's is equal to the number of b's in a string. (10)

OR

Q. 5 What is the significance of the Universal Turing Machine in the theory of computation and (10)
computer science?

Q. 6 Describe the role of context-free grammars in syntax analysis. How can PDAs and TMs simulate this? (10)

OR

Q. 6 Discuss the application of TMs in spell-checking and text formatting. Provide a simplified TM-based model. (10)

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