

Code No: 155BK

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, January - 2025

FORMAL LANGUAGES AND AUTOMATA THEORY

(Common to CSE, IT, ECM, ITE, CSE(CS))

Time: 3 Hours

Max. Marks: 75

**Note:** i) Question paper consists of Part A, Part B.

ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.

iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

**PART - A**

**(25 Marks)**

- 1.a) Define the term Finite State Machine. [2]
- b) What is the significance of the String and an alphabet in automata theory? [3]
- c) What is a Regular Expression? [2]
- d) Write the regular expressions for the language: The set of strings of 0's and 1's such that every pair of adjacent 0's appears before any pair of adjacent 1's. [3]
- e) What is a parse tree? Give an example. [2]
- f) How does CFG define a language? Give an example. [3]
- g) How do we compute the set of reachable symbols of a grammar? [2]
- h) Define the pumping lemma for CFL's. [3]
- i) What is a Turing Machine? [2]
- j) What are the properties of recursive languages? [3]

**PART - B**

**(50 Marks)**

- 2.a) Design a finite automaton that recognizes the language of all strings over the alphabet  $\{0, 1\}$  where the number of 1's is even and 0's is odd.
- b) Using the concept of finite automata, explain how a string can be accepted or rejected by deterministic finite automata. [5+5]

**OR**

- 3.a) Convert the following NFA to its equivalent DFA:

	0	1
$\rightarrow p$	$\{p, q\}$	$\{p\}$
$q$	$\{r\}$	$\{r\}$
$r$	$\{s\}$	$\emptyset$
$*s$	$\{s\}$	$\{s\}$

- b) What is the role of Transition diagram and table in Finite automata theory? Explain.

[5+5]

- 4.a) Write down the applications of Regular Expressions.  
 b) Convert the following regular expressions to NFA's with (epsilon) $\epsilon$ -transitions: [4+6]  
 i)  $(0+1)^*1(0+1)$ .      ii)  $11(0+1)^*$

5.a) Convert the following DFA to a regular expression:

	0	1
$\rightarrow q_1$	$q_2$	$q_3$
$q_2$	$q_1$	$q_3$
$*q_3$	$q_2$	$q_1$

- b) List and explain the closure properties of regular languages. [5+5]
- 6.a) Define Context free grammar. What are the key components in it?  
 b) Construct the PDA to the following grammar: [4+6]  
 $S \rightarrow AB$        $A \rightarrow BS/b$        $B \rightarrow SA/a$

- 7.a) Obtain a CFG to generate for the following:  
 i) unequal number of a's and b's.  
 ii) equal number of a's and b's followed by b.  
 b) Write down the applications of Context-Free Grammars and Push Down Automata. [5+5]

- 8.a) What is Greibach Normal Form (GNF)? How does it differ from CNF?  
 b) Consider the following Grammar:

$S \rightarrow AAA \mid B$        $A \rightarrow aA \mid B$        $B \rightarrow \epsilon$

- i) Eliminate  $\epsilon$ -productions  
 ii) Eliminate any unit production in the resulting grammar  
 iii) Eliminate any useless symbols in the resulting grammar  
 iv) Convert the resulting grammar into CNF. [4+6]

9. Explain in detail about Chomsky normal form with suitable example. [10]

10. Design a T.M for copying of information from one place to the other place. Make all the necessary assumptions. Give example of the working of your T.M. [10]

OR

- 11.a) What are Universal Turing Machines? Explain briefly about Turing reducibility.  
 b) Discuss briefly about decidability and undecidability problems. [5+5]