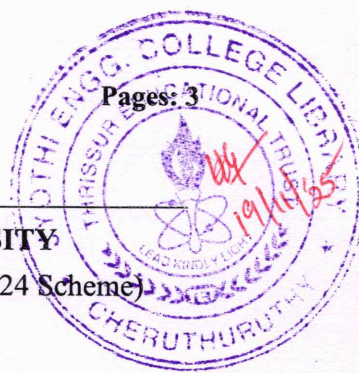


Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (R) (FT/WP) Examination November 2025 (2024 Scheme)

**Course Code: PCCST302****Course Name: THEORY OF COMPUTATION**

Max. Marks: 60

Duration: 2 hours 30 minutes

PART A*(Answer all questions. Each question carries 3 marks)*

CO Marks

- | | | | |
|---|---|-----|-----|
| 1 | Define an alphabet, string and language with suitable examples. | CO2 | (3) |
| 2 | A vending machine has three buttons: A, B, and C. Customers can press the buttons in any order and any number of times. The machine will give the product only if at least once in the whole button sequence, button A is pressed and immediately after that button B is pressed (the pattern "AB" must appear). Design a DFA for this machine. | CO2 | (3) |
| 3 | A programmer claims a Regular Expression, $RE = (ab)^*$ for generating a language $L = \{a^n b^n \mid n > 1\}$. State whether the claim is true or false. Justify your claims with sample strings. | CO2 | (3) |
| 4 | Write a Context-Free Grammar (CFG) for the language with equal number of 0's and 1's. | CO3 | (3) |
| 5 | Prove that Context Free Languages are not closed under intersection and complement. | CO3 | (3) |
| 6 | Convert the following grammar to Chomsky Normal Form.
$S \rightarrow aSb \mid ab$ | CO3 | (3) |
| 7 | A programmer claims that every TM is guaranteed to halt eventually. Explain contradiction using the reasoning with halting problem of Turing Machine. | CO5 | (3) |
| 8 | Explain Chomsky's hierarchy of languages. List the four types of grammars and their respective machines. | CO1 | (3) |

PART B

(Answer any one full question from each module, each question carries 9 marks)

Module -1

- 9 a) In a login system, a user must enter password with binary digits containing **11** as a substring. CO2

(5)

i) Design an NFA for the above set of strings.

ii) Convert the NFA to the equivalent DFA.

(4)

- 10 a) Given below, the transition table of a DFA, M. Assume that q_0 is the start state and q_3 is the final state. CO2

State	a	b
q_0	q_1	q_3
q_1	q_2	q_3
q_2	q_2	q_2
q_3	q_1	q_3
q_4	q_4	q_4

i) Write the regular language $L(M)$.

(2)

ii) Write the Regular Expression of the language L.

(2)

iii) Find the equivalent minimum state DFA from the given DFA.

(5)

Module -2

- 11 a) Convert the Regular Expression $(0+1)^*01$ into equivalent FA. CO2 (5)

- b) State and prove any two closure properties of Regular Languages. CO1 (4)

- 12 a) It is claimed that the language $L = \{ww \mid w \in \{a,b\}^*\}$ is regular because it is simple to recognize. What is your claim, True or False. CO2 (5)

Prove your claim using pumping lemma.

- b) Generate the string $a + a * a$ using this grammar, $S \rightarrow S + S \mid S * S \mid a$. CO2 (4)
Check whether the grammar is an ambiguous grammar or not.

Module -3

- 13 a) i) List the differences between DPDA and NDPDA. CO3 (3)
- ii) Explain why checking whether an input is a palindrome
 $(L = \{ww^R \mid w \in \{0,1\}^*\})$ requires a nondeterministic PDA. (2)
- iii) Design a NPDA for the language L. (4)
- 14 a) Design a PDA for the Compiler that validates nested symbols in the following style. $\{ [()] \}$. CO3 (5)
- b) Convert the given grammar to Greibach Normal Form (GNF). CO3 (4)
- $S \rightarrow A B \mid b$
- $A \rightarrow a A \mid \epsilon$
- $B \rightarrow b B \mid a$

Module -4

- 15 a) Design a Turing Machine that accepts all binary strings starting and ending with the same symbol. CO4 (6)
- b) A Turing Machine simulates multiple machines by interleaving their steps. Each simulated machine runs on its own encoded input within the same tape. CO4 (3)
- i). What kind of Turing Machine is this?
- ii). What theoretical concept does this illustrate?
- 16 a) Design a Turing machine that should replace every 0 with 1 and every 1 with 0 in a binary string. Illustrate the working of TM with the IDs for the string 1101. CO4 (6)
- b) A machine accepts palindromes by using two tapes, one reads the input left-to-right, another, right-to-left, and compares symbols. What type of Turing Machine is it, and why might it be more efficient than a single-tape machine? CO4 (3)
