D/E/TZ

Reg. No:

Final Assessment Test – April 2026

VIT® Vellore Institute of Technology

Course: **BCSE304L - Theory of Computation**

Class NBR(s): **1218/1231/1234/1237/1240/1242/ 1247/1249/1251/1255/1257/1259/1261/1267/1271/ 1280/1306/1309/1315/1317/3881/4006/4007/6647/ 6648**

Slot: **E1+TE1**

Time: **Three Hours**

Max. Marks: **100**

- **KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

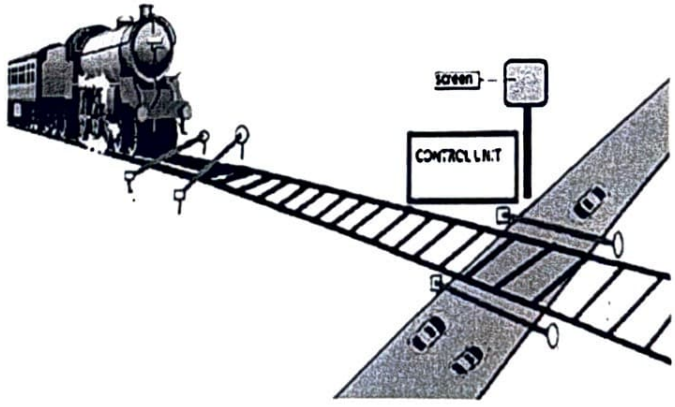
COs	CO Statements
CO1	Compare and analyze different computational modes.
CO2	Apply formal mathematical methods to prove properties of languages, grammar and automata.
CO3	Identify limitations of some computational models and possible methods of proving them.
CO4	Represent the abstract concepts mathematically with notations.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions
(10 X 10 = 100 Marks)

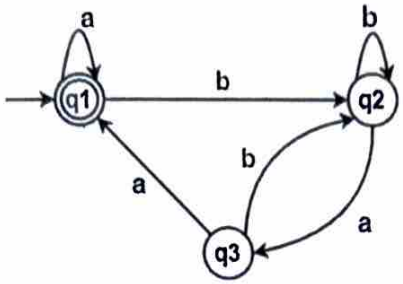
1. Let the alphabet, Σ = {a, b} **CO4 BL1**
   Find the following:
   a) List all strings of length ≤ 2 over Σ.
   b) L^* and L^+
   c) Find the number of strings of length 3 over Σ.
   d) Write two examples of strings that belong to Σ^*.

2. Design a Finite State Machine for an Unmanned Railway crossing gate as shown in the figure below: **CO1 BL3**



The unmanned Railway crossing gate will be automatically performing the following operations like opening, opened, closed and closing state based on the signal received from main control system. Assume that the start state is open and the final state is closed. Your design must consider all possible cases / conditions, and you must define the inputs and the states relevant to real-world unmanned railway crossing gate scenario. Ensure that your design will satisfy the above-mentioned critical problem statement.

3. Derive a regular expression from the given deterministic finite automata using Arden's theorem. **CO2 BL3**



4. Give a regular expression for the following language L? **CO2 BL4**

   a) $L = \{w \mid w \in \{a, b\}^*$ where every occurrence of "a" is followed by a "b"$\}$.

   b) Give the strings accepted by the language L.

   c) Construct a DFA for the above given language.

5. Convert the given Non-Deterministic Finite Automata to a Deterministic Finite Automata? **CO1 BL3**

   Note: Q0 -start state and Q1-final state

State/Inputs	a	b
→Q0	Q1,Q2,Q3	Q2,Q3
Q1*	Q1,Q2	Q2,Q3
Q2	ϕ	Q3
Q3	Q4	Q2,Q3,Q4
Q4	ϕ	ϕ

6. Give the grammar to generate the context-free language $L = \{a^i b^j c^k \mid i, j, k \geq 0$ and either i = j or j = k$\}$. Check whether the generated grammar is ambiguous or not. If your answer is **Yes** or **No**, justify your answer. **CO3 BL2**

7. Using Cocke-Younger-Kasami Algorithm check whether the string 000111 is a member of the L(G) defined with the Grammar Rules **CO3 BL3**

   P: S→ ε | AB | XB; Y→AB | XB; X → AY; A→0; B→1

8. Design a Push-Down Automata that accept the language $L=\{ww^R \mid w \in (a, b)^+\}$ with empty stack. Validate your design by using "the strings abba and aaba" and give the instantaneous description to match your design. **CO1 BL3**

9.a) Construct a Turing machine that accept the language $L = \{a^{2^n} \mid n \geq 0\}$. Give the Instantaneous description of the string "aaaa" to verify the correctness of your design. **CO1 BL3**

OR

9.b) Construct a Turing machine that perform the division operation using unary representation numbers? **CO1 BL3**

Input format: 111111011 (6 ÷ 2)
Output format: 111 (Result : 3)

10.a) Prove that the given languages L1 & L2 are closure under recursive language closure properties such as Union, Intersection, Concatenation and Kleene star **CO2 BL2**

$L_1 = \{ 1^n2^n3^n \mid n >= 0\}$ and
$L_2 = \{4^m5^m6^m \mid m >= 0\}$

OR

10.b) Explain post correspondence problem and determine whether the given lists have the Post Correspondence Problem solution or not. **CO2 BL2**

List A	List B
110	110110
0011	00
0110	110

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