REG.NO.: 24MIDD0185

SLOT: D2+TD2

VIT

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
CONTINUOUS ASSESSMENT TEST - II
FALL SEMESTER 2025-2026

Programme Name & Branch	**: M.Tech. (Integrated) – MIC, MID**
Course Code and Course Name	**: CSI1003 – Formal Languages and Automata Theory**
Faculty Name(s)	**: Prof. G Rajarajan, Prof.V Vijayarajan , Prof. R Kannadasan**
Class Number(s)	**: 2465, 2466, 2468**
Date of Examination	**: 08.10.2025 - ForeNoon**
Exam Duration	**: 90 minutes** **Maximum Marks: 50**

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- CO1: Model, compare and analyse different computational models
  CO2: Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.
  CO3: Identify limitations of some computational models and possible methods of proving them

Q. No	Question	Marks	CO	BL
1.	a) Let us assume L1 and L2 are Regular Sets. There is an operation called "connect" which connects languages and it is defined as $\{m_a p_k, m_b p_{k-1}, m_c p_{k-2}, \ldots \cdot m_{k-1} p_b, m_k p_a \mid m_a, m_b, m_c, \ldots, m_{k-1}, m_k \varepsilon L1$ and $p_k, p_{k-1}, p_{k-2}, \ldots p_b, p_a \varepsilon L2\}$. As L1 and L2 are Regular (as per assumption), will they be closed under the operation "connect"? Justify your answer.	5	2	3
	b) Using pumping lemma of Regular language, either prove or disprove the following: L={ # ^{c} | where c is non-composite number over $\Sigma = \{\#\}$ } is not a Regular Set.	5		
2.	a) Let L= {$a^n b^n$ | n>0} is a Context Free Language. Tell whether the grammar generating this language L is inherently ambiguous or unambiguous? If so, brief the difference between the unambiguous language and inherently ambiguous language.	4	3	4
	b) Convert the following into CNF: S→ 0X1X X→ 1X | 0Y | € Y→ 2 | X NOTE: € means epsilon (empty string) and S is the start Symbol and terminal set = {0,1,2}. Also, find the number of derivations required to derive a valid string whose length is 1000, from your resultant CNF.	6		

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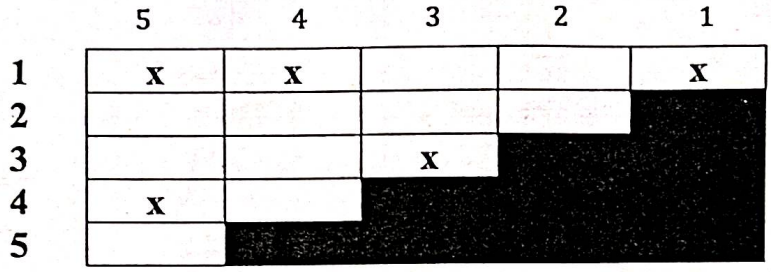
3.	Use CYK algorithm and check the membership of "baaba" and infer the following table containing cells marked 'X' are True or False for the given grammar. (S is the start symbol of Grammar) S→AB | BC A→BA | a B→CC | b C→AB | a  • The cell (1,1) indicates the substring "b" is also member of this Grammar. (True / False) ? • The cell (4,5) indicates the substring "ba" can be derivable from S . (True / False) ? • The cell (1,5) indicates the string "baaba" is derivable from the given grammar. (True / False) ? • The cell (1,4) indicates the substring "baab" cannot be derivable from the start symbol of grammar (True / False)? • The cell (3,3) indicates the substring "a" satisfies the membership of grammar (True / False) ?	10	3	4
4.	Design PDA that recognizes the following language $L=\{ i^p j^q k^r l^s \mid p,q,r,s >0$ and p=s over $\Sigma = \{ i, j, k, l \} \}$. Also verify the strings "iijkll"and "ijjkkl" using instantaneous descriptions of PDA	10	1	3
5.	Let $L=\{\alpha\beta \mid \alpha \varepsilon \{0,1\}^+$ and β *is exact copy of* $\alpha\}$ **Statement 1:** Deterministic Pushdown Automata (DPDA) can be designed for the given language and in fact Non-deterministic Pushdown Automata (NPDA) can also be designed for the same. **Statement 2:** DPDA is not at all possible to design and only Non-Deterministic Pushdown Automata is possible as the power of NPDA is more than DPDA **Statement 3:** This is a special case in which only DPDA can be designed, but not NPDA. **Statement 4:** Neither DPDA nor NPDA can be designed for the given language. Out of these 4 statements, which one is correct? Justify Properly with valid explanations or proof, examples to validate your claim.	10	1	5