REG.NO.:

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
WINTER SEMESTER 2024-2025

SLOT: F1+TF1

Programme Name & Branch	**: B.Tech, CSE**
Course Code and Course Name	**: BCSE304L – Theory of Computation**
Faculty Name(s)	: KANAGARAJ R, MADIAJAGAN M, SATHIYA KUMAR C, KARTHIK G M, BASKARAN P, PARTHASARATHY G, SARITHA MURALI, RAJARAJAN G , SHALINI L, UMA PRIYA D, BOOMINATHAN P, LAKSHMANAN K, BHAWANA TYAGI, BHUVANESWARI M, IYAPPAN P, ISLABUDEEN M, PRAKASH M, SATHYA K, ADRIJA BHATTACHARYA, DEBI PRASANNA ACHARJYA, K.KRISHNA RANI SAMAL,SUGANTHINI C
Class Number(s)	**: VL2024250501633, 1615, 1619, 1625, 1637, 1639, 1635, 1653, 1631, 1643, 1617, 1651, 1649, 1645, 1627, 1647, 1629, 1641, 1623, 1613, 1621, 1655**
Date of Examination	**: 21-Mar-2025, 2:00 PM – 3.30 PM**
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)

Q. No		Question	M	CO	BL
1.	a)	Prove that the language $L = \{a^n b^m \mid 1 \leq n < m\}$ is regular language or not.	7	2	3
	b)	**Let h be a function defined as $h: \Sigma \to \Gamma^*$ (i.e., letter to word substitution)** and is called homomorphism. The function h is extended for words with $h(ab) = h(a).h(b)$ $for\ a, b \in \Sigma$. The inverse homomorphism function h^{-1} is defined in a usual way. Consider the following homomorphism h from the alphabet $\{0,1,2\}$ to $\{a,b\}$ defined by: $h(0) = ab, h(1) = b, h(2) = aa$. 1. What is $h(0210)$? **1 mark** 2. If L is the language whose regular expression is $(ab + baa) * bab$, what is $h^{-1}(L)$? **2 marks**	3		
2.	a)	Consider the grammar $X \to aXb \mid XX \mid \epsilon$. Prove that the grammar is ambiguous.	3	3	2
	b)	Design context free grammar for the language $L = \{a^i b^j c^k \mid i = j + k\}$ and derive the string $a^4 b^3 c$ using your grammar.	4		
	c)	**Consider the grammar G with $S \to 0S1 \mid 1S0 \mid \epsilon$.** In this grammar, for every 0 there is a 1 and vice versa. Is this grammar generating $L = \{w \mid n_0(w) = n_1(w)\}$? Justify. If not, what further modifications are required in the grammar in order to generate the language L?	3		
3.	a)	Consider the grammar $S \to ASA \mid aB, A \to B, B \to b \mid \epsilon$. Convert into Chomsky Normal Form	6	3	4
	b)	Consider the context-free grammar whose rules are $S \to SS \mid Sa \mid a$. Convert into equivalent grammar in GNF.	4		
4.		Given the context-free grammar $G: S \to XY, X \to YY \mid 0, Y \to XY \mid 1$. Use the CYK algorithm to determine whether the strings **00110** is in the language generated by the given grammar.	10	3	3
5.	a)	Consider the PDA for accepting palindrome strings over $\{a, b\}$. For the below incomplete trace sequence (instantaneous description – ID) and moves for the given string $ababababa$, identify the required state or partial input string or	5	1	4

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	stack content in the "fill in the blanks" entry. Note q_0 is the start state and q_f is the final state, Z_0 is the start stack symbol. $(q_0, abababab a, Z_0)$ $\vdash (q_0, bababab a, aZ_0)$ $\vdash (q_0, ababab a, baZ_0)$ $\vdash (q_0, babab a, -)$ $\vdash (q_0, abab a, -)$ $\vdash (-, bab a, babaZ_0)$ $\vdash (q_1, -, abaZ_0)$ $\vdash (q_1, ba, baZ_0)$ $\vdash (q_1, a, aZ_0)$ $\vdash (-, \epsilon, Z_0)$ $\vdash (q_f, \epsilon, Z_0)$			
	b) Consider the language $L = \{a^{2n}c^m b^n \mid n, m \geq 1\}$. The objective is to construct a (pushdown automata) PDA for this language and below are the partial transition rules. The main idea is to push a **0** in the stack whenever ***a*** is read and when ***b*s** are read, they need to be cancelled against **0**s such a way that for every one ***b*** is read, two **0**s need to be cancelled out in the stack. You are expected to fill-in the remaining rules which are left un-attempted **(denoted with - in the rules) and complete the rules such that the constructed PDA will accept the given language *L*. FYI, the transition function $\boldsymbol{\delta}$ of the PDA is defined as: $\boldsymbol{\delta} : Q \times \Sigma \cup \{\lambda\} \times \Gamma \rightarrow$ *finite subset of* $Q \times \Gamma^*$. You are allowed to use only one (new) additional state which is q_f, the final state. Write only incomplete rules 2,4,6,7,8 for answering the question. *Z* is the start stack symbol.** 1. δ(q0, a, Z) = (q1, 0Z) 2. δ(q1, a,–) = (q1, 00) 3. δ(q1, c, 0) = (q2, 0) 4. δ(q2, c,–) = (–,–) 5. δ(q2, b, 0) = (q3, λ) 6. δ(q3,–,–) = (–, λ) 7. δ(q4, b,–) = (–,–) 8. δ(q4, λ,–) = (–,–)	5		

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