



**SCHOOL OF COMPUTER SCIENCE AND ENGINEERING**  
**CONTINUOUS ASSESSMENT TEST - II**  
**WINTER SEMESTER 2023-2024**

**SLOT: B1 + TB1**

**Programme Name & Branch** : B.Tech  
**Course Code** : BCSE304L  
**Course Name** : Theory of Computation

**Faculty Name(s)** : Prof. Sathiyakumar, Prof. Anand M, Prof. Lakshmanan K, Prof. Viswanathan P, Prof. Arumuga Arun R, Prof. Shalini L, Prof. Kannadasan R, Prof. Gunavathi C, Prof. Navamani T M, Prof. Rajarajan G, Prof. Madijagan M, Prof. Saritha Murali, Prof. Delhibabu R, Prof. Vishnupriya, Prof. Krishnaraj N, Prof. Bhuvaneswari M, Prof. Kanagaraj R, Prof. Sathya K, Prof. Anand Bihari, Prof. Baskaran P, Prof. Hussain Ahmed Chowdhury

**Class Number(s)** : VL2023240500758, 0762, 0764, 0767, 0769, 0770, 0773, 0783, 0788, 0794, 0842, 0859, 1011, 1013, 1024, 1027, 1028, 1031, 1034, 1038, 1040

**Duration: 90 min.**

**Max. Marks: 50**

Q. No	Question	Marks
1.	a) For languages A and B, let the perfect shuffle of A and B be the language $\{w \mid w = a_1b_1 \cdots a_kb_k, \text{ where } a_1 \cdots a_k \in A \text{ and } b_1 \cdots b_k \in B, \text{ each } a_i, b_i \in \Sigma\}$ . Show that the class of regular languages is closed under perfect shuffle.	5
	b) Prove using pumping lemma, the following language is not regular $L = \{w \in \{0,1\}^* \mid w \text{ contains more 0's than 1's}\}$	5
2.	(a) Design a CFG for the language $L = \{ww^Rzz^R \mid w, z \in \{0,1\}^+, 011 \text{ is a substring of } w \text{ and }  z  \text{ is odd, } w^R \text{ is the reverse of } w, z^R \text{ is the reverse of } z\}$ . Explain the use of each production in the constructed grammar?	5
	(b) Convert the given Context free grammar G into an equivalent context free grammar $G_1$ in Chomsky normal form (CNF) $S \rightarrow aXbX$ $X \rightarrow aY \mid bX \mid \lambda$ $Y \rightarrow X \mid c$	5
3.	(a) Show that the language $L = \{\beta\#\beta^R\#\beta \mid \text{where } \Sigma = \{a,c,\#\} \text{ and } \beta \in \{a,c\}^*\}$ is not context free ( $\beta^R$ is the reverse of $\beta$ ).	5
	(b) Write the above language L (in Question 3(a)) as the intersection of two context-free languages (over $\Sigma$ ).	5



**SCHOOL OF COMPUTER SCIENCE AND ENGINEERING**  
**CONTINUOUS ASSESSMENT TEST - II**  
**WINTER SEMESTER 2023-2024**

**SLOT: B1 + TB1**

4.	<p>Consider the following context free grammar (where A is the start symbol)</p> $A \rightarrow BA \mid AC \mid a$ $B \rightarrow CB \mid BA \mid b$ $C \rightarrow AC \mid CB \mid a$ <p>Apply CYK algorithm for the input string <i>abbaa</i>. Find the nonterminal set where X is marked in the table. Without steps full marks will not be awarded.</p> <table border="1"> <tr> <td>X</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td>X</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td>X</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>X</td> <td></td> <td></td> </tr> <tr> <td>X</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td>b</td> <td>b</td> <td>a</td> <td>a</td> </tr> <tr> <td>a</td> <td>b</td> <td>b</td> <td>a</td> <td>a</td> </tr> </table>	X						X					X						X			X						b	b	a	a	a	b	b	a	a	10
X																																					
	X																																				
	X																																				
		X																																			
X																																					
	b	b	a	a																																	
a	b	b	a	a																																	
5.	<p>Give a push down automata (PDA) that recognizes the language L of all strings <math>w \in \{0,1\}^*</math> such that the first and last symbol of w are the same, and moreover, if the length of w is odd, then the middle symbol of w is different from the first and the last. For example, strings 00, 11, 010, 010100010010, 0101010 are in L, but <math>\lambda</math>, 0, 1, 000, 111, 110, 00001, 1001001 are not. Show the configurations made by the constructed PDA for the input strings (a) 0101010 (b) 111</p>	10																																			

\*\*\*\*\*