## R. V. COLLEGE OF ENGINEERING

Autonomous Institution affiliated to VTU
IV Semester B. E. Examinations Oct/Nov-2022
Computer Science and Engineering
THEORY OF COMPUTATION

Time: 03 Hours

Maximum Marks: 100

## Instructions to candidates:

- 1. Answer all questions from Part A. Part A questions should be answered in first three pages of the answer book only.
- 2. Answer FIVE full questions from Part B. In Part B question number 2, 7 and 8 are compulsory. Answer any one full question from 3 and 4 & one full question from 5 and 6.

## PART A

1	1.1	Construct DFA which recognizes language corresponds to the regular expression $(0+11*0)(0+1)*$ .	02
	1.2	Give the regular expression which generates the language "The set of all	
		strings over $\Sigma = \{0, 1\}$ contains at least two 0's".	01
	1.3	Show that the grammar which indicated productions is ambiguous.	
		$S \rightarrow AB \mid aaB, A \rightarrow a \mid Aa, B \rightarrow b.$	01
	1.4	Identify the language generated by the grammar with productions	
		S→aaS bbS Saa Sbb abSab abSba baSba baSab €.	02
	1.5	How many useless variables are in the grammar S→AB AC,	
		A →aAb bAa a, B→bbA aaB AB, C→abCa aDb, D→bD ac.	01
	1.6	Identify the nullable variables in the grammar $S\rightarrow ABCa bD$ , $A\rightarrow BC b$ ,	
		$ B\rightarrow b  \in C\rightarrow c \in D\rightarrow d.$	01
	1.7	Write the left linear grammar equivalent to the below right linear grammar.	00
	1.0	$A \rightarrow aB bD a, B\rightarrow aA bc, C\rightarrow aD bB b, D\rightarrow aC bA.$	02
	1.8	Construct the parser tree for the string aaabaabba from the grammar with	
		productions. $S \rightarrow SS bTT TbT TTB  \in$ ,	
		$ S \rightarrow SS $ bit [161] 11B  E, $ T \rightarrow aS SAS Sa a$	02
	1.9	To derive a string aaabbababb from the grammar with productions	02
	1.7	$S \rightarrow aB bA$ , $A \rightarrow a aS bAA$ , $B\rightarrow b bS aBB$ . How many steps are there in the	
		derivation.	01
	1.10	Write the transition diagram of the tuning machine which accepts the	
		language L={W\W €{a,b}* and W ends with abb}.	02
	1.11	Describe the language generated by the unrestricted grammar with the	
		productions	
		$S \to FM, F \to FaA FbB E$	
		$Aa \rightarrow aA, Ab \rightarrow bA, Ba \rightarrow aB, Bb \rightarrow bB,$	
		$AM \rightarrow Ma, BM \rightarrow Mb, M \rightarrow \in$	02
	1.12	If $L_1$ and $L_2$ are recursively numerable languages over $\Sigma$ , then $L_1$ U $L_2$ is	01

1.13	Find the solution to the belo	w inst	ance of	f port of	correspondence problem	
		i	A	В		
		1	10	101		
		2	01	100		
		3	0	10		
		4	100	0		02
		5	1	010		

## PART B

		PARI B	
2	a	Explain the algorithm to find an equivalent NFA from the given NFA for the NFA- E. Use the algorithm to draw an NFA for the NFA- E given below.	
		A B a B a B a	8
	b	Explain the algorithm to minimize the states in DFA. Minimize the DFA below.	
		2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	
		W b	8
3	а	State and prove the pumping lemma for regular languages. Use pumping lemma to show the language L= $\{WW \mid W \in \{0,1\}^*\}$ is not regular.	10
	b	Let $M_1$ and $M_2$ are the two DFA's pictured below which recognizes language $L_1$ and $L_2$ respectively. Find DFA's for i) $I_1$ ii) $L_1$ U $L_2$ iii) $L_1 \cap L_2$	
		M1: 0 0 M2: 00 1 1 2 00,11	
			06
		OR	
4	a	Give the context free grammars which generates the following languages i) $L_1 = \{a^i b^j c^k   i=j \text{ or } j=k\}$	
		ii) $L_2 = \{a^i b^j c^k   i=j+k\}$	08

equivalent grammar in Chomsky normal form S→AA CA BaB A→aaBa CDA  aa DC B→BB bAB bb b aS C →Ca Bc bb a b D→bD b Find the equivalent grammar by eliminating left recursion in the grammar with productions S→0S1 IS0 01S 10S S01 S10 €  5 a Construct PDA to recognize L= [W W €[a, b]* and W is a palindrome]. Show by using instantaneous descriptions the abbbba is accepted.  b What are the steps to be followed find an equivalent PDA from the given CFG. Find the PDA which is equivalent to the below grammar. S→S+S S→S S>S S  S/S (S) a Let W = (a + a) ≯ a. Show that this string is accepted by the equivalent PDA constructed.  OR  6 a State and prove pumping lemma for CFLs. Apply this lemma on L= [WW W €[a,b]*] is not context free. Show that the context free language are closed under union operation but not closed under intersection operation. C bescribe the algorithms for the following decision problem. "Given a CFG, is L(G) is finite or empty".  7 a Give the equivalent left linear grammar for the language accepted by the finite automata whose transition diagram shown below:  8 a A→A C B a, C→Da Bb, D→Ca Ab b, A→Ba Db  8 a Design tuning machine which accepts the language L= [W W C a,b]* and W is a palindrome]. Using instantaneous descriptions show that the string babba is accepted by the tuning machine.  Write a note on the following: i) Multitape tuning machine.  ii) Chomsky hierarchy		b	Find the context free grammar with the productions as follows, find an	
A →aaBa   CDA   aa   DC B →bB   bAB   bb   as   C C →Ca   bC   bb   a  b D →bD   b C →Ca   bC   bb   a  b D →bD   b C ← Find the equivalent grammar by climinating left recursion in the grammar with productions S→0S1   ISO   01S   10S   S01   S10   €  5 a Construct PDA to recognize L=  W W C a, b * and W is a palindrome . Show by using instantaneous descriptions the abbbba is accepted.  6 b What are the steps to be followed find an equivalent PDA from the given CFG. Find the PDA which is equivalent to the below grammar. S→S+S S−S S→S S/S S S a Let W = (a + a) > a. Show that this string is accepted by the equivalent PDA constructed.  6 a State and prove pumping lemma for CFLs. Apply this lemma on L=  WW W C a,b **] is not context free. b Show that the context free language are closed under union operation but not closed under intersection operation. c Describe the algorithms for the following decision problem. "Given a CFG, is L(G) is finite or empty".  7 a Give the equivalent left linear grammar for the language accepted by the finite automata whose transition diagram shown below:  8 write the DFA such that the language of the DFA is same as the language generated by the grammar B→Aa Cb a, C→Da Bb, D→ Ca Ab b, A→Ba Db  8 a Design tuning machine which accepts the language L=  W W C a,b * and W is a palindrome . Using instantaneous descriptions show that the string babbab is accepted by the tuning machine.  8 b Write a note on the following: i) Multitape tuning machine				
B →bB   bAB   bb   aS C → Ca   bC   bb   a   b D →bD   b				
C →Ca  bC    bb  a   b D →bD   b C Pind the equivalent grammar by climinating left recursion in the grammar with productions S→OS1   ISO   O1S   IOS   S01   S10   €  5 a Construct PDA to recognize L=  W  W € a, b * and W is a palindrome . Show by using instantaneous descriptions the abbbba is accepted.  6 b What are the steps to be followed find an equivalent PDA from the given CFG. Find the PDA which is equivalent to the below grammar.  5 → S + S   S - S  S > S   S / S   S				
D →bD b Find the equivalent grammar by eliminating left recursion in the grammar with productions S→0S1 IS0 0IS IOS S01 S10 €  Construct PDA to recognize L= {W W C{a, b}* and W is a palindrome}. Show by using instantaneous descriptions the abbbba is accepted.  What are the steps to be followed find an equivalent PDA from the given CFG. Find the PDA which is equivalent to the below grammar. S→S+S S→S S> S S S S S a Let W = (a+a) ≯ a. Show that this string is accepted by the equivalent PDA constructed.  OR  State and prove pumping lemma for CFLs. Apply this lemma on L= {WW W   (a,b)** is not context free.} Show that the context free language are closed under union operation but not closed under intersection operation. c Describe the algorithms for the following decision problem. "Given a CFG, is L(G) is finite or empty".  Give the equivalent left linear grammar for the language accepted by the finite automata whose transition diagram shown below:  b Write the DFA such that the language of the DFA is same as the language generated by the grammar B→Aa Cb a, C→Da Bb, D→Ca Ab b, A→Ba Db  White a policy long instantaneous descriptions show that the string babbab is accepted by the tuning machine.  b Write a note on the following. i) Multitape tuning machine				
with productions S→0S1 1S0 01S 10S S01 S10  €  1				04
S→0\$1   180   018   1810   €  8		c		
Solve the equivalent left linear grammar for the language accepted by the finite automata whose transition diagram shown below:  By Write the DFA such that the language of the DFA is same as the language generated by the grammar  By →Aa Cb a, A⇒Ba Db, A⇒Ba Db, A⇒Ba Db, Ba Db, A⇒Ba Db, Ba			<u> </u>	04
by using instantaneous descriptions the abbbba is accepted.  What are the steps to be followed find an equivalent PDA from the given CFG. Find the PDA which is equivalent to the below grammar.  \$\( S \to S + S \cong S \subseteq S \cong S \subseteq S \cong S \subseteq S \cong S \subseteq S \su			5-051 150 015 105 501 510 €	04
b What are the steps to be followed find an equivalent PDA from the given CFG. Find the PDA which is equivalent to the below grammar. S → S + S   S - S   S > S + S   S - S   S > S   S   S   S   S   S   S   S	5	а		
CFG. Find the PDA which is equivalent to the below grammar.  S → S + S   S - S   S > S   S / S   (S) a  Let W = (a + a) ≯ a. Show that this string is accepted by the equivalent PDA constructed.  OR  State and prove pumping lemma for CFLs. Apply this lemma on L = {WW   W €{a,b}*} is not context free.  Show that the context free language are closed under union operation but not closed under intersection operation.  Describe the algorithms for the following decision problem. "Given a CFG, is L(G) is finite or empty".  Give the equivalent left linear grammar for the language accepted by the finite automata whose transition diagram shown below:  b Write the DFA such that the language of the DFA is same as the language generated by the grammar  B → Aa   Cb   a,  C → Da   Bb,  D → Ca   Ab   b,  A → Ba   Db  8  a Design tuning machine which accepts the language L= {W   W €{a,b}* and W is a palindrome}. Using instantaneous descriptions show that the string babbab is accepted by the tuning machine.  Write a note on the following:  i) Multitape tuning machine		_		08
S → S + S   S - S   S + S   S / S   S / S   S   S   S   S   S		b		
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			ii) Chomsky hierarchy	08