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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:

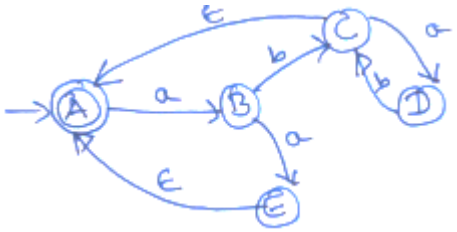
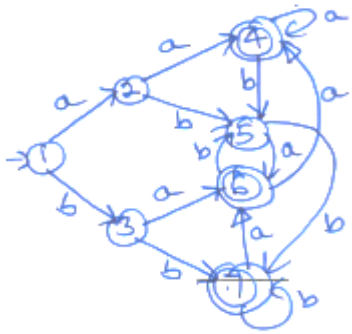
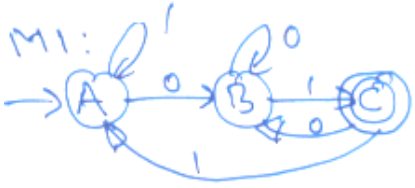
1. Answer all questions from Part A. Part A questions should be answered in first three pages of the answer book only.
2. Answer FIVE full questions from Part B. In Part B question number 2, 7 and 8 are compulsory. Answer any one full question from 3 and 4 & one full question from 5 and 6.

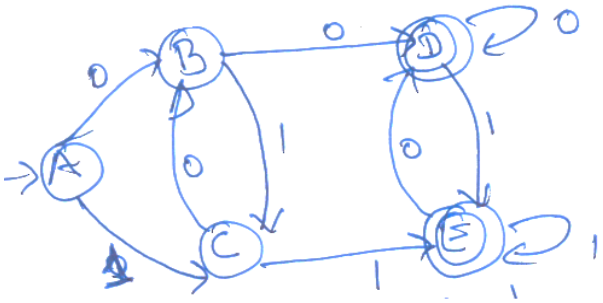
PART A

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 Σ={0, 1} contains at least two 0`s".	01
	1.3	Show that the grammar which indicated productions is ambiguous. S→AB|aaB, A →a|Aa, B→b.	01
	1.4	Identify the language generated by the grammar with productions S→aaS|bbS|Saa|Sbb|abSab|abSba|baSba|baSab|Є.	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→ABCa|bD, A→BC|b, B→b| Є , C→c| Є, D→d.	01
	1.7	Write the left linear grammar equivalent to the below right linear grammar. A →aB|bD|a, B→aA|bc, C→aD|bB|b, D→aC|bA.	02
	1.8	Construct the parser tree for the string aaabaabba from the grammar with productions. S →SS|bTT|TbT|TTB| Є, T→aS|SAS|Sa|a	02
	1.9	To derive a string aaabbababb from the grammar with productions S →aB|bA, A →a|aS|bAA, B→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 Є{a,b}* and W ends with abb}.	02
	1.11	Describe the language generated by the unrestricted grammar with the productions $S \rightarrow FM, F \rightarrow FaA\|FbB\|\in$ $Aa \rightarrow aA, Ab \rightarrow bA, Ba \rightarrow aB, Bb \rightarrow bB,$ $AM \rightarrow Ma, BM \rightarrow Mb, M \rightarrow \in$	02
	1.12	If L_1 and L_2 are recursively numerable languages over Σ, then L_1 U L_2 is _____.	01

1.13	Find the solution to the below instance of port correspondence problem i A B 1 10 101 2 01 100 3 0 10 4 100 0 5 1 010		02

PART B

2	a	Explain the algorithm to find an equivalent NFA from the given NFA for the NFA- Є. Use the algorithm to draw an NFA for the NFA- Є given below.  	8
	b	Explain the algorithm to minimize the states in DFA. Minimize the DFA below.  	8
3	a	State and prove the pumping lemma for regular languages. Use pumping lemma to show the language L= {WW | WЄ{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) $L_1 \cup L_2$ iii) $L_1 \cap L_2$   	06
		OR	
4	a	Give the context free grammars which generates the following languages i) $L_1 = \{a^i b^j c^k \mid i=j \text{ or } j=k\}$ ii) $L_2 = \{a^i b^j c^k \mid i=j+k\}$	08

	b	Find the context free grammar with the productions as follows, find an equivalent grammar in Chomsky normal form S→AaA|CA|BaB A →aaBa|CDA| aa|DC B →bB|bAB| bb|aS C →Ca|bC| bb|a|b D →bD|b	04
	c	Find the equivalent grammar by eliminating left recursion in the grammar with productions S→0S1|1S0|01S|10S|S01|S10| Є	04
5	a	Construct PDA to recognize L= {W|W Є{a, b}* and W is a palindrome}. Show by using instantaneous descriptions the abbbba is accepted.	08
	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. $S \to S+S \mid S-S \mid S \rightarrowtail S \mid S/S \mid (S) \mid a$ Let $W = (a+a) \rightarrowtail a$. Show that this string is accepted by the equivalent PDA constructed.	08
		OR	
6	a	State and prove pumping lemma for CFLs. Apply this lemma on L= {WW|W Є{a,b}*} is not context free.	08
	b	Show that the context free language are closed under union operation but not closed under intersection operation.	04
	c	Describe the algorithms for the following decision problem. "Given a CFG, is L(G) is finite or empty".	04
7	a	Give the equivalent left linear grammar for the language accepted by the finite automata whose transition diagram shown below:  	08
	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	08
8	a	Design tuning machine which accepts the language L= {W|W Є{a,b}* and W is a palindrome}. Using instantaneous descriptions show that the string babbab is accepted by the tuning machine.	08
	b	Write a note on the following: i) Multitape tuning machine ii) Chomsky hierarchy	08