USN | | | | | | | | | | |

RV COLLEGE OF ENGINEERING®

(An Autonomous Institution affiliated to VTU)

IV Semester B. E. Fast Track Examinations July-19

Computer Science and Engineering

THEORY OF COMPUTATIONS

Time: 03 Hours ***Maximum Marks: 100***

Instructions to candidates:

1. Answer all questions from Part A. Part A questions should be answered in the first three pages of the answer book only.
2. Answer FIVE full questions from Part B.

PART A

1	1.1	Give DFA accepting the language over $\sum = \{0,1\}$, the set of all strings that begin with 01.	02
	1.2	For the regular expression $(ab^* + (ab)^*b)$, find an equivalent $NFA\text{-}\epsilon$ by applying kleen'stheorem. Do not attempt to simplify the answer.	02
	1.3	What is the language generated by the CFG with the productions $$S \to aS_b \mid bS_a \mid SS \mid \epsilon$$	02
	1.4	Define right most derivation. Give right most derivation for the string $abaaba$ in the grammar with the productions: $S \to aSaSbS \mid aSbSaS \mid bSaSaS \mid \epsilon$	02
	1.5	Define deterministic pushdown automata.	01
	1.6	Give the transition diagram for PDA recognizing the language: $f = \{a^n b^n \mid n \geq 0\}$	02
	1.7	Construct $DPDA$ equivalent to the DFA whose transition table is as below. Here state A is the start state and state C is the final state. $$\begin{array}{c\|c\|c} & 0 & 1 \\ \hline A & B & A \\ B & B & C \\ C & B & A \end{array}$$	02
	1.8	Identify the useless variables in the CFG below: $$S \to A \mid B \mid C, A \to aAa \mid B \mid a, B \to bb \mid bB, C \to aCaa \mid D, D \to baD \mid abD$$	02
	1.9	obtain turing machine to accept the language $L = \{w \mid w\{\in \{a,b\}\}^* \; and \; w \; ends \; with \; aba\}$	02
	1.10	If L_1 is CFL and L_2 is regular , then $L_1 \cap L_2$ is _________.	01
	1.11	Recursively enumerable languages are also called as _________.	01
	1.12	If L_1 and L_2 are recursively enumerable languages over $\sum$ then $L_1 \cap L_2$ is _________.	01

PART B

2	a	Define DFA. Give DFA which accepts the following languages over the alphabet $\sum = \{a, b\}$ i) Strings that do not end with ab ii) Strings that do not contain the substring aa.	08

b Consider the NFA pictured as below in Fig 2b, using the subset construction, draw the DFA accepting the same language.

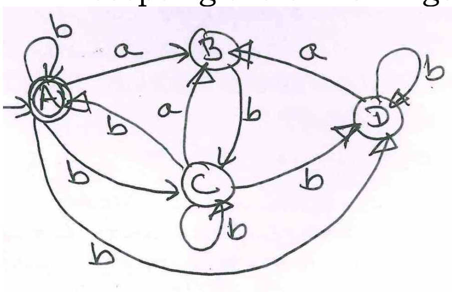


Fig 2b

08

OR

3 a Define the following;

i) $NFA{-}\in$

ii) language of $NFA{-}\in$

iii) $\in -closure(q)$, where $q \in Q$ of $NFA{-}\in$.

For the $NFA{-}\in$ below, compute $\delta * (A, aba)$ and $\delta * (A, aaabbb)$.

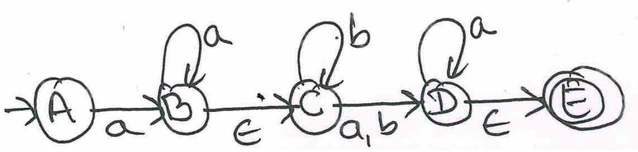


Fig 3a

08

b For the DFA below in Fig 3b, use the minimization algorithm to find a minimum state DFA recognizing the same language [by table filling approach].

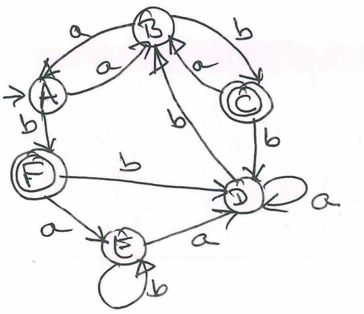


Fig 3b

08

4 a Define regular expressions. Give regular expressions which generates the following languages over the alphabet $\Sigma = \{0,1\}$.

i) Set of all strings containing a substring 00.

ii) Set of all strings without two consecutive zeros.

06

b Find the equivalent regular expression for the DFA below. Use kleen's theorem part-II.

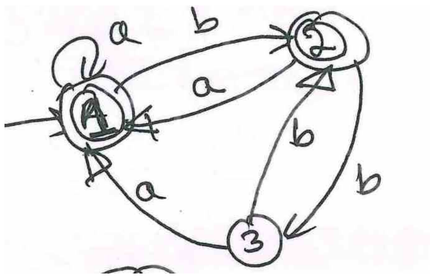
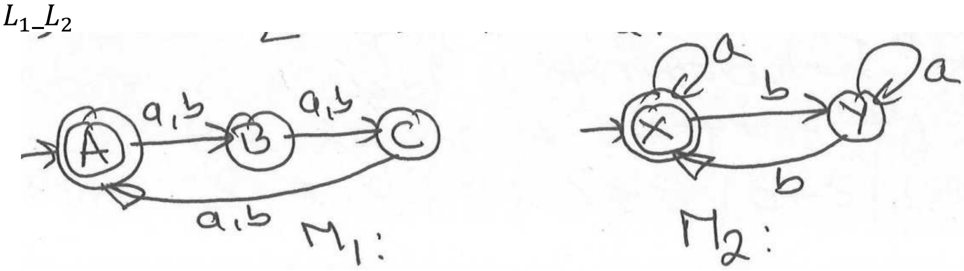


Fig 4b

10

OR

5	a	state and prove pumping lemma for regular languages.	06
	b	Using pumping lemma show that the language $L = \{xy \mid x, y \in \{0,1\}^* \text{ and } y \text{ is either } x \text{ or } x^r\}$ is not regular.	04
	c	Let M_1 and M_2 are $DFA's$ as shown below in fig 5c accepting languages L_1 and L_2 respectively. Draw $DFAs$ accepting the following languages. i) $L_1 \cap L_2$ ii) $L_1 - L_2$  Fig 5c	06
6	a	Define CFG and language generated by CFG. Construct CFG to generate the following languages. i) $L_1 = \{a^i b^j c^k \mid k = i + j, i \geq 0, j \geq 0\}$ ii) $L_2 = \{a^i b^j c^k \mid i = j \text{ or } j = k\}$	06
	b	Consider the CFG, G with productions $S \rightarrow aB \mid bA, A \rightarrow a \mid aS \mid bAA$, $B \rightarrow b \mid bS \mid aBB$. Obtain LMD, RMD and derivation tree for the string $aabbabab$.	06
	c	Define ambiguity in CFG. Show that the CFG below is ambiguous. $S \rightarrow aS \mid Sa \mid a$.	04
		OR	
7	a	Simplify the following grammar $S \rightarrow ABC \mid AB$ $A \rightarrow BA \mid BC \mid a \mid \epsilon$ $B \rightarrow AC \mid CB \mid b \mid \epsilon$ $C \rightarrow BC \mid AB \mid A \mid C$	08
	b	Given below a CFG G, find a grammar G' in GNF generating $L(G) - \{\in\}$ $S \rightarrow AB$ $A \rightarrow BS \mid a$ $B \rightarrow SA \mid b$	08
8	a	Define PDA and instantaneous description (ID). Construct PDA to accept set of all palindromes over $\{a, b\}$.Show by IDs the string $aabaabaa$ is acceptabled by the PDA.	08
	b	List the steps to convert the given CFG to equivalent PDA by empty stack. Convert the CFG below to its equivalent PDA by empty stack. Show that that string $a + (a * b)$ is generated by the grammar and the same is accepted by the equivalent PDA. $S \rightarrow S + S \mid S * S \mid s - s \mid (S) \mid a \mid b$	08
		OR	
9	a	How to find an equivalent CFG from a given PDA.	04
	b	State and prove pumping lemma for $CFLs$. Show that the language $L_1 = \{a^i b^j c^k \mid i < j < k\}$ is not CFL.	06
	c	Prove that CFLs are not closed under intersection and difference.	06

10	a	Define turing machine and the language of turing machine. Design TM to perform the string copy operation. The string is constructed over $\Sigma = \{a, b\}$. Trace the machine for string bab.	08
	b	Define unrestricted grammar .Give unrestricted grammar to generate the language $L = \{a^n b^n c^n \| n \geq 1\}$. Show that the string $aabbcc$ is generated.	04
	c	Prove that if L is recursive, then L is recursively enumerable also.	04
		OR	
11	a	Design turing machine to accept palindrome over $\Sigma = \{a, b\}$. Give the sequence of IDs for the string $abba$.	08
	b	Write a note on: i) Multistage turing machine ii) Chomeky hierarchy.	08