16IS52

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

RV COLLEGE OF ENGINEERING®

Autonomous Institution affiliated to VTU

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

Information Science and Engineering

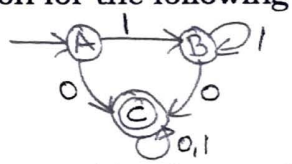
THEORY OF COMPUTATION

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

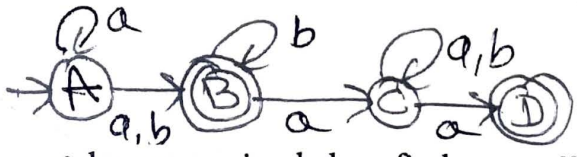
PART-A

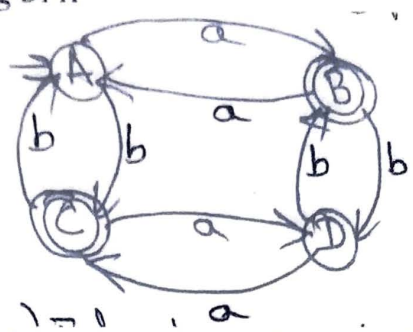
1	1.1	Write the regular expression for the following *DFA*: 	01
	1.2	Describe the language generated by the regular expression $(a+b)^*a(a+b)^*a(a+b)^*$	01
	1.3	Give the regular expression to generate a string over $\Sigma = \{0,1\}$ such that the string does not contain consecutive 0's.	01
	1.4	If $L_1 \subseteq L_2$ and L_1 is not regular, then $L_2$is also not regular. Is this statement *TRUE* or *FALSE*?	01
	1.5	Show that the grammar $S \rightarrow aSb \mid aaSb \mid \in$ is ambiguous.	01
	1.6	Consider *CFG* with productions $S \rightarrow aSbScS \mid aScSbS \mid bSaScS \mid bScSaS \mid cSaSbS \mid cSbSaS \mid \in$ Is this grammar generates the language $L = \{w \in \{a,b,c\}^* \mid n_a(w) = n_b(w) = n_c(w)\}$.	01
	1.7	What language over $\{a,b\}$ does the CFG with productions $S \rightarrow aaS \mid bbS \mid Saa \mid Sbb \mid abSab \mid abSba \mid baSba \mid baSab \mid \in$ generates?	01
	1.8	For the string $a+a+a+a+a$ derived from the grammar $S \rightarrow S+S \mid S-S \mid S*S \mid S/S \mid (S) \mid a$. How many distinct parser trees are there?	01
	1.9	Construct parser tree for the string *aaabaabba* in the grammar with productions $S \rightarrow SS \mid bTT \mid TbT \mid TTb \mid \in, T \rightarrow aS \mid SaS \mid Sa \mid a$.	01
	1.10	Identify the useless variables in the grammar $S \rightarrow AB \mid AC$, $A \rightarrow aAb \mid bAa \mid a, B \rightarrow bbA \mid aaB \mid AB, C \rightarrow abCa \mid aDb, D \rightarrow bD \mid aC$.	01
	1.11	For the *DFA* given by the following transition table, find its equivalent linear grammar without $\in$-productions, there A is the start state and B is the final state	01

δ	a	b
A	B	D
B	A	C
C	D	B
D	C	A

1.12	Say whether the following statement is *TRUE* or *FALSE*. "Every regular language can be accepted by a *DPDA* with only two states in which there are no $\in$-transitions and no symbols are ever removed from the stack.	0
1.13	Construct *DPDA* equivalent to the *DFA* whose transition table is as below. Here *A* is start state and *B* is final state. $\begin{array}{\|c\|c\|c\|}\hline \delta & 0 & 1 \\ \hline A & A & B \\ \hline B & C & A \\ \hline C & A & B \\ \hline \end{array}$	01
1.14	Define the language of a Turing Machine.	01
1.15	Recursively enumerable languages are also called as _____ languages.	01
1.16	Obtain Turing machine to accept the language $L = \{w \mid w \in \{a,b\}^* \text{ and } w \text{ ends with } abb\}$.	01
1.17	Describe the language generated by the unrestricted grammar with productions $S \to ABCS \mid ABC,\ AB \to BA, AC \to CA,\ BC \to CB,\ BA \to AB,$ $CA \to AC,\ CB \to BCm\, A \to a,\ B \to b, C \to c$	01
1.18	Algorithms written for Turing machine that always halts is said to be _____.	01
1.19	If L_1 and L_2 are recursive enumerable languages over Σ, then $L_1 \cap L_2$ is _____.	01
1.20	For every unrestricted grammar there exists _____.	01

PART-B

2	a	Define *NFA*, extended transition function δ^* for *NFA* and language accepted by *NFA*.	04
	b	Consider the *NFA* below, construct *DFA* accepting the language which is same as the language accepted by the given *NFA*. 	04
	c	For each of the regular expression below, find an $\in -NFA$ recognizing language corresponds to the regular expressions. i) $((ab)^*b + ab^*)^*$ ii) $(ab + (aab)^*)(aa + a)$	04
	d	Using pumping lemma for regular sets, show that the language below is not regular. $L = \{xy \mid x, y \in \{0,1\}^* \text{ and } y \text{ is either } x \text{ or } x^r\}$.	04
3	a	Define Context Free Grammar (*CFG*) and language generated by *CFG*. Give *CFGs* to generate the following languages i) $L_1 = \{a^i b^j c^k \mid i = j + k\}$ ii) $L_2 = \{a^i b^j c^k \mid j = i \text{ or } j = k\}$	06
	b	Define ambiguity in *CFG*. Show that the given grammar is ambiguous. $S \to a \mid Sa \mid bSS \mid SSb$	04

c	Consider the following *DFA* 		
	i) Identify the language accepted by this *DFA*. ii) Give the equivalent right linear grammar to this *DFA* iii) Show that the string $w = aababba$ is accepted by *DFA* and w is generated by the right linear grammar.		06
	OR		
4 a	Define null productions and unit productions. For the *CFG* below find an equivalent *CFG* with no null productions and no unit productions that generates the same language, except possible for ∈. $S \rightarrow AB\|ABC, A \rightarrow BA\|BC\|a\| \in, B \rightarrow AC\|CB\|b\| \in, C \rightarrow BC\|AB\|A\|c$		06
b	Define *CNF* grammar, convert the below grammar to *CNF* grammar $S \rightarrow AaA\|CA\|BaB,$ $A \rightarrow aaBa\|CDA\|aa\|DC,$ $B \rightarrow bB/bAB/bb/as,$ $C \rightarrow Ca/bC/D,$ $D \rightarrow bD\| \in$		06
c	What is left recursion? How to remove left recursion in *CFG*? Eliminate left recursion in the following grammar: $S \rightarrow 0S1\|1S0\|01S\|10S\|S01\|S10\| \in$		04
5 a	Define Push Down Automat (*PDA*) and Instantaneous Description (*ID*). Construct *PDA* to recognize $L = \{ww^R\|w \in \{0,1\}^*\}$. Show by *IDs* the string 011110 is accepted.		06
b	List the steps to convert the given *CFG* to equivalent *PDA* by empty stack. Convert the below *CFG* to equivalent *FDA* by empty stack. $S \rightarrow aSb\|bSa\|a\|b\| \in$		04
c	Define Deterministic Push Down Automata (*DPDA*). Give transition table for *DPDA* recognizing the language $L = \{a^n b^{n+m} a^m \| n, m \geq 1\}$		06
	OR		
6 a	State and prove pumping lamma for context free languages, show that the language $L = \{a^i b^{21} a^i \| i > 0\}$ is not a *CFL*.		06
b	Show that the following languages are CFL, but their complements are not *CFL*. i) $L_1 = \{a^i b^j c^k \mid i < j\}$ ii) $L_2 = \{a^i b^j c^k \mid i < k\}$		06
c	Describe the algorithms for the following decision problems. i) Given a *CFG* G, is $L(G) = \phi$? ii) Given a *CFG* G, is $L(G)$ *finite*?		04

7	a	Define Turing Machine (TM), language acceptance by Turing Machine.	04
	b	Design Turing Machine to accept $L = \{w \mid w \in \{a,b\}^*$ and w is a palindrome $\}$. Using instantaneous description, show that the string *abaaba* is accepted by the machine.	06
	c	Write a note on the following: i) Multi tape turing machine ii) Multi head turing machine.	06
8	a	Define unrestricted grammar. Give unrestricted grammar to generate the language $L = \{ww \mid w \in \{a,b\}^*\}$. Show that the string $abbabb \in L$.	06
	b	Write a note on Chomeky hierarchy.	06
	c	Show that if L is recursively enumerable language whose complement is also recursively enumerable, then L is recursive.	04