RV Educational Institutions
RV College of Engineering

Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi

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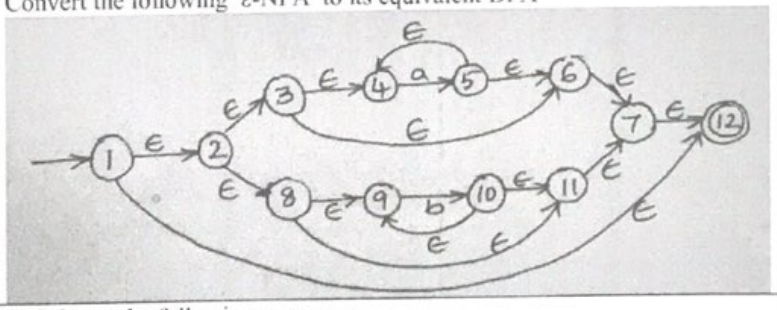
4G3- V3.(50-72)

Academic year 2020-2021 (Even Sem)

DEPARTMENT OF

INFORMATION SCIENCE & ENGINEERING

Date	4th June 2021	Maximum Marks	50
Course Code	18IS46	Duration	120 Min
Sem	IV Semester	Closed Book Online Test-1	
THEORY OF COMPUTATION			

Sl. No.	Questions	M	BT	CO
1.a	List the steps to convert regular grammar into finite automata. Convert the following grammar using the same. S → 0A | 1B | 0 | 1 A → 0S | 1B | 1 B → 0A | 1S	04	L1	CO3
1.b	Convert the below grammar to CNF form: $S \rightarrow AB\|ABC, A \rightarrow BA\|BC\|a\|\epsilon, B \rightarrow AC\|CB\|b\|\epsilon, C \rightarrow BC\|AB\|A\|c$	06	L3	CO3
2.a	State Pumping Lemma for Regular Languages. By using P.L, Prove that L = { $ww^R \mid w \in (0+1)^*$} is not regular.	06	L5	CO1
2.b	Check whether the following grammar is ambiguous. Prove your answer. S → aB | bA A → aS | bAA | a B → bS | aBB | b	04	L3	CO3
3.a	Convert the following ε-NFA to its equivalent DFA 	07	L3	CO1
3.b	Left factor the following grammar: S → bSSaaS | bSSaSb | bSb | a S → aSSbS | aSaSb | abb | b	03	L3	CO3
4.a	Define left linear grammar and Obtain the same for the given DFA: 	05	L3	CO3

4.b	Find a string of minimum length in {a,b}* NOT in the language a*b*(ba)*a*	02	L1	CO3
4.c	Define left recursion. Eliminate left recursion from the following grammar: $S \rightarrow L \mid x$ $L \rightarrow L, S \mid S$	03	L3	CO3
5.a	Write a short note on decision properties of regular languages.	04	L2	CO1
5.b	Define useless variables. In each case, given the context free grammar G, find an equivalent CFG with no useless variables. i. $S \rightarrow ABC \mid BaB, A \rightarrow aA \mid BaC \mid aaa, B \rightarrow bBb \mid a, C \rightarrow CA \mid AC$ ii. $S \rightarrow AB \mid AC, A \rightarrow aAb \mid bAa \mid a \mid \varepsilon, B \rightarrow bbA \mid aaB \mid AB, C \rightarrow abCa \mid aDb \mid \varepsilon$ $D \rightarrow bD \mid aC$	06	L3	CO3

BT-Blooms Taxonomy, CO-Course Outcomes, M-Marks

Marks Distribution	Particulars		CO1	CO2	CO3	CO4	L1	L2	L3	L4	L5	L6
	Test	Max Marks	17	--	33	--	4	34	--	--	6	--

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ToC CIE-1 Solution

V-3.

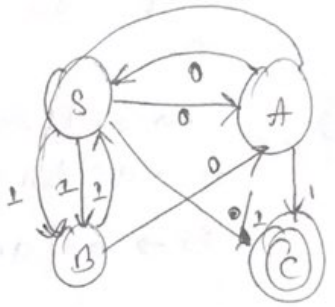
04/06/2021.

1.a] Given:

$S \to 0A \mid 1B \mid 0 \mid 1$

$A \to 0S \mid 1B \mid 1$

$B \to 0A \mid 1S.$



⇒ 2M

Steps: ~~Step~~ i $A \to aB \Rightarrow \delta(A,a) = B$

$A \to a \Rightarrow \delta(A,a) = F.S$ ⇒ 2M

$A \to \epsilon \Rightarrow \delta(A,\epsilon) = A \to F.S$

1.b] $S \to AB \mid ABC$

$A \to BA \mid BC \mid a \mid \epsilon$

$B \to AC \mid CB \mid b \mid \epsilon$

$C \to BC \mid AB \mid A \mid C.$

S, A, B, C are nullable variables.

Eliminate null productions - 2M

——— " ——— unit ——— " ——— 2M.

Convert to CNF - 2M

$S \to AB \mid AC \mid BC \mid ABC \mid BA \mid CB \mid a \mid b \mid C$

$A \to BA \mid BC \mid AC \mid CB \mid AB \mid a \mid b \mid C.$

$B \to$ ———— " ————

$C \to$ ———— " ————

$Y \to BC$

2.a] statement of pumping lemma - 2M.

proof: $L = \{ ww^R \mid w \in (0+1)^* \}$ ie → 4M

2.b] $S \to aB \mid bA$

$A \to aS \mid bAA \mid a$

$B \to bS \mid aBB \mid b$.

or any other string

The grammar is ambiguous - 1M

$S \Rightarrow aB$

$a\,aBB$

$aabSB$

$aabbAB$

$aabbaB$

$aabbab$ // - ~~2M~~ 1.5M

$S \Rightarrow aB$

$\Rightarrow aaBB$

$aabB$

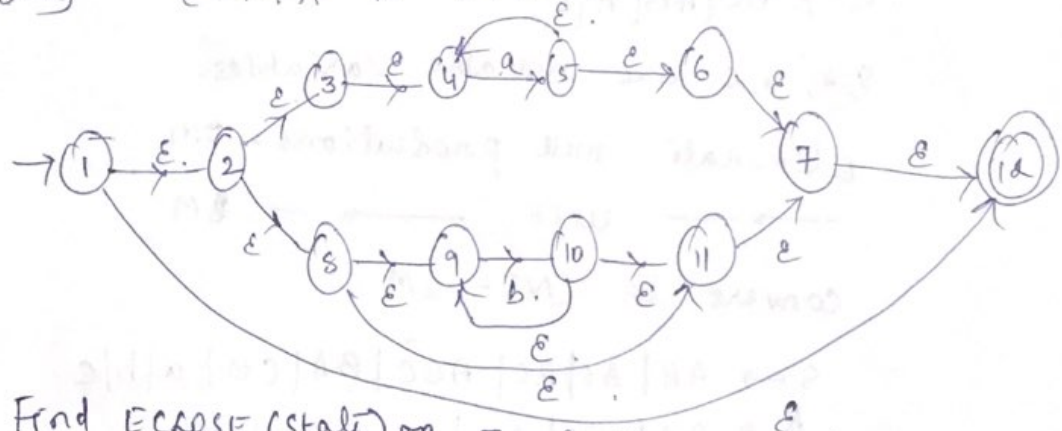
$aabbS$

$aabbaB$

$aabbab$ // - ~~2M~~ 1.5M

2 LMD's or 2 RMD's or 2 parse trees

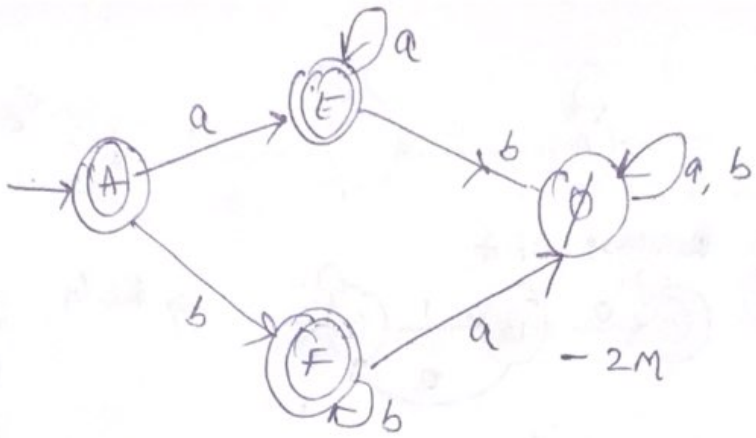
3.a) ε - NFA to DFA conversion.



Find ECLOSE (state) on $\Sigma = \{a, b\}$ - 4M

State	ECLOSE (state)
1	{1, 2, 3, 4, 6, 7, 8, 9, 11, 12} → A
2	{2, 3, 4, 6, 7, 8, 9, 11, 12} - B
3	{3, 4, 6, 7, 12}
4	{
5	

Find initial & final states - 1M



– 2M

3b] Left factor the following:

i) $S \rightarrow bSSaaS \mid bSSaSb \mid bSb \mid a$

soln $S \rightarrow bS' \mid a$

$S' \rightarrow SSaaS \mid SSaSb \mid Sb$

$S' \rightarrow SS''$

$S'' \rightarrow SaaS \mid SaSb \mid b.$

1.5 * 2 = 3M.

ii) $S \rightarrow aSSbS \mid aSaSb \mid abb \mid b$

soln $S \rightarrow aS' \mid b$

~~$S' \rightarrow SSbS \mid SaSb \mid bb$~~

$S' \rightarrow SS'' \mid bb$

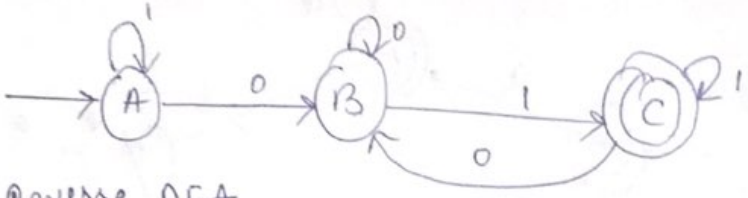
$S'' \rightarrow SbS \mid aSb.$

4a] Left linear grammar def^n - 1M

All productions are of the form

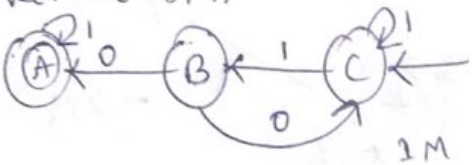
$A \rightarrow Bx$

$A \rightarrow x$



Reverse DFA

(1)



$\Rightarrow$ RLG

$C \rightarrow 1C \mid 1B$

$B \rightarrow 0A \mid 0C \mid 0B$

$A \rightarrow 1A \mid \epsilon$. 1M

1M

(3) Reverse productions on RHS

$C \rightarrow C_1 \mid B_1$

$B \rightarrow A0 \mid C0 \mid B0$

$A \rightarrow A_1 \mid \epsilon$.

2M.

$\therefore G = (\{C, B, A\}, \{0, 1\}, P, C)$ is required LLG.

4b] bab. — 2M. (Other strings won't be given marks) since it is a direct obj qn.

4c] Left recursion- $A \rightarrow A\alpha \mid \beta$

Soln: $A \rightarrow \alpha A' \mid \beta$. $\rightarrow$ 1M

$S \rightarrow L \mid a$ $\rightarrow$ no L.R

$L \rightarrow L, S \mid S$. $\rightarrow$ $L \rightarrow SL'$ $\rightarrow$ 2M.

$L' \rightarrow \epsilon \mid ,SL'$

5a] Decision properties of regular languages:

Explain ↳ membership property

→ Infiniteness ——

→ Emptiness ——

Defⁿ - 1M.

5b) $S \to ABC \mid BaB$, $A \to aA \mid BaC \mid aaa$, $B \to bBb \mid a$, $C \to CA \mid AC$ } no null & unit productions

Sol^n C is useless ∵ C does not derive any string.

∴ $S \to BaB$
$A \to aA \mid aaa$ → 2M
$B \to bBb \mid a$

A is useless ∵ A is not accessible.

↳ ∴ final $S \to BaB$
$B \to bBb \mid a$.

ii) $S \to AB \mid AC$
$A \to aAb \mid bAa \mid a \mid \varepsilon$
$B \to bbA \mid aaB \mid AB$ → 3M.
$C \to abCa \mid aDb \mid \varepsilon$
$D \to bD \mid aC$.

Variables S, A, C are nullable.

Eliminate unit productions.

Variable D is useless ∵ $D \not\Rightarrow x$ D does not derive any string.

∴ $S \to AB \mid AC \mid aAb \mid bAa \mid ba \mid ab \mid a \mid bbA \mid aaB \mid bb \mid abCa \mid aba$

$A \to aAb \mid bAa \mid ab \mid ba \mid a$
$B \to bbA \mid aaB \mid AB \mid bb$
$C \to abCa \mid aba$.