	THEORY OF COMPUTATION
	CLASS TEST-2_
2	UBMITTED BY: AIMAN SIDDIQUA.
	2K18 MC 008
1	P= { S→ aAa, A → bBB, B → ab, C→aB}
	There are no null and unit froductions here.
	STEP 1
	bis = 507
	$W_1 = \{B\}$ as $B \rightarrow ab$ is terminal
	Wz = {B}U {A,C} (A) A, A with a E (SU W)
	W3 = {B, A, C} U {S}
	° G = ( 35, A, B, C2 S - 12 S - 1
	Some ( ¿S,A,B,C}, ¿a,by, ¿S→aka, A→b B→ab, c→aB¸, S;)
	STEP 2
	W1 = { S4
+c	Wz = { S}U {a, A} (5-) aAa)
	W3 = {8, a, A} v { b, B} (A → bBB)
	Wy = {S, a, A, b, B} v \$
	W= \ S, A, B, a, b \

$VN' = \{VN_1 \cap W\} = \{S, A, B\}$ $\Sigma' = \{W \cap \Sigma_1\} = \{a,b\}$ $P' = \{S \Rightarrow aAa, A \Rightarrow bBB, B \Rightarrow ab\}$ $\vdots  \text{Reduced Grammax}  G_1 = \{VN_1, \Sigma', P', S\}$ $B \Rightarrow A \Rightarrow AA \mid DB$ $A \Rightarrow AA \mid DB \mid A \Rightarrow AA \mid AA \mid DB \mid AA \mid AA$		511 212 02 122
P' = $\{S \rightarrow 0Aa, A \rightarrow bBB, B \rightarrow ab\}$ i. Reduced Grammar $G = \{VN', \Sigma', P', S\}$ (3) $S \rightarrow 1A \mid DB$ $A \rightarrow 1AA \mid 0S \mid 0$ $B \rightarrow 0BB \mid 1S \mid 1$ STEP1 There are no null of unit productions here.  STEP-2  Elimination of terminal, on R.H.S.  Let $G = \{VN', \Sigma_1, P_1, S\}$ i. $A \rightarrow 0, B \rightarrow 1$ are included in $F = 0$ i. $S \rightarrow 1A$ gives $S \rightarrow C_1A$ and $C_1 \rightarrow 1$ $S \rightarrow 0B$ gives $S \rightarrow C_0B$ and $C_0 \rightarrow 0$ ii) $A \rightarrow 1AA$ gives $A \rightarrow C_1AA$ and $C_1 \rightarrow 1$ $A \rightarrow 0S$ gives $A \rightarrow C_1AA$ and $C_2 \rightarrow 0$	V^	$= 200, 000$ = $25, A, B^2$
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Reduced Grammar G = { Vn', Z', P', S}  (3) S   A   1A   OB    A   1A   OS   O  B   OBB   1S   1   STEP1 There are no null of unit productions here.  STEP-2  Elimination of terminals on R.H.S.  Let G, = (Vn', Z, Pt, S)  (1) A   0, B   1 Are included in fi  (i) S   1 A   3 OB gives S   CoB and Co   0  A   1 AA gives A   CoS and Co   0  A   OS gives A   CoS and Co   O		
(2) $S \rightarrow 1A \mid OB$ $A \rightarrow 1AA \mid OS \mid O$ $B \rightarrow OBB \mid 1S \mid 1$ STEP1 There are no null of unit productions here.  STEP-2  Elimination of terminals on R.H.S.  Let $G_1 = (VN', S_1, P_1, S)$ i) $A \rightarrow 0$ , $B \rightarrow 1$ are included in $P_1$ ii) $S \rightarrow 1A$ gives $S \rightarrow C_1A$ and $C_1 \rightarrow 1$ $S \rightarrow OB$ gives $S \rightarrow C_0B$ and $C_0 \rightarrow O$ iii) $A \rightarrow 1AA$ gives $A \rightarrow C_1AA$ and $C_1 \rightarrow 1$ $Q \rightarrow OS$ gives $A \rightarrow C_1AA$ and $C_2 \rightarrow O$		= } S > aAa, A -> bBB, B -> ab}
A $\rightarrow$ 1AA   OS O B $\rightarrow$ OBB   1S   1 STEP1 There are no null of unit productions here. STEP-2 Elimination of terminal on R.H.S. Let G <sub>1</sub> = (VN , S <sub>1</sub> , P <sub>1</sub> , S) i) A $\rightarrow$ 0, B $\rightarrow$ 1 are included in P <sub>1</sub> Gi) S $\rightarrow$ 1A gives S $\rightarrow$ C1A and C1 $\rightarrow$ 1 S $\rightarrow$ 0B gives S $\rightarrow$ C0B and C0 $\rightarrow$ 0 cii) A $\rightarrow$ 1AA gives A $\rightarrow$ C1AA and C3 $\rightarrow$ 1 D $\rightarrow$ 0S gives A $\rightarrow$ C0S and C0 $\rightarrow$ 0	• • •	Reduced Grammar G = { VN', Z', P', S}
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STEP 1 There are no null of unit productions here.  STEP-2  Elimination of terminal on R.H.S.  Let $G_1 = (V_1 , S_1, P_1, S_2)$ i) $A \rightarrow 0$ , $B \rightarrow 1$ are included in $P_1$ ii) $S \rightarrow 1A$ gives $S \rightarrow C_1A$ and $C_1 \rightarrow 1$ $S \rightarrow 0B$ gives $S \rightarrow C_0B$ and $C_0 \rightarrow 0$ iii) $A \rightarrow 1AA$ gives $A \rightarrow C_1AA$ and $C_1 \rightarrow 1$ $A \rightarrow 0S$ gives $A \rightarrow C_1AA$ and $C_1 \rightarrow 0$	(§)	3 -> 1A   OB
STEP 1 There are no null of unit productions here.  STEP-2  Elimination of terminal on R.H.S.  Let $G_1 = (VN, S_1, P_1, S_2)$ i) $A \rightarrow 0$ , $B \rightarrow 1$ are included in $P_1$ ii) $S \rightarrow 1A$ gives $S \rightarrow C_1A$ and $C_1 \rightarrow 1$ $S \rightarrow 0B$ gives $S \rightarrow C_0B$ and $C_0 \rightarrow 0$ iii) $A \rightarrow 1AA$ gives $A \rightarrow C_1AA$ and $C_1 \rightarrow 1$ $Q \rightarrow 0S$ gives $A \rightarrow C_1AA$ and $C_2 \rightarrow 0$		
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STEP-2  Elimination of terminal on R.H.S.  Let $G_1 = (VN_1, \Sigma_1, P_1, S)$ i) $A \to 0$ , $B \to 1$ are included in $P_1$ ii) $S \to 1A$ gives $S \to C_1A$ and $C_1 \to 1$ $S \to 0B$ gives $S \to C_0B$ and $C_0 \to 0$ iii) $A \to 1AA$ gives $A \to C_1AA$ and $C_1 \to 1$ $A \to 0S$ gives $A \to C_1AA$ and $C_2 \to 0$	CTO1 TO	
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Let $G_1 = (VN, S_1, P_1, S)$ i) $A \rightarrow 0, B \rightarrow 1$ are included in $P_1$ ii) $S \rightarrow 1A$ gives $S \rightarrow C_1A$ and $C_1 \rightarrow 1$ $S \rightarrow 0B$ gives $S \rightarrow C_0B$ and $C_0 \rightarrow 0$ iii) $A \rightarrow 1AA$ gives $A \rightarrow C_1AA$ and $C_0 \rightarrow 0$ $A \rightarrow 0S$ gives $A \rightarrow C_0S$ and $C_0 \rightarrow 0$	STE	P-2
(i) $A \rightarrow 0$ , $B \rightarrow 1$ are included in $P_1$ (ii) $S \rightarrow 1A$ gives $S \rightarrow C_1A$ and $C_1 \rightarrow 1$ $S \rightarrow 0B$ gives $S \rightarrow C_0B$ and $C_0 \rightarrow 0$ (iii) $A \rightarrow 1AA$ gives $A \rightarrow C_1AA$ and $C_0 \rightarrow 0$ $Q \rightarrow 0S$ gives $A \rightarrow C_0S$ and $C_0 \rightarrow 0$		Elimination of terminals on R-H.S.
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S $\rightarrow$ 08 gives S $\rightarrow$ CoB and Co $\rightarrow$ 0 cii) A $\rightarrow$ 1AA gives A $\rightarrow$ CoAA and Co $\rightarrow$ 1 Q $\rightarrow$ 0S gives A $\rightarrow$ CoS and Co $\rightarrow$ 0		
(iii) $A \rightarrow 1AA$ gives $A \rightarrow C_1AA$ and $C_2 \rightarrow 1$ $Q \rightarrow OS$ gives $A \rightarrow C_2S$ and $C_2 \rightarrow 0$		$S \rightarrow OB$ gives $S \rightarrow CoB$ and $Co \rightarrow O$
$A \rightarrow OS$ gives $A \rightarrow CoS$ and $Co \rightarrow O$ (iv) $B \rightarrow OBB$ gives $B \rightarrow CoBB$ and $Co \rightarrow O$ $B \rightarrow 1S$ gives $B \rightarrow CoS$ and $Co \rightarrow O$		
(iv) $B \rightarrow OBB$ Ugives $B \rightarrow CoBB$ and $Co \rightarrow O$ $B \rightarrow 15$ gives $B \rightarrow CoBB$ and $Co \rightarrow 1$		A -> OS gives A -> CoS and Co -> O
$B \rightarrow 15$ gives $B \rightarrow C_1S$ and $C_1 \rightarrow 1$		(iv B → OBB gives B → CoBB and Co → O
U		$B \rightarrow 15$ gives $B \rightarrow CIS$ and $CI \rightarrow 1$
		U

1-1-1	Hence VN' = SS, A, B, Co, C13
	P. = S S > CALCOR A > CALCOSIO
	$P_{i} = \begin{cases} S \rightarrow C_{i}A \mid C_{0}B, A \rightarrow C_{i}AA \mid C_{0}S \mid O \\ B \rightarrow C_{0}BB \mid C_{1}S \mid 1, C_{0}\rightarrow 0, C_{1}\rightarrow 1 \end{cases}$
	10 / 000 / 010   12 , 00 / 01 / 12
	STEP-3
	Restricting the number of variables on R.H.S
	let G2 = (Vn", Z1, P2, S)
	i) S > CIA COB, A -> COS O, B -> CIS, 1, Co -> 0,
	C1-> 1 are added to P2 as they are in required
-	form.
	ci) A → CIAA gives A → CIC' C' → AA
	$A \rightarrow CAA$ gives $A \rightarrow CC'$ $C' \rightarrow AA$ $B \rightarrow COBB$ gives $B \rightarrow COC''$ $C'' \rightarrow BB$
	Hence UN" = 3 S, A, B, Co, C1, C', C"?
	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
	$B \rightarrow CoC'' \mid C_1S \mid 1, C_0 \rightarrow 0, C_1 \rightarrow 1,$
-	$C' \rightarrow AA$ , $C'' \rightarrow BB$ ?
	Ge is the required gramman.
	V
	6) 0 0 0
	(3.) S -> SbS a String: abababa
	Leftmost Derivation.
	$S \rightarrow SbS \rightarrow abS \rightarrow abSbS \rightarrow ababS$
	$\rightarrow$ abab 868 $\rightarrow$ ababab $\rightarrow$ abababa

Right most Derivation:
S -> SbS -> Sba -> SbSba -> Sbaba -> SbSbaba -> Sbababa> abababa
Another night most Degination for abababa:
S→ SbS → SbSbS → SbSbSba → SbSbaba → Sbababa → abababa
Since we have more—than one degivation for abababa, the grammar is ambiguous.
(4) L- { an2   n713
To show it is not context free.
Stelp 1 Assume L is context free. Let in be the natural number obtained by using the pumping lemma.
Step 2  Let $z = \alpha^{n^2}$ .
We write $z = uvwxy$ where $1 \le  vx  \le n$ (This is possible because $ vwx  \le n$ by pumping
lemma')
$\frac{\text{Let }  VX  = m, m \leq n}{\text{By pumping Lemma, } uv^2wx^2y \text{ is in } L.}$

As $ uv^2wx^2u  > n^2$ $ uv^2wx^2y  = K^2$ where
As $\left  uv^2wx^2y \right  > n^2$ , $\left  uv^2wx^2y \right  = K^2$ where $  K > n+1   \rightarrow 1$ .
But $\left uv^2wx^2y\right  = n^2 + m < n^2 + 2n + 1 \longrightarrow 2$
From (1) 2 (2)
uv²wx²y  strictly lies between n² and (n+1)² which means uv²wx²y & L.
(n+1)2 which means uv2wxy & L.
This is a contradiction.
Hence San2: n > 1 ] is not context free.
PUMPING TEMMA FOR CFL:
let L be a CFL. Then we can find a natural
number n such that:
in Every ZEL with  z  = n can be written as
uvwxy for some string u, v, w, x,y
(i) (vx) > 1
$(iii)   \forall WX   \leq n$
(iv) uvkwxky EL + K20)