Q1 Give a simple description of the language generated by the grammar with productions

$S \to aA \quad P_1$

$A \to bS \quad P_2$

$S \to \wedge \quad P_3$

Sol:

$$S \overset{P_1}{\Rightarrow} aA \overset{P_2}{\Rightarrow} abS \overset{P_1}{\Rightarrow} abaS \overset{P_2}{\Rightarrow} ababS$$

$$\Rightarrow ab.ab.ab.....S$$

$$\overset{P_3}{\Rightarrow} (ab)^n \wedge \quad \wedge \in L(G)$$

$$(ab)^n \in L(G)$$

Therefore $L(G) = \{(ab)^n : n \geq 0\}$

Q 2 Let $\Sigma = \{a, b\}$ Find G

$L = \{a^n b^m : n \geq 0, m > n\}$

Sol: Generate an equal number of a's & b's then one or more b's as needed.

$S \to AB$

$A \to aAb \mid \wedge$

$B \to bB \mid b$

Q 3 $L = \{a^n \cdot b^{n-3} : n \geq 3\}$ find G

Sol put $n = m + 3$

$L = \{a^{m+3} \cdot b^m : m \geq 0\}$

So $S \to aaaA$

$A \to aAb \mid \wedge$

Q4: $L = \{w : |w| \bmod 3 = 0\}$ find G when $\Sigma = \{a\}$

Sol $\because |w| \bmod 3 = 0$ shows w is multiple of 3

i.e $L = \{\wedge, aaa, aaaaaa, aaaaaaaaa, \ldots\}$

$\therefore S \to aaaS \mid \wedge$

Q5: $L = \{w : |w| \bmod 3 > 0\}$ where ~~$w \in \{a\}$~~ $\Sigma = \{a\}$ Q7 ©

find G

Sol:

$\because |w| \bmod 3 > 0$

$\therefore |w| \bmod 3 = 1 \rightarrow (1)$

$|w| \bmod 3 = 2 \rightarrow (2)$

First is covered by

$$S_1 \rightarrow aaa S_1 \mid a$$

Second is covered by.

$$S_2 \rightarrow aaa S_2 \mid aa$$

The two can be combined into a single grammar by.

$$S \rightarrow S_1 \mid S_2$$

Q6: $L = \{w : n_a(w) = n_b(w) \quad w \in \{a,b\}^*\}$

w has equal no of a & b

Sol using the concept of balanced parenthesis

$S \rightarrow S.S$

$S \rightarrow aSb$

$S \rightarrow bSa$ (change) → differ from balanced parenthesis

$S \rightarrow \wedge$

Q7: $L = \{w : n_a(w) = n_b(w) + 1\}$ find G

$S \rightarrow aS_1$ (If string start with a)

$S \rightarrow S_1 S$ (If string start with b)

$S_1 \rightarrow S_1 S_1$

$S_1 \rightarrow aS_1b \mid bS_1a \mid \wedge$

Q7 ⓒ Find the grammar that generates

$$L = \{ a^n b^m : (n+m) \text{ is even} \}$$

Sol

$$S \rightarrow A_e B_e \mid A_o B_o$$

$$A_e \rightarrow aaA_e \mid \Lambda$$

$$B_e \rightarrow bbB_e \mid \Lambda$$

$$A_o \rightarrow aA_e$$

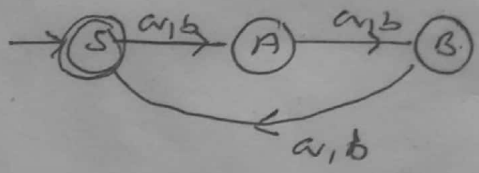
$$B_o \rightarrow bB_e$$

Q7 ⓓ Find Grammar for $L = \{ w : |w| \bmod 3 = 0 \}$ $w \in \{a,b\}^*$

$$S \rightarrow \Lambda \mid aA \mid bB$$

$$A \rightarrow aB \mid bB$$

$$B \rightarrow aS \mid bS$$



(IV)

(VII) Q. Construct a grammar for palindrome strings over $\Sigma = \{a, b, c\}$.

Sol

$S \rightarrow aSa$
$S \rightarrow bSb$
$S \rightarrow cSc$
$S \rightarrow a|b|c|\Lambda$

(VI) Q. Find the context-free grammars that generate the language:

$L = \{ a^i b^j c^k \mid i = j+k \}$.

$a^{j+k}\, b^j\, c^k$

$a^k [a^j b^j] c^k$

$a S c \mid A$

Sol

$S \rightarrow aSc \mid A \mid \Lambda$
$A \rightarrow aAb \mid \Lambda$

(V) Q. Construct a CFG for the following language set

$L = \{ a^{2n} b^n : n \geq 1 \}$

Sol

$S \rightarrow aaSb \mid aab$

Q. $L(G) = \{ w \in \{a, b\}^* : w$ has equal no. of a's & b's $\}$

Sol

$S \rightarrow aB \mid bA$
$A \rightarrow aS \mid bAA \mid a$
$B \rightarrow bS \mid aBB \mid b$