$(a+b)^* \Rightarrow aX \mid bX \mid \epsilon$

Q) Construct CFG for the following

(1) Alternate sequence of 0's & 1's starting with

$\Rightarrow S \rightarrow 01S \mid 01$

(2) Do not contain 3 consecutive a over {a, b}

$\Rightarrow S \rightarrow aX \mid bX \mid \epsilon$
$X \rightarrow aY \mid bX \mid \epsilon$
$Y \rightarrow bS \mid \epsilon$

(3) $L = \{ x \in \{0,1\}^* \mid x$ has equal number of 0's and 1's $\}$

$\Rightarrow RE = (01+10)^*$
$S \rightarrow 01S \mid 10S \mid \epsilon$

(4) Design a CFG over {a, b} to accept set of all palindromes.

$\Rightarrow$ (i) Even palindrome
$S \rightarrow aSa \mid bSb \mid \epsilon$

(ii) Odd palindrome
$S \rightarrow aSa \mid bSb \mid a \mid b$

(5) Starting & ending with different letter over {a, b}

$\Rightarrow RE = a(a+b)^*b + b(a+b)^*a$

$S \rightarrow aXb \mid bXa$
$X \rightarrow aX \mid bX \mid \epsilon$

(6) $L = \{ 0^n 1^{2n} \mid n \geq 0 \}$

$\Rightarrow S \longrightarrow 0 S 11 \mid \epsilon$

(7) $a^{2n} b^n$

$\Rightarrow S \longrightarrow aaSb \mid \epsilon$

(8) $(110 + 11)^* (10)^*$

$\Rightarrow S \rightarrow 110S \mid 11S \mid A$

$A \rightarrow 10A \mid \epsilon$

(9) $(11)^* (010 + 01)^*$

$\Rightarrow S \rightarrow 11S \mid A$

$A \rightarrow 010S \mid 01S \mid \epsilon$