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TOA

ASSIGNMENT #2

Q:1) Generate (Context Free Grammer) CFGs for the following:

a) $(ab+ba)^* \cdot ba$

Language = { bba, abbba, babba, abbabba, baabbba, ababbba ..... }

CFG:

$S \rightarrow Abba$

$A \rightarrow abA \mid baA \mid \varepsilon$

b) $L = \{ a^n b^m c^m d^n ; n, m >= 2 \}$

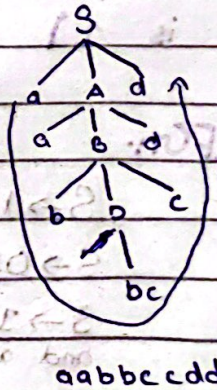
CFG:

$S \rightarrow aSd \mid aAd$

$A \rightarrow aAd \mid aBd$

$B \rightarrow bBc \mid bDc$

$D \rightarrow bDc \mid bc$



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3 c) A language with words that have equal no of a's and b's (in no particular order)

$L = \{ ab, ba, abba, baab, abab, baba, bbaa, aabb \ldots \}$

CFG:-

$S \rightarrow aSb \mid bSa \mid \varepsilon$

d) $a^i b^j c^k \mid i, j, k \geq 0$ and $i = j$ or $i = k$

$i = j$ (k can be any value

$i = k$ (j can be any value

CFG

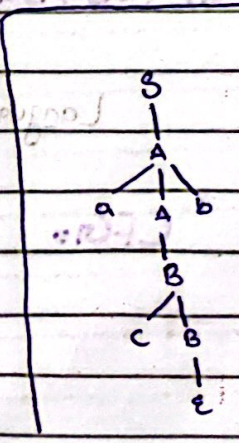
$S \rightarrow AC$

$A \rightarrow aAb \mid B$

$B \rightarrow bBc \mid \varepsilon$

$C \rightarrow aCc \mid D$

$D \rightarrow bD \mid \varepsilon$



e) $\{ x \in \{0,1\}^* \mid$ the length of w is odd and middle symbol is 1 $\}$

CFG:-

S → 1 (This ensures that middle symbol is 1)

S → 0S0 (ensure its length is odd by adding '0' on both side)

S → 1S1 (ensure it length is odd by adding '1' on both side) and all combination

So,

$S \rightarrow 1 \mid 0S0 \mid 1S1 \mid 0S1 \mid 1S0$

f) $\{i^a j^b k^c \mid a,b,c \geq 0 \text{ and } a+b=c\}$

$S \rightarrow iSK$ (add one 'i' and one 'k' simultaneously)

$S \rightarrow jAK$ (add one 'j' and one 'k' simultaneously)

$S \rightarrow \varepsilon$ (if $a+b=c=0$)

So CFG:-

~~$S \rightarrow iSK \mid jAK \mid \varepsilon$~~

$S \rightarrow iSK \mid A \mid \varepsilon$

$A \rightarrow jAK \mid \varepsilon$

g) $\{x \in \{0,1\}^* \mid$ Symbol at position is same as symbol at position $i+2$ and $|x| \geq 2\}$

CFG:-

$S \rightarrow A \mid B \mid C \mid D$

$A \rightarrow 00A \mid 00$

$B \rightarrow 11B \mid 11$

$C \rightarrow 10C \mid 10$

$D \rightarrow 01D \mid 01$

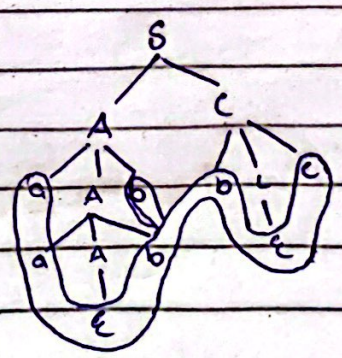
h) $L = \{a^i b^j c^k ; j = i+k ; i \geq 0 ; k \geq 0\}$

CFG:-

$S \rightarrow AC \mid \varepsilon$

$A \rightarrow aAb \mid \varepsilon$

$C \rightarrow bCc \mid \varepsilon$



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i) $L = \{a^i b^j c^k ; i \leq j ; i \geq 0 ; k \geq 0\}$

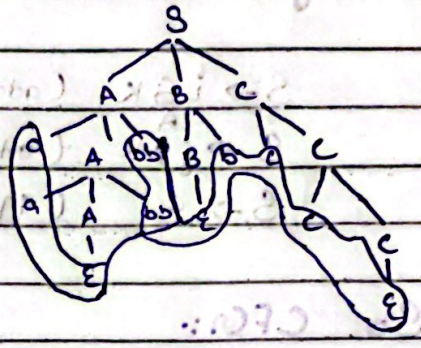
CFG:-

$S \rightarrow ABC \mid \varepsilon$

$A \rightarrow aAbb \mid aAb \mid \varepsilon$

$B \rightarrow Bb \mid \varepsilon$

$C \rightarrow cC \mid \varepsilon$



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j) $L = \{a^i b^j c^k ; i \geq j ; i \geq 0 ; k \geq 0\}$

$a^2 b^2 c^4$

CFG:-

$S \rightarrow AB \mid \varepsilon$

$B \rightarrow cB \mid \varepsilon$

$A \rightarrow aaXAb \mid \varepsilon$

$X \rightarrow aX \mid \varepsilon$