Practice CFG

U20CS110
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Ques-1 Convert the following grammer into CNF

1. $S \to BAB \mid B \mid \varepsilon$
   $B \to 00 \mid \varepsilon$

$S \to B \mid \varepsilon$ removal of useless symbol
$B \to 00 \mid \varepsilon$

$S \to B \mid \varepsilon$ (removal of ε product^n)
$B \to 00$

$S \to 00 \mid \varepsilon$ (removal of unit produc^n)

$S \to XY \mid \varepsilon$
$X \to 0$
$Y \to 0$

(restricting it to one-terminal or 2 non-terminals)

CNF

2. $S \to aAbB$
   $A \to aA \mid a$
   $B \to bB \mid b$

$S \to PAQB$ $P \to a$ $Q \to b$

$A \to PA \mid a$
$B \to QB \mid b$

$\Rightarrow S \to XY$

$A \to PA \mid a$
$B \to QB \mid b$
$P \to a$
$Q \to b$
$X \to PA$
$Y \to QB$

CNF

3→ $S \to 1A \mid 0B$
$A \to 1AA \mid 0S \mid 0$
$B \to 0BB \mid 1S \mid 1$

⇒ $S \to XA \mid YB$ (mixed string → solid NT)
$A \to XAA \mid YS \mid 0$
$B \to YBB \mid XS \mid 1$

⇒ $S \to XA \mid YB$
$A \to PA \mid YS \mid 0$ (n length NT → 2 length NT)
$B \to 0B \mid XS \mid 1$
$P \to XA$
$0 \to YB$ CNF

4→ $S \to aAD$
$A \to aB \mid bAB$
$B \to b$
$D \to d$

⇒ $S \to XAB$
$A \to XB \mid BAB$ (mixed string → Solid NT)
$B \to b$
$D \to d$

⇒ $S \to PD$
$A \to XB \mid 0B$ (n length NT → 2 length NT)
$P \to XA$
$0 \to BA$
$B \to b$
$D \to d$ CNF

5. $S \to ASA \mid aB$
$A \to B \mid S$
$B \to b \mid \varepsilon$

$\Rightarrow$ $S \to ASA \mid aB \mid a$
$A \to B \mid S$ (removal 'ε' product^n)
$B \to b$

$\Rightarrow$ $S \to ASA \mid aB \mid a$
$A \to b \mid ASA \mid aB \mid a$ (removal of unit produc^n)
$B \to b$

$\Rightarrow$ $S \to ASA \mid XB \mid a$
$A \to b \mid ASA \mid XB \mid a$
$B \to b$ (mixed string $\to$ solid NT)
$X \to a$

$\Rightarrow$ $S \to PA \mid XB \mid a$
$A \to b \mid PA \mid XB \mid a$ (n length string $\to$ 2 length NT)
$B \to b$
$X \to a$
$P \to AS$ CNF

6 $\to$ $S \to SS \mid (S) \mid \varepsilon$

$S \to SS \mid (S) \mid ( )$
$S \to SS \mid LSR \mid LR$ (removal of ε produc^n)
$L \to ($
$R \to)$ (mixed string $\to$ solid NT)

$S \to SS \mid VR \mid LR$
$V \to LS$ (n length string $\to$ 2 length string)
$L \to ($ $R \to)$ CNF

Ques 1. Convert the following CFG into GNF

$S \to ABb \mid a$
$A \to aaA \mid b$
$B \to bAb \mid bBB \mid ABB \mid a$

⇒ $S \to ABY \mid a$
$A \to XXA \mid b$
$B \to YAY \mid YBB \mid ABB \mid a$
$X \to a$
$Y \to b$

(mixed string → solid NT)

$S \to AP \mid a$
$A \to X\Theta \mid b$
$B \to YR \mid YT \mid AT \mid a$
$X \to a$
$Y \to b$
$P \to BY$
$\Theta \to XA$
$R \to AY$
$T \to BB$

(Converted to CNF)

CNF

$S \to bP \mid a$
$A \to a\Theta \mid b$
$B \to bR \mid bT \mid a$
$X \to a$
$Y \to b$
$P \to aY$
$\Theta \to aA$
$R \to bY$
$T \to aB$

(Converted to GNF)

(GNF)

2→ $S \to AB$
$A \to BS \mid b$
$B \to SA \mid a$

$S \to AB$
$A \to BAB \mid b$ (removal of left recursion)
$B \to ABA \mid a$

$S \to bB$
$A \to aAB \mid b$ (Converted to GNF)
$B \to bBA \mid a$

3. $E \to E+T \mid T$
$T \to T*F \mid F$
$F \to id \mid (E)$

⇒ $E \to TE'$
$E' \to +TE' \mid \varepsilon$
$T \to FT'$
$T' \to FT' \mid \varepsilon$ (removal of left recursion)
$F \to id \mid (E)$

$E \to TE' \mid T$
$E' \to +TE' \mid +T$
$T \to FT' \mid F$
$T' \to *FT' \mid *F$ (removal of Null product^n)
$F \to id \mid (E)$

⇒ $E \to TE' \mid FT' \mid id \mid (E)$
$E' \to +TE' \mid +T$
$T \to FT' \mid id \mid (E)$
$T' \to *FT' \mid *F$ (removal of unit product^n
$F \to id \mid (E)$

⇒
E → TE' | FT' | ID | LER
E' → PTE' | PT
T → FT' | ID | LER
T' → MFT' | MF
F → ID | LER
I → i
D → d
P → +
M → *
L → (
R →)

[removal of mixed string and converting into solid NT

⇒
E → TE' | FT' | ID | LX
E' → PY | PT
T → FT' | ID | LX
T' → MZ | MF
F → ID | LX
I → i
D → d
P → +
M → *
L → (
R →)
X → ER
Y → TE'
Z → FT'

(Converted into CNF)

→

E → iDE' | iDT' | iD | (X
E' → +Y | +T
T → iT' | iD | (X
T' → *Z | *F
F → iD | X
I → i
D → d
P → +
M → *
L → (
R →)
X → iDR
Y → iT'E'
Z → iDT'

(Converted into GNF)

GNF