Assignment - 2

Date

Umamah Hussain

21L-1858

A.)
S → TU | V
T → aTb | ε
U → cU | ε
V → aVc | W
W → bW | ε

1.) Eliminate Epsilon Production

∴ T → ε
S → TU | V | U
T → aTb | ab
U → cU | ε
V → aVc | W
W → bW | ε

∴ U → ε
S → TU | V | U | T | ε
T → aTb | ab
U → cU | c
V → aVc | W
W → bW | ε

∴ W → ε
S → TU | V | U | T | ε
T → aTb | ab
U → cU | c
V → aVc | W | ε
W → bW | b

∴ V → ε
S → TU | V | U | T | ε
T → aTb | ab
U → cU | c
V → aVc | W | ac
W → bW | b

2.) Eliminate Unit Production

∴ S → V
S → U
S → T
V → W

S → TU | aVc | ac | bW | b | cU | c | aTb | ab | ε
T → aTb | ab
U → cU | c
V → aVc | bW | b | ac
W → bW | b

3.) Eliminate Useless Symbols

$S \to TU \mid aVc \mid ac \mid bW \mid b \mid cUc \mid c \mid aTb \mid ab \mid \varepsilon$
$T \to aTb \mid ab$
$U \to cUc \mid c$
$V \to aVc \mid bW \mid b \mid ac$
$W \to bW \mid b$

4.) Transformation

$A \to a$
$B \to b$
$C \to c$

$S \to TU \mid AVC \mid AC \mid BW \mid AB \mid CUc \mid c \mid ATB \mid b \mid \varepsilon$
$T \to ATB \mid AB$
$U \to CUc \mid c$
$V \to AVC \mid BW \mid b \mid AC$
$W \to BW \mid b$

$AV \to P$
$AT \to Q$

$S \to TU \mid PC \mid AC \mid BW \mid AB \mid CU \mid QB \mid c \mid b \mid \varepsilon$
$T \to QB \mid AB$
$U \to CUc \mid c$
$V \to PC \mid BW \mid AC \mid b$
$W \to BW \mid b$

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

1.) Add new starting state :
$S_0 \to S$
$S \to ASA \mid aB$
$A \to B \mid S$
$B \to b \mid \varepsilon$
$X \to A$

2.) Remove Null Production :

$\therefore B \to \varepsilon$

$S_0 \to S$
$S \to ASA \mid aB \mid a$
$A \to B \mid S \mid \varepsilon$
$B \to b$
$X \to A$

$\therefore A \to \varepsilon$
$S_0 \to S$
$S \to ASA \mid aB \mid a \mid SA \mid AS \mid S$
$A \to B \mid S$
$B \to b$
$X \to A \mid \varepsilon$

$\therefore X \to \varepsilon$
$S_0 \to S$
$S \to ASA \mid aB \mid a \mid SA \mid AS \mid S$
$A \to B \mid S$
$B \to b$
$X \to A$

3.) Remove Unit Production :
$\therefore S_0 \to S, \ S \to S, \ A \to B, \ A \to S, \ X \to A$

$S_0 \to ASA \mid aB \mid a \mid SA \mid AS$
$S \to ASA \mid aB \mid a \mid SA \mid AS$
$A \to b \mid ASA \mid aB \mid a \mid SA \mid AS$
$B \to b$
$X \to b \mid ASA \mid aB \mid a \mid SA \mid AS$

4.) Remove Useless Symbols :

$\therefore X$ will be removed since it's unreachable
$S_0 \to ASA \mid aB \mid a \mid SA \mid AS$
$S \to ASA \mid aB \mid a \mid SA \mid AS$
$A \to b \mid ASA \mid aB \mid a \mid SA \mid AS$
$B \to b$

5.) Retransform :
$S_0 \to XA \mid QB \mid SA \mid AS \mid a$
$S \to XA \mid QB \mid SA \mid AS \mid a$
$A \to XA \mid QB \mid SA \mid AS \mid a \mid b$
$B \to b$

$\therefore Q \to a$
$\therefore \underline{\underline{X \to AS}}$

C.) S → a | aA | aB
    A → aBB | ε
    B → Aa | b

1.) Remove Null Production:
  ∴ A → ε

  S → a | aA | aB
  A → aBB
  B → Aa | b | a

2.) Remove Unit Production:
  not needed

3.) Remove Useless Symbols:
  not needed

4.) Transforming:

  S → a | XA | XB
  A → XY
  B → AX | a | b
  X → a
  Y → BB