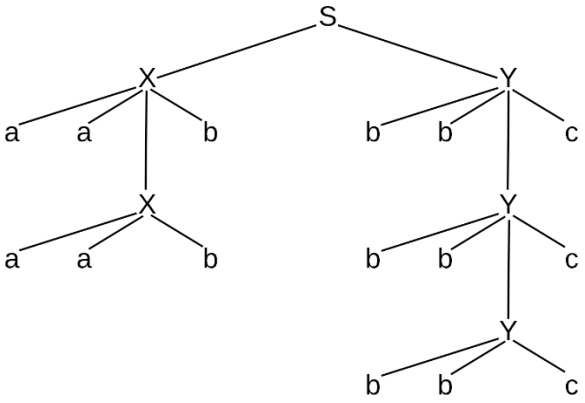
**Khuyen Le Thi Minh – s5128**

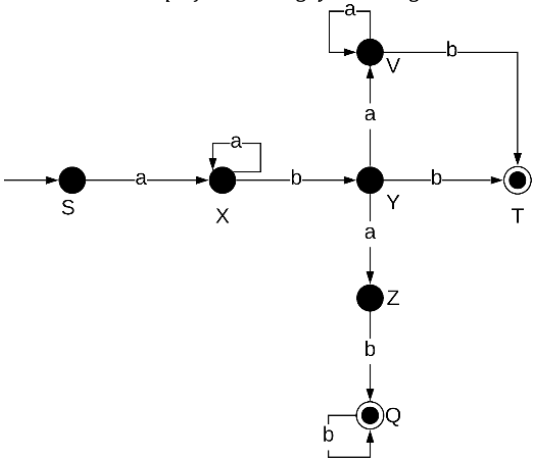
**Homework 08**

**1.** *Give a context – free grammar generating the language* $\{a^{2n}b^{n+2k}c^k : n, k \geq 1\}$.
*Give a derivation tree for the word aaaabbbbbbbbccc*

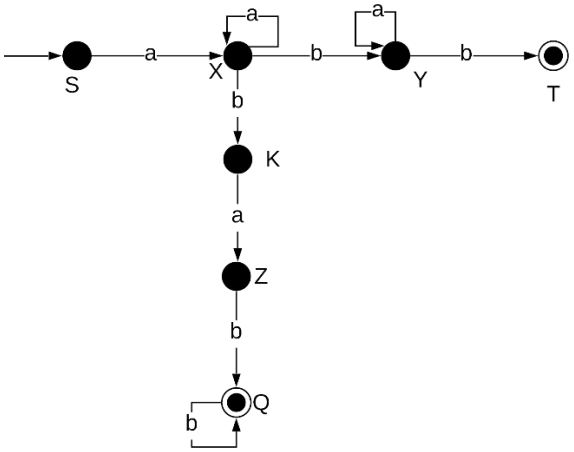
$a^{2n}b^{n+2k}c^k = a^{2n}b^n b^{2k}c^k$ *so we can devide the language to two part:* $X \to a^{2n}b^n$ *and* $Y \to b^{2k}c^k$
$S \to XY$
$X \to aab|aaXb$
$Y \to bbc|bbYc$
*Derivation tree for word aaaabbbbbbbbccc:*




**2.** *Give a linear grammar generating the language* $a^+b(a^*b|ab^+)$
$S \to XbYb|XbaZ$
$X \to aX|a$
$Y \to aY|\varepsilon$
$Z \to bZ|b$
*Attempt for strongly linear grammar*




$S \to aX$
$X \to aX|bY$
$Y \to aV|bT|aZ$
$V \to aV|bT$
$T \to \varepsilon$
$Z \to bQ$
$Q \to bQ|\varepsilon$
*Checking:*
$Q \to bQ|\varepsilon \Longrightarrow b^*$
$Z \to bQ \Longrightarrow bb^* = b^+$
$V \to aV|bT \Longrightarrow a^+b|b \Longrightarrow a^*b$
$Y \to aV|bT|aZ \Longrightarrow aa^*b|b|ab^+ \Longrightarrow a^+b|b|ab^+ \Longrightarrow a^*b|ab^+$
$X \to aX|bY \Longrightarrow a^+bY|bY \Longrightarrow a^*bY \Longrightarrow a^*ba^*b|a^*bab^+$
$S \to aX \Longrightarrow aa^*ba^*b|aa^*bab^+ \Longrightarrow a^+ba^*b|a^+bab^+ \Longrightarrow a^+b(a^*b|ab^+)$




$S \to aX$
$X \to aX|bY|bK$
$Y \to aY|bT$
$T \to \varepsilon$
$K \to aZ$
$Z \to bQ$
$Q \to bQ|\varepsilon$
*Checking:*
$Q \to bQ|\varepsilon \Longrightarrow b^*$
$Z \to bQ \Longrightarrow bb^* = b^+$
$K \to aZ \Longrightarrow ab^+$
$Y \to aY|bT \Longrightarrow a^+b|b \Longrightarrow a^*b$
$X \to aX|bY|bK \Longrightarrow a^+bY|bY|a^+bK|bK \Longrightarrow a^*bY|a^*bK$
$\Longrightarrow a^*ba^*b|a^*bab^+$
$S \to aX \Longrightarrow aa^*ba^*b|aa^*bab^+ \Longrightarrow a^+ba^*b|a^+bab^+$
$\Longrightarrow a^+b(a^*b|ab^+)$