⑦

b) $L = \{a^n b^m : n \neq m-1\}$

$S \to Ab$
$A \to aAb \mid$

c) $L = \{a^n b^m : n \neq 2m\}$

$S \to aaSb \mid A \mid B$
$A \to aA \mid a$
$B \to Bb \mid b \mid ab$

⑥ Eliminate useless Production:

eliminate $S \to B$
$S \to C$

$S \to a \mid aA \mid Aa \mid cCD$
$A \to aB \mid \lambda$
$B \to Aa$
$C \to cCD$
$D \to ddd \mid Cd$

⑦ Eliminate λ-Productions

Step1: eliminate $A \to \lambda$

$S \to aB \mid aaB$
$B \to bb \mid \lambda$

Step2: if $B \to \lambda$

$S \to a \mid aa \mid aB \mid aaB$
$B \to bb$

⑧

(b) $n = m$

$S \to AC$
$A \to aAb \mid$
$C \to cC \mid$

$m \neq k$

$S \to AC \mid TbBY \mid TYcC$
$A \to aTb \mid$
$C \to cC \mid$
$Y \to bYc \mid$
$B \to bB \mid b \mid$
$T \to aT \mid a \mid$

(c) $L = \{a^n b^m c^k : k = n+m\}$

$S \to aSc \mid k$
$A \to bAc \mid$

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⑤ Convert the grammar

$S \to AB \mid aB$
$A \to aab \mid \lambda$
$B \to bbA$

eliminate λ

$V_N = \{A\}$

$S \to AB \mid aB \mid B$
$A \to abb$
$B \to bbA \mid bb$

Substitution:

$S \to AB \mid aB \mid bbA \mid bb$
$A \to abb$
$B \to bbA \mid bb$

$S \to AB \mid XB \mid YYB \mid YY$
$A \to XYY$
$B \to YYA \mid YY$
$X \to a$
$Y \to b$

$S \to AB \mid XB \mid CB \mid C$
$A \to CX$
$B \to CA \mid C$
$C \to YY$

⑬ $S \to ABb \mid a$
$A \to aaA \mid B$
$B \to bAb$

$S \to A_1,\ A \to A_2,\ B = A_3$

$A_1 \to A_2A_3b \mid a$
$A_2 \to aaA_2 \mid A_3$
$A_3 \to bA_2b$

$A_1 \to A_2A_3b \mid a$
$A_1 \to aaA_2A_3b \mid A_3A_3b \mid a$
$A_1 \to aaA_2A_3b \mid bA_2bA_3b \mid a$

① CYK

$x_{1,2} = (x_{ii}, x_{i+1,j})$
$= (x_{11}, x_{22})$
$= BB \quad BB = BB$
$= \{A\}$

$x_{23} = x_{22}, x_{33}$
$= BB \quad AB$
$= AB \quad AB \quad BB \quad BB$
$= AB \quad BB$
$= SAB$

$x_{34} = (x_{33}, x_{44})$
$= AB \quad AB$
$= SB \quad SB$
$= SB$

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④ aaabbbbbab can't be constructed by CYK algorithm because S → b cannot take a terminal from any two productions.

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