6.1 a)

① $S \to a \mid \wedge \mid (T)$

② $T \to T, S \mid S$ ⎱

③ $T \to T, S \mid a \mid \wedge \mid (T)$

↓

$\begin{cases} T \to aT' \mid \wedge T' \mid (T)T' \\ T' \to , ST' \mid \varepsilon \\ S \to a \mid \wedge \mid (T) \end{cases}$

PROCEDURE S
begin if SYM= 'a' or '∧' then advance
    else if SYM = '('
        advance
        T;
        if SYM= ')' then advance
        else error
    else error
    end

PROCEDURE T

```
begin if SYM = 'a' or 'ʌ' then
            advance
            T';
        else if SYM = '(' then
            advance
            T;
            if  SYM = ')' then advance
            T'
            else  error
        else   error
        end

  PROCEDURE T'
begin if  SYM = ',' then  advance
      S; T';
   end
```

(b)
计算 FIRST 集和 FOLLOW 集
$T \rightarrow a T' | \wedge T' | (T) T'$

$T' \rightarrow , S T' | \varepsilon$

$S \rightarrow a | \wedge | (T)$

FIRST (S) = {a, ∧, (}
FIRST(T) = {a, ∧, (}
FIRST (T') = {',' }
FOLLOW (S) = {#, ',',) }
FOLLOW (T) = {) }
FOLLOW (T') = {) }

∴ 不含左递归且任意 A ∈ V_N, FIRST (A)∩FOLLOW(A)=∅
∴ 是 LL(1) 文法

	a	∧	(	)	,	#
S	S→a	S→∧	S→(T)			
T	T→aT'	T→∧T'	T→(T)T'			
T'				T'→ε	T'→,ST'	

6.2 (b). S→Ab
           A→ a|B|ε
           B→ b|ε
    ①:文法不含左递归

②:每个非终结符的产生式的候选首集两两不相交

$FIRST(S) = \{a, b\}$

$FIRST(A) = \{a, b\}$

$FIRST(B) = \{b\}$

$FOLLOW(S) = \{\#\}$

$FOLLOW(A) = \{b\}$

$FOLLOW(B) = \{b\}$

$FIRST(A) \cap FOLLOW(A) = \{b\} \neq \emptyset$

$FIRST(B) \cap FOLLOW(B) = \{b\} \neq \emptyset$

原文法可转换为

$S \rightarrow ab \mid bS'$

$S' \rightarrow b \mid \varepsilon$

此时 $FIRST(S) = \{a, b\}$

$FIRST(S') = \{b\}$

$FOLLOW(S) = \{\#\}$

$FOLLOW(S') = \{\#\}$

此时满足③

∴ (b)原文法不是 LL(1), 转换为

$S \rightarrow ab \mid bS'$

$S' \rightarrow b \mid \varepsilon$

是 LL(1)

(C) $S \rightarrow aSe \mid B$, $B \rightarrow bBe \mid C$ $C \rightarrow cCe \mid d$

$$FIRST(C) = \{c, d\}$$

$$FIRST(B) = \{b, c, d\}$$

$$FIRST(S) = \{a, b, c, d\}$$

易知 此文法无左递归且每个非终结符产生式的首字符集不相交

$$FOLLOW(S) = \{\#\}$$

$$FOLLOW(B) = \{\#, e\}$$

$$FOLLOW(C) = \{\#, e\}$$

∴ 每个非终结符 A，FOLLOW(A) ∩ FIRST(A) = ∅

此文法是 LL(1) 文法

6.3 $E \to EOE \mid Ui \mid (E) \mid i$　　$O \to + \mid *$　　$U \to + \mid -$

(a). $FIRST(U) = \{+, -\}$

$$FIRST(O) = \{+, *\}$$

$$FIRST(E) = \{+, -, (, i\}$$

$$FOLLOW(E) = \{\#, +, *,)\}$$

$$FOLLOW(O) = \{+, -, (, i\}$$

$$FOLLOW(U) = \{i\}$$

(b). 不是，原因如下　　存在左递归

(c) $E \to EOE \mid Ui \mid (E) \mid i$

↓

$E \rightarrow UiE' | (E)E' | iE' | U_i | (E) | i$

$E' \rightarrow OEE' | OE$

此时 FIRST 和 FOLLOW 集不相交，故是 LL(1)文法

(d). PROCEDURE O;

```
begin
    if    sym = '+' or '*'
    then    advance
    end;
PROCEDURE U;
    begin
        if    Sym = '+' or '-'
        then    advance;
        end
```

```
PROCEDURE E;
    begin   if   Sym = '(' then
            begin    advance
                E;
                if   Sym = ')' then
                    begin
                        advance;
                        E'
```

```
                end
            else  error
            end
        else if  sym = 'i'  then
            begin
                advance;
                E'  ;
            end
        else    begin
                V;
                if   sym = 'j'  then
                    advance
                    E;
                if  sym = 'i'  then
                    advance ;
                else   error
            else  error
            end;
        end;
(e)   bool   ana() {
        if (S. top () ==a && a == '#')
            return true;
```

```
        x = S.pop();
            if (isVN(x)) {
                if (M[x,a]) {
                    S.push (M[x,a])
                }
                else     call_error();
            }
        }
```

6.4.

(1) FIRST (P) = {int , d, print , ε}
    FIRST (Ď) = {ε , int}
      FIRST (D) = {int}
      FIRST (Š) = {ε, d, print}
      FIRST (S) = {d, print}
      FIRST (E) = {i, d}
    FOLLOW (P) = {#}
     FOLLOW (Ď) = {d, print, #}
     FOLLOW (D) = {d, print, #}
     FOLLOW (Š) = {#}
     FOLLOW (S) = {i}
     FOLLOW (E) = {*, T, ;}

(2). 有 Ď → ĎD 左递归 以及 E→ Et·|E*d

不是 (LL1) 文法

(3). $D \to \varepsilon | D D D$ 改为 $\begin{cases} D \to D' \\ D' \to D D' | \varepsilon \end{cases}$

$E \to i | d | E + i | E * d$ 改为

$\begin{cases} E \to i E' | d E' \\ E' \to + i E' | * d E' | \varepsilon \end{cases}$

此时所有产生式候选集无相同

转化为 (LL1)

(4)(5) 求法与 6.3 同理