8. Given the grammer

$S \to aABb$

$A \to c \mid \epsilon$

$B \to d \mid \epsilon$

i. Compute FIRST and FOLLOW sets

ii. Construct the predicitive parsing table

iii. Show that move made by the predicitive parser on the input ;acdb

Solⁿ:

$S \to aABb$

$A \to c \mid \epsilon$

$B \to d \mid \epsilon$

Compute first and follow sets

$FIRST(S) = FIRST(a)$

$= \{a\}$

$FIRST(A) = FIRST(c) \cup FIRST(\epsilon)$

$= \{c, \epsilon\}$

$FIRST(B) = FIRST(d) \cup FIRST(\epsilon)$

$= \{d, \epsilon\}$

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

FOLLOW (A)

$S \to aABb$

$A \to \alpha B \beta$

$FOLLOW(A) = FIRST(\beta)$

$FOLLOW(A) = FIRST(B)$

$= \{d, \epsilon\}$

$= \{d, \epsilon\} - \epsilon \cup FOLLOW(B)$

FOLLOW(A) = $\{d, \epsilon\} - \epsilon \cup \{b\}$
$= \{d, b\}$

FOLLOW(B)

$S \rightarrow aABb$
$A \rightarrow \alpha B \beta$

FOLLOW(A) = FIRST(β)

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

SYMBOL	FIRST	FOLLOW
S	$\{a\}$	$\{\$\}$
A	$\{c, \epsilon\}$	$\{d, b\}$
B	$\{d, \epsilon\}$	$\{b\}$

Non terminal	a	c	d	b	$
S	$S \rightarrow aABb$				SYNCH
A		$A \rightarrow c$	$A \rightarrow \epsilon$	$A \rightarrow \epsilon$	
B			$B \rightarrow d$	$B \rightarrow \epsilon$	

STACK	INPUT	REMARK
S$	;acdb $	Error SKIP ;
S$	acdb $	
aABb $	acdb $	
ABb $	cdb$	
cBb $	cdb $	
Bb$	db $	
db$	db $	
b$	b$	
$	$	

1. Construct predictive parsing table for the following grammar

$S \rightarrow aABb$
$A \rightarrow c|\epsilon$
$B \rightarrow d|\epsilon$

Solution:-

Computing the First and Follow sets for the given grammar

Consider the grammar,

$S \rightarrow aABb$

$$\text{First}(S) = \text{First}(a) = \{a\}$$

$A \rightarrow c|\epsilon$

$$\text{First}(A) = \text{First}(c) \cup \text{First}(\epsilon) = \{c\} \cup \{\epsilon\} = \{c\ \epsilon\}$$

$B \rightarrow d|\epsilon$

$$\text{First}(B) = \text{First}(d) \cup \text{First}(\epsilon) = \{d\} \cup \{\epsilon\} = \{d\ \epsilon\}$$

Follow sets:-

Consider the grammar,

$S \rightarrow aABb$

$$\text{Follow}(S) = \phi = \{\$\}$$

$A \rightarrow c|\epsilon$

Follow(A)

$S \rightarrow aABb$

It is in the form

$A \rightarrow \alpha B \beta$

Follow(A) = First(β)

Follow(B) = First(B)

$= \{d, \epsilon\}$

$= \{d, \epsilon\} - \epsilon \cup$ Follow(B)

$= \{d, \epsilon\} - \epsilon \cup \{b\}$

$= \underline{\{d, b\}}$

Follow(B)

$S \rightarrow aABb$

$A \rightarrow \alpha B \beta$

Follow(A) = First(β)

Follow(B) = First(b)

$= \underline{\{b\}}$

SYMBOL	FIRST	FOLLOW
S	{a}	{\$}
A	{c, ε}	{d, b}
B	{d, ε}	{b}

Nonterminal	a	c	d	b	\$
S	$S \rightarrow aABb$				SYNCH
A		$A \rightarrow c$	$A \rightarrow \epsilon$	$A \rightarrow \epsilon$	
B			$B \rightarrow d$	$B \rightarrow \epsilon$	

* Given the Grammer, $S \rightarrow (L) \mid a$
$L \rightarrow L, S \mid S$

(i) Do the necessary changes to make it suitable for LL(1) parser

(ii) Check the resultant grammer is LL(1) or not

(iii) Show the moves made by the predective parser on the input (a,(a,a))

Soln

$S \rightarrow (L) \mid a$

$L \rightarrow L, S \mid S$

As the given grammer is left recursive because of,

$L \rightarrow L, S \mid S$

First eliminate left recursion

$A \rightarrow A\alpha \mid B$

can be converted as
$A \rightarrow BA'$
$A' \rightarrow \alpha A' \mid \epsilon$

We can write $L \rightarrow L, S \mid S$ as

$L \rightarrow SL'$

$L' \rightarrow , SL' \mid \epsilon$

Now, the grammer taken for predective parsing

$S \rightarrow (L) \mid a$

$L \rightarrow SL'$

$L' \rightarrow , SL' \mid \epsilon$

Compute first and follow sets

$$\text{First}(S) = \text{First}(() \cup \text{First}(a)$$
$$= \{(\} \cup \{a\}$$
$$= \{(\; a\}$$

$$\text{First}(L) = \text{First}(S)$$
$$= \{(\; a\}$$

$$\text{First}(L') = \text{First}(,) \cup \text{First}(\epsilon)$$
$$= \{,\} \cup \{\epsilon\}$$
$$= \{, \epsilon\}$$

Follow(S) =

$$L \rightarrow SL'$$
$$A \rightarrow \alpha B \beta$$

$$\text{Follow}(B) = \text{First}(\beta)$$
$$\text{Follow}(S) = \text{First}(L')$$
$$= \{, \epsilon\}.$$
$$= \{, \epsilon\} - \epsilon \cup \text{Follow}(L')$$
$$= \{, \epsilon\} - \epsilon \cup \{)\}$$
$$= \{,) \; \$\}$$

Follow(L)

$$S \rightarrow (L)$$
$$A \rightarrow \alpha B \beta$$

$$\text{Follow}(B) = \text{First}(\beta)$$
$$\text{Follow}(L) = \text{First}())$$
$$= \{)\}$$

Follow (L')

$$L \rightarrow SL'$$

$$A \rightarrow \alpha B$$

$$\text{Follow}(B) = \text{Follow}(A)$$

$$\text{Follow}(L') = \text{Follow}(L)$$

$$= \{) \}$$

SYMBOL	FIRST	FOLLOW
S	$\{ (\; a \}$	$\{ , \;) \; \$ \}$
L	$\{ (\; a \}$	$\{) \}$
L'	$\{ , \; \epsilon \}$	$\{) \}$

Parsing Table

Non-Terminal-s	Inputs				
	a	(	)	,	$
S	$S \rightarrow a$	$S \rightarrow (L)$			
L	$L \rightarrow SL'$	$L \rightarrow SL'$			
L'			$L' \rightarrow \epsilon$	$L \rightarrow ,SL'$	

The above resultant grammer is in LL(1)

Moves made by a predictive parser on input (a,(a,a))

MATCHED	STACK	INPUT	ACTION
	S$	(a,(a,a))$	
	(L)$	(a,(a,a))$	$S \rightarrow (L)$
(	L)$	a,(a,a))$	Match (
(	SL')$	a,(a,a))$	$L \rightarrow SL'$
(	aL')$	a,(a,a))$	$S \rightarrow a$
(a	L')$	,(a,a))$	Match a
(a	,SL')$	,(a,a))$	$L' \rightarrow ,SL'$
(a,	SL')$	(a,a))$	Match ,
(a,	(L)L')$	(a,a))$	$S \rightarrow (L)$
(a,(	L)L')$	a,a))$	Match (
(a,(	SL')L')$	a,a))$	$L \rightarrow SL'$
(a,(	aL')L')$	a,a))$	$S \rightarrow a$
(a,(a	L')L')$	,a))$	Match a
(a,(a	,SL')L')$	,a))$	$L' \rightarrow ,SL'$
(a,(a,	SL')L')$	a))$	Match ,
(a,(a,	aL')L')$	a))$	$S \rightarrow a$
(a,(a,a	L')L')$	))$	Match a
(a,(a,a	)L')$	))$	$L' \rightarrow \epsilon$
(a,(a,a)	L')$	)$	Match)
(a,(a,a)	)$	)$	$L' \rightarrow \epsilon$
(a,(a,a))	$	$	Match)

9) Given the Grammer

$$S \to a \mid b \mid (L)$$

$$L \to L, S \mid S$$

(a) Construct 1st and follow sets.

(b) Construct Predictive parsing table.

(c) Show the moves mode by the predictive parser on the following Input ((a, b), a)

Soln :-

As the given Grammer is left Recursive because of

$$L \to L, S \mid S$$

first eliminate left Recursion

$$A \to A\alpha \mid \beta$$

Can be converted as $A \to \beta A'$

$$A' \to \alpha A' \mid \epsilon$$

we can write

$L \to L, S \mid S$ as

$$L \to SL'$$

$$L' \to , SL' \mid \epsilon$$

Know the Grammer taken for predictive parsing is

$$S \to (L) \mid a \mid b$$

$$L \to SL'$$

$$L' \to , SL' \mid \epsilon$$

Compute first and follow sets.

$$\text{first}(S) = \text{first}(() \cup \text{first}(a) \cup \text{first}(b)$$

$$= \{(\} \cup \{a\} \cup \{b\}$$

$$= \{(\ a\ b\}$$

$First(L) = First(S)$
$= \{a\ b\ c\}$

$first(L') = first(,) \cup first(\epsilon)$
$= \{,\ \epsilon\}$

FOLLOW :-

$FOLLOW(S) =$

$L \rightarrow SL'$
$A \rightarrow \alpha B \beta$

$FOLLOW(S) = First(L')$
$= \{,\ \epsilon\}$
$= \{,\ \epsilon\} - \epsilon \cup FOLLOW(L')$
$= \{,\ \epsilon\} - \epsilon \cup \{)\}$
$= \{,\ )\}$
$= \{,\ ),\ \$\}$

$FOLLOW(L) =$

$S \rightarrow (L)$
$A \rightarrow \alpha B \beta$

$FOLLOW(L) = first())$
$= \{)\}$

$FOLLOW(L') =$

$L \rightarrow SL'$
$A \rightarrow \alpha B$

$FOLLOW(L') = FOLLOW(L)$
$= \{)\}$

Symbol	first	follow
S	{ a b (}	{ ,) $ }
L	{ a b (}	{) }
L'	{ , ϵ }	{) }

Predictive Parsing table:

Non terminals	a	b	(	)	,	$
S	S -> a	S -> b	S -> (L)			
L	L -> SL'	L -> SL'	L -> SL'			
L'				L' -> ϵ	L' -> ,SL'	

iii) The moves made by the predictive parser for the following Input ((a, b), a)

Matched	STACK	INPUT	ACTION
	S$	((a,b),a)$	
	(L)$	((a,b),a)$	S->(L)
(	L)$	(a,b),a)$	Match (
(	SL')$	(a,b),a)$	L->SL'
(	(L)L')$	(a,b),a)$	S->(L)
((	L)L')$	a,b),a)$	Match (
((	SL')L')$	a,b),a)$	L->SL'
((	aL')L')$	a,b),a)$	S->a
((a	L')L')$	,b),a)$	Match a
((a	,SL')L')$	,b),a)$	L'->,SL'
((a,	SL')L')$	b),a)$	Match ,
((a,	bL')L')$	b),a)$	S->b
((a,b	L')L')$	),a)$	Match b
((a,b	)L')$	),a)$	L'->ϵ
((a,b)	L')$	,a)$	Match)
((a,b)	,SL')$	,a)$	L'->,SL'
((a,b),	SL')$	a)$	Match ,
((a,b),	aL')$	a)$	S->a
((a,b),a	L')$	)$	Match a
((a,b),a	)$	)$	L'->ϵ
((a,b),a)	$	$	Match)