

Sajid-VI Islam

2222219

Course Title: Compiler Construction

Course Code: CSE313

Assignment: 02

Section: 02

Submission Date: 07.05.2025

Assignment 2

$$1. S \rightarrow abABC / DE_2$$

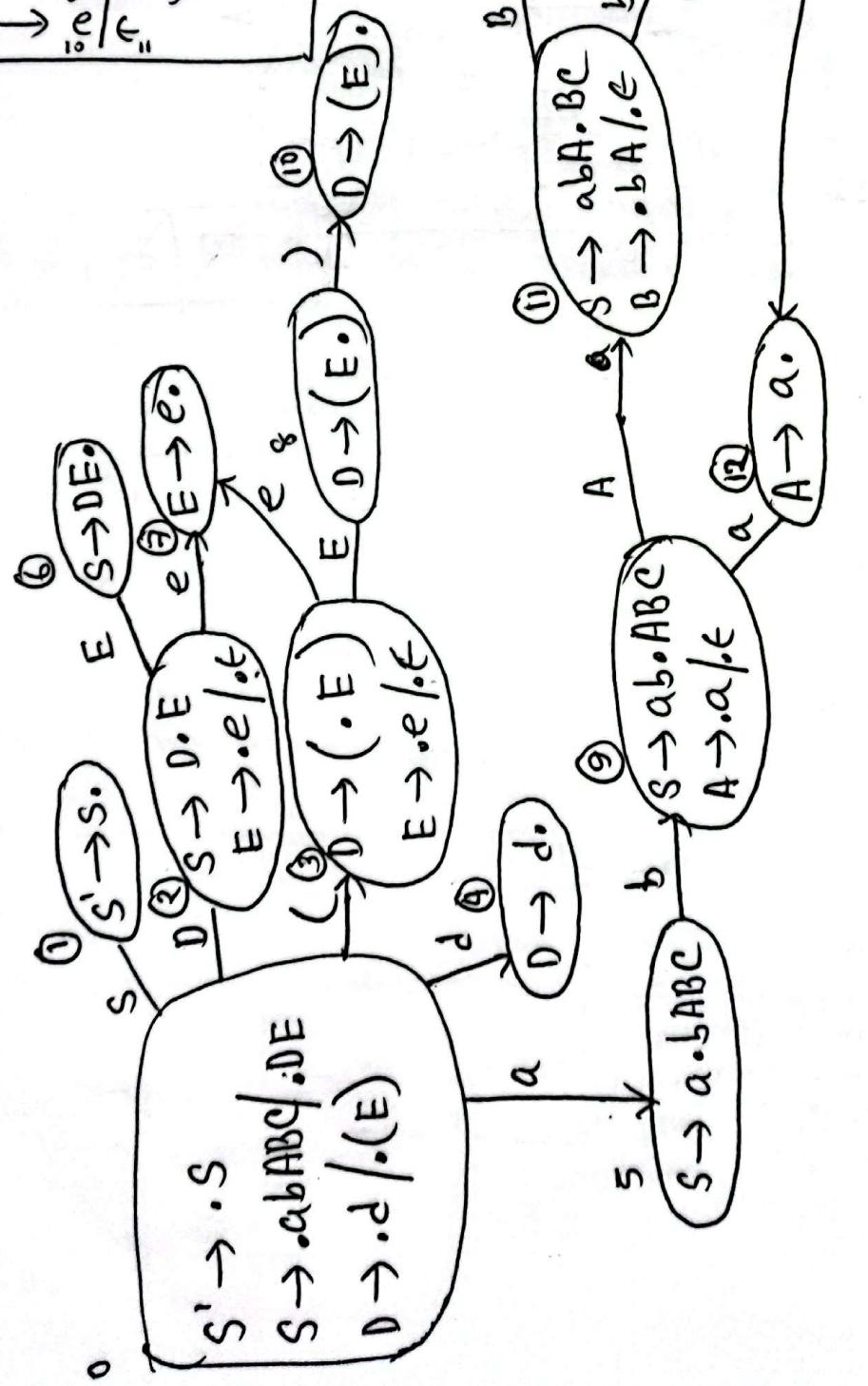
$$A \rightarrow a_3 / e_4$$

$$B \rightarrow b_5 A_6 / e_7$$

$$C \rightarrow c_8$$

$$D \rightarrow d_9 / (E_10)$$

$$E \rightarrow e_11 / e_12$$



State Transition Table for LR(0)

	a	b	c	d	e	(\$)	\$	S	A	B	C	D	E	Goto, V
0	S5			S4			S3		1					2
1														
2														
3	R11	R11	R11	R11	R11	R11	S7/R11	R11	R11	R11	R11	R11	R11	6
3	R11	R11	R11	R11	R11	R11	S7/R11	R11	R11	R11	R11	R11	R11	8
4	R8	R8	R8	R8	R8	R8	R8	R8	R8	R8	R8	R8	R8	
5		S9												
6	R2	R2	R2	R2	R2	R2	R2	R2	R2	R2	R2	R2	R2	
7	R10	R10	R10	R10	R10	R10	R10	R10	R10	R10	R10	R10	R10	
8														
9	S12/R4	R4	R4	R4	R4	R4	R4	R4	R4	R4	R4	R4	R4	11
10	R9	R9	R9	R9	R9	R9	R9	R9	R9	R9	R9	R9	R9	
11	R6	R6/S14	R6	R6	R6	R6	R6	R6	R6	R6	R6	R6	R6	13
12	R3	R3	R3	R3	R3	R3	R3	R3	R3	R3	R3	R3	R3	
13		S16												15
14	R4/S12	R4	R4	R4	R4	R4	R4	R4	R4	R4	R4	R4	R4	17
15	R1	R1	R1	R1	R1	R1	R1	R1	R1	R1	R1	R1	R1	
16	R2	R7	R2	R7	R7	R7	R7	R7	R7	R7	R7	R7	R7	
17	R5	R5	R5	R5	R5	R5	R5	R5	R5	R5	R5	R5	R5	

There are several conflicts in LR(0) Transition Table. So Parsing is not possible using LR(0).

State Transition Table for SLR(1)

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

$$\text{Follow}(c) = \{\$\}$$

action, T

$$\text{Follow}(A) = \{b, c\}$$

$$\text{Follow}(D) = \{e, \$\}$$

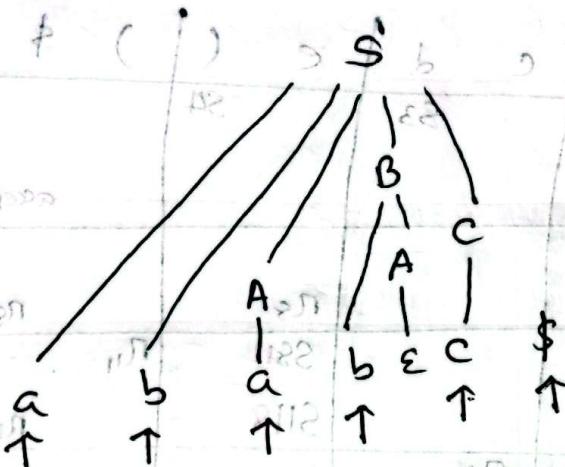
$$\text{Follow}(B) = \{c\}$$

$$\text{Follow}(E) = \{)\}, \$\}$$

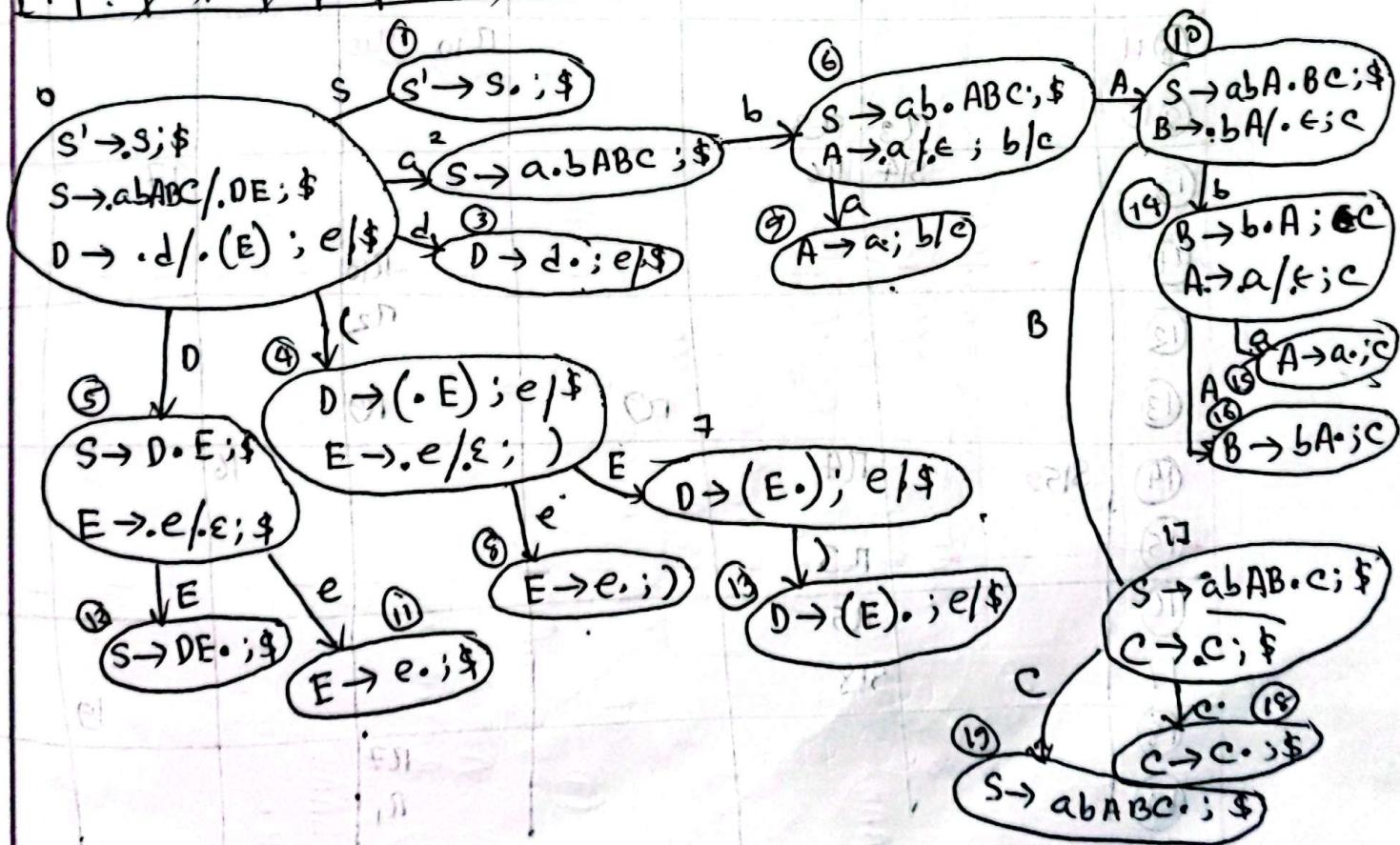
goto, V

	a	b	c	d	e	()	\$	S	A	B	C	D	E
0	s5			s4		s3			1					
1									accept					
2					s7		r11	r11					6	
3					s7		r11	r11					8	
4					r8		r11	r11					F	
5			s9	0/2									2	
6									r2					
7									r2					
8														
9	s12	r4	r4											
10					r9				r9					
11					s14	r6								
12			r3	r3										
13					s16									
14	s12	r4	r4											
15														
16					(c)4				r1					
17									r7					

Parsing Using SLR(1)



\$ 0 2 5 b g d 12 A 11 B 14 A 17 B 13 C 16 C 15 S 1 (\$\$) Accept



8 State Transition Table for CLR(1) and LALR(1)

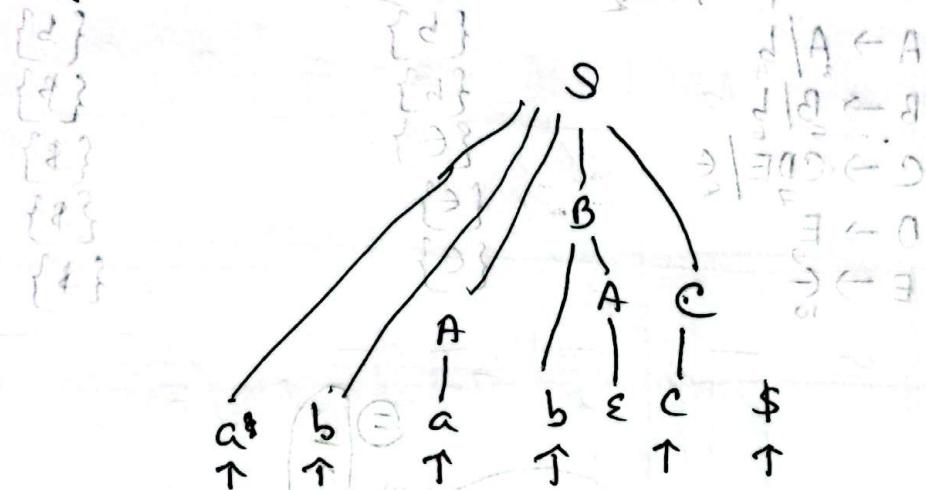
	a	b	c	d	e	()	\$	S	A	B	C	D	E
0	s2			s3		s4			1					5
1										accept				
2		s6												
3										r8A		r8		
4										r11				7
5										r11				12
6	s9	r4			r4								10	
7														
8										r10	r10			
9														
10														17
11														
12														
13														
14														16
15														
16														
17														
18														19
19														

PARSING Using CLR(1)

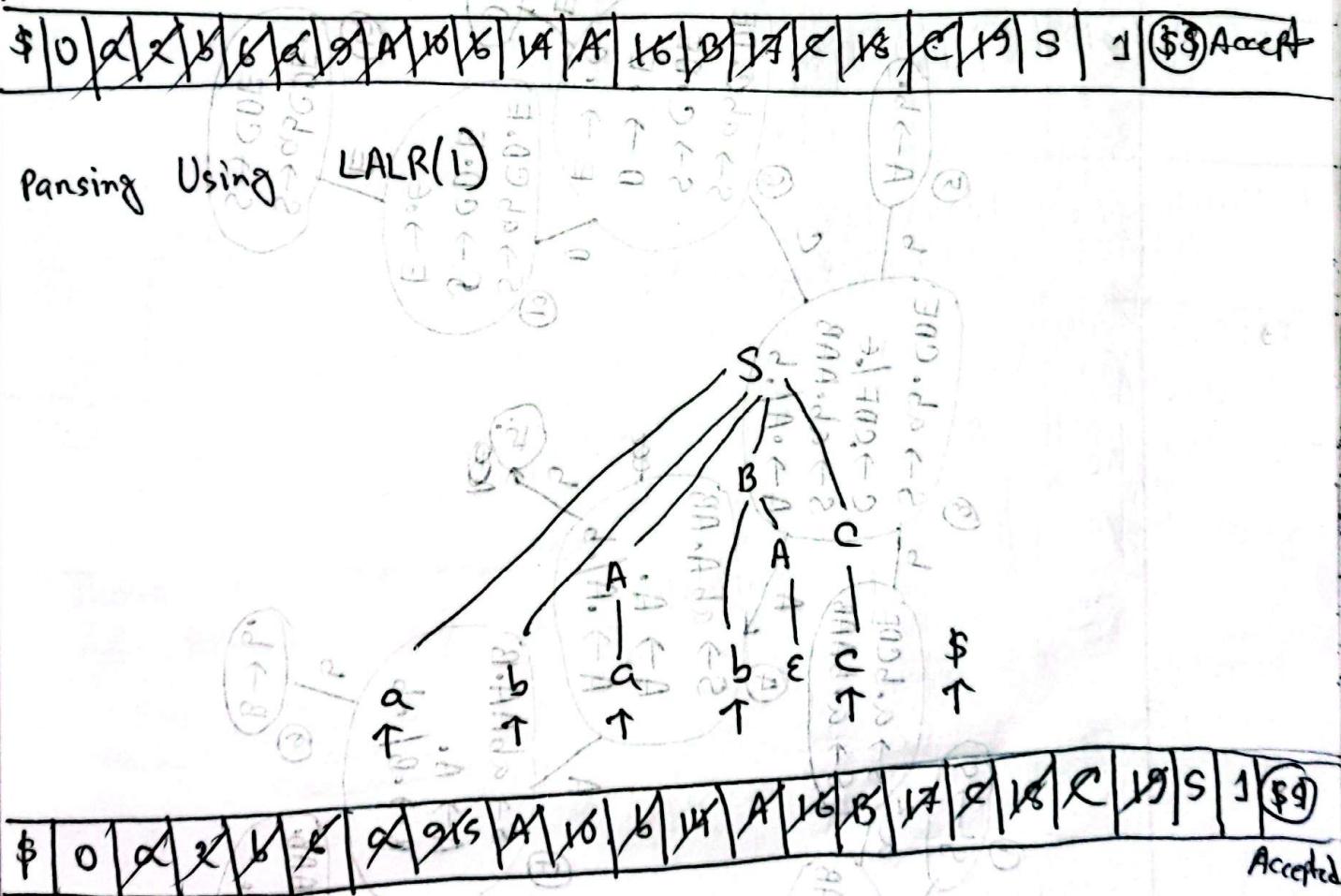
FOR F0M

T88LT

{P} {F} {PAAAH} {E} {GUE} {PAAAH}



PARSING Using LALR(1)



Accepted

FIRST

FOLLOW

$$2. S \rightarrow abCDE / abAAB$$

$$A \rightarrow A / b$$

$$B \rightarrow B / b$$

$$C \rightarrow CDE / \epsilon$$

$$D \rightarrow E$$

$$E \rightarrow \epsilon$$

{ a }

{ b }

{ b }

{ E }

{ E }

{ E }

(1) FIRST { \$ }

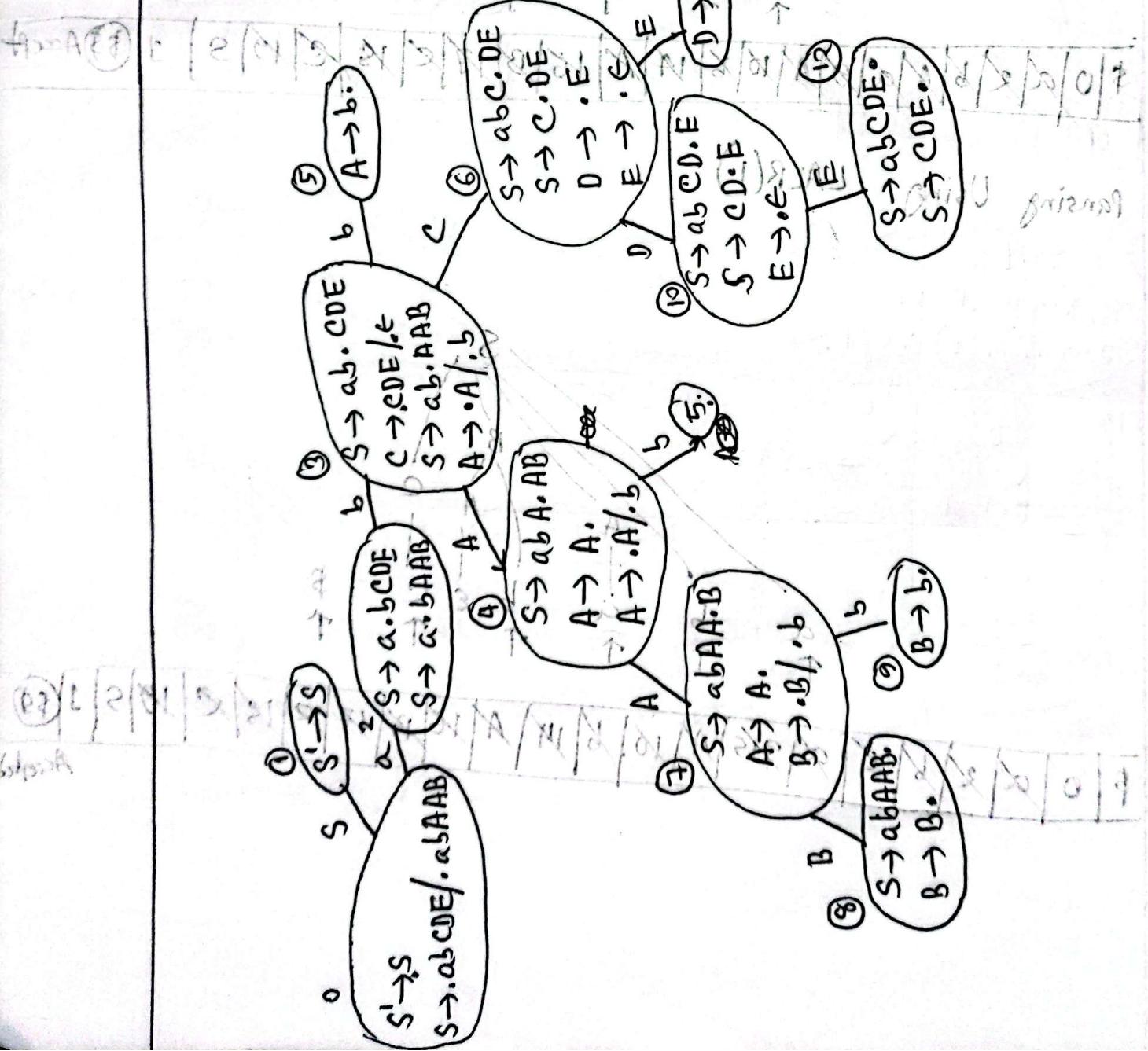
{ b }

{ \$ }

{ \$ }

{ \$ }

{ \$ }



State Transition Table for LR(0)

	α	a	b	T	\$	S	A	B	C	D	E
0		s_2				1				0	
①				accept						①	
2		s_3								3	
③	r_8		s_5/r_8		r_8		4		6		
④	r_3		s_5/r_3		r_3		7			9	
⑤	r_4		r_4		r_4					④	
⑥	r_{10}		r_{10}		r_{10}					10	11
⑦	r_3		s_9/r_3		r_3		9		8		
⑧	r_2/r_5		r_2/r_5		r_2/r_5					⑤	
⑨	r_6		r_6		r_6					⑥	
⑩	r_{10}		r_{10}		r_{10}					②	
⑪	r_9		r_9		r_9					⑦	
⑫	r_1/r_2		r_1/r_2		r_1/r_2		11			⑪	12

There are SR and RR conflict in the Table so parsing not possible using LR(0).

(1) r_2 follow as direct top parent of r_2

(2) r_2 follow as direct top parent of r_2

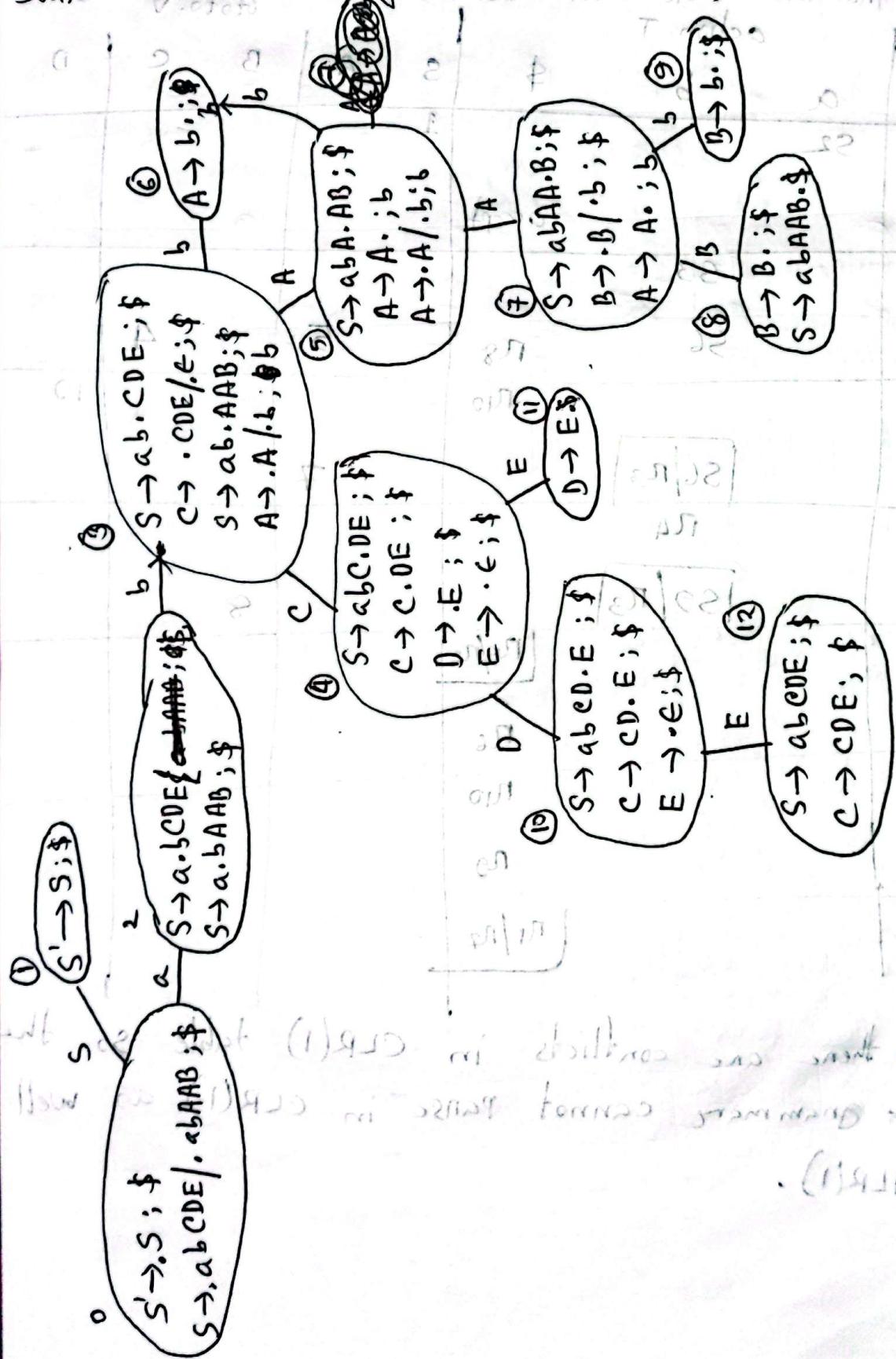
State Transition Table for SLR(1)

		a	b	\$	s	A	B	C	D	E
0	S2				1				2	0
①				accept						0
2	S3						3		3	2
③							3	3	3	3
④							4	4	4	4
⑤							5	5	5	5
⑥							6	6	6	6
⑦							7	7	7	7
⑧							8	8	8	8
⑨							9	9	9	9
⑩							10	10	10	10
⑪							11	11	11	11
⑫							12	12	12	12

There are RR and SR conflict in the table.

So Parsing not possible by using SLR(1)

State Transition Diagram for LR(0) and LALR(1)



State Transition Table for CLR(1)

So there are conflicts in CLR(1) table so the grammar cannot parse in CLR(1) as well as LALR(1).

3. $P \rightarrow SR/S$
 $R \rightarrow bSR/bS$
 $S \rightarrow WbS/W$
 $W \rightarrow L * W/L$
 $L \rightarrow id$

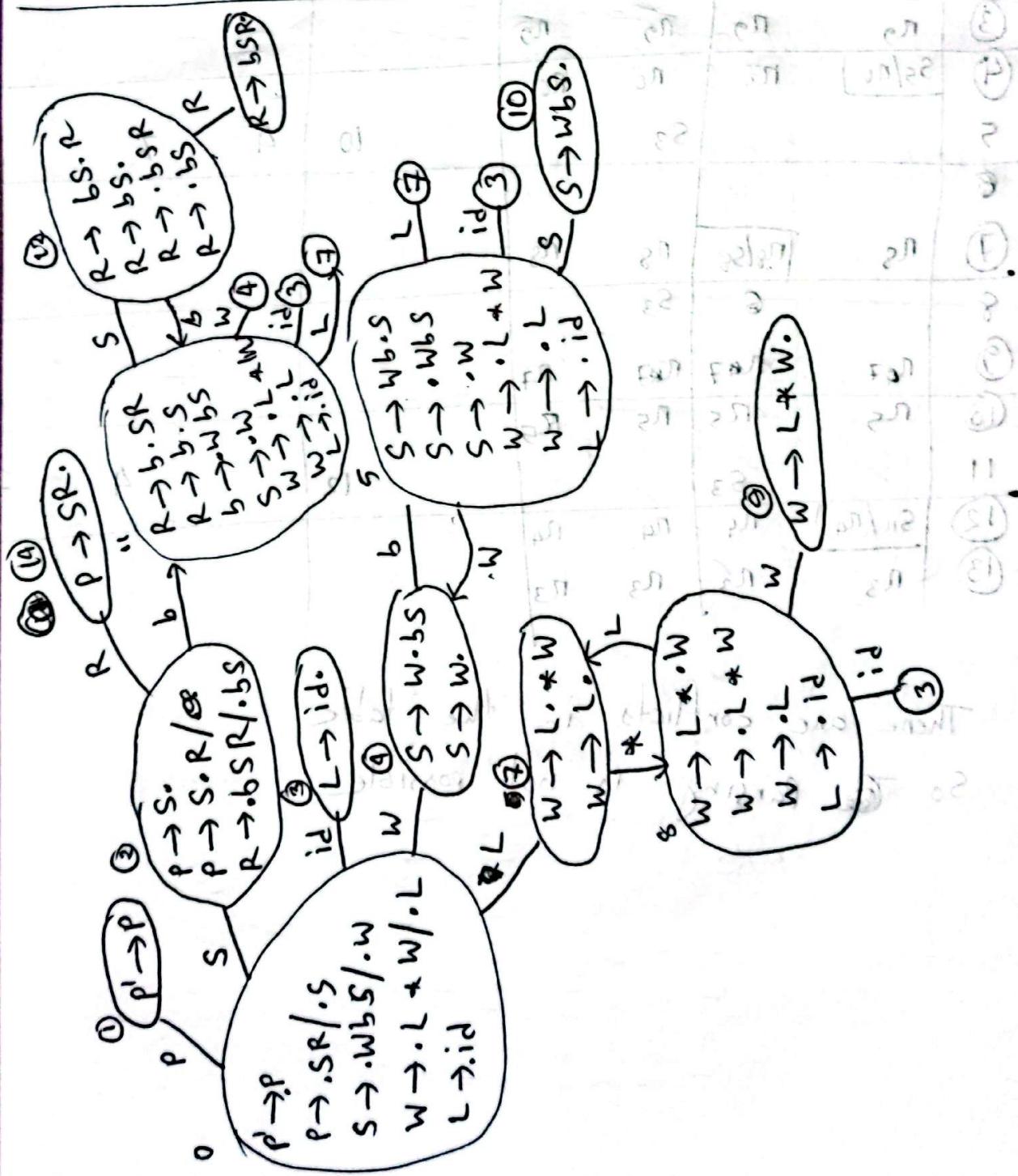
Follow(SP) = { \$ }

$$\text{Follow}(R) = \{\$ \}$$

$$\text{Follow}(S) = \{ b, \$ \}$$

$$\text{Follow}(w) = \{b, \$\}$$

$$\text{Follow}(L) = \{\star, b, \$\}$$



State Transition Table - LR(0)

	b	*	$\{ \text{id}, \$ \}$	P	S	R	W	L
0			$\{ \text{id} \} = (\text{id})_{\text{wolfo}}$		2		$2d / 2d \leftarrow 2$	$2 / 2d \leftarrow 2$
1	*		$\{ \text{id}, *, \$ \}$	accept	wolfo		$W \leftarrow J \leftarrow W$	$J \leftarrow b \leftarrow J$
2	S_1 / R_2	R_2	R_2	R_2				7
3	R_2	R_2	R_2	R_2				
4	S_5 / R_6	R_6	R_6	R_6				
5			S_3			10	4	
6								
7	R_8	R_8 / S_8	R_8	R_8				
8		*	S_3					
9	R_{47}	ΣR_{47}	R_{47}	R_{47}	R_7			
10	R_5	R_5	R_5	R_5	R_5			
11			S_3			12	4	7
12	S_11 / R_4	R_4	R_4	R_4				
13	R_3	ΣR_3	R_3	R_3				

There are conflicts in the table

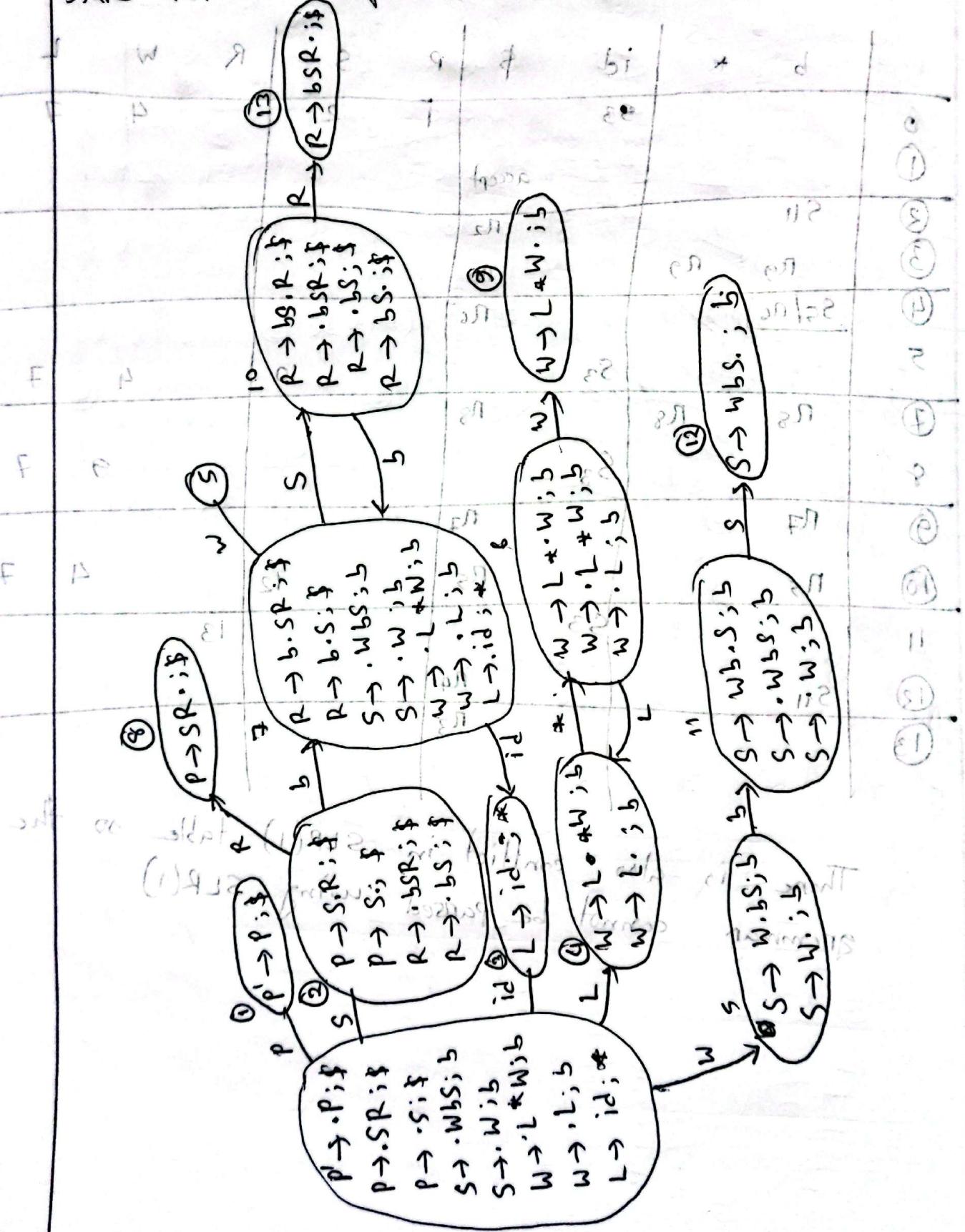
So Parsing is not possible

State Transition Table (SLR(1))

	b	*	id	\$	p	s	R	w	L
0 ①			s ₃		1	2		4	7
②	s ₁₁								
③	r ₉	r ₉			r ₂				
④	s ₅ /r ₆				r ₆				
5			s ₃				5	10	4 7
⑦ 8	r ₈	r ₈			r ₈				
⑨	r ₇				r ₇				
⑩	r ₅				r ₅		12		4 7
11			s ₃		r ₄				13
⑫	s ₁₁				r ₃				
⑬									

There is also conflict in SLR(1) table so the grammar cannot be parsed using SLR(1)

State Transition Diagram (CLR(1), LALR(1))



CLR(1)

	b * id \$	P	S	R ← A W	L
0	S_3	1	2	5	4
1	accept				
2	S_7	R_{12}	9	8	
3	R_9			$b \leftarrow a$	
4	$R_8 S_6$		(1) $A \rightarrow S_6$	(0) $A \rightarrow S_5$	
5	R_5 / S_{12}				
6				$A_2 \leftarrow a$	4
7	S_3		i	$3 \leftarrow a$	4
8		R_1			
9	R_7				
10	S_7		14		
11	0 8 A 2	P b		5	
12	R_5				
13	2 P S	R_3			

There is conflict in CLR(1) table ^{as} the grammar cannot be parsed in CLR(1) ^{as} also in 2ALR(1)

$$4. S \rightarrow SAa / \epsilon$$

↓

w A → B
B → C
C → D
D → d

S

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

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

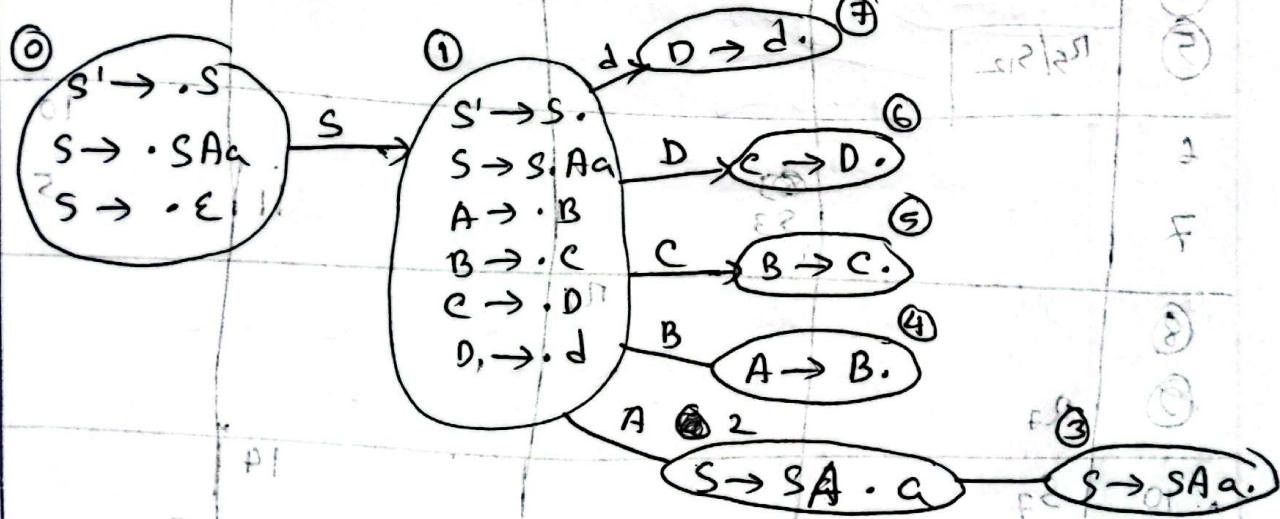
$$\text{Follow}(B) = \{a\}$$

$$\text{Follow}(C) = \{a\}$$

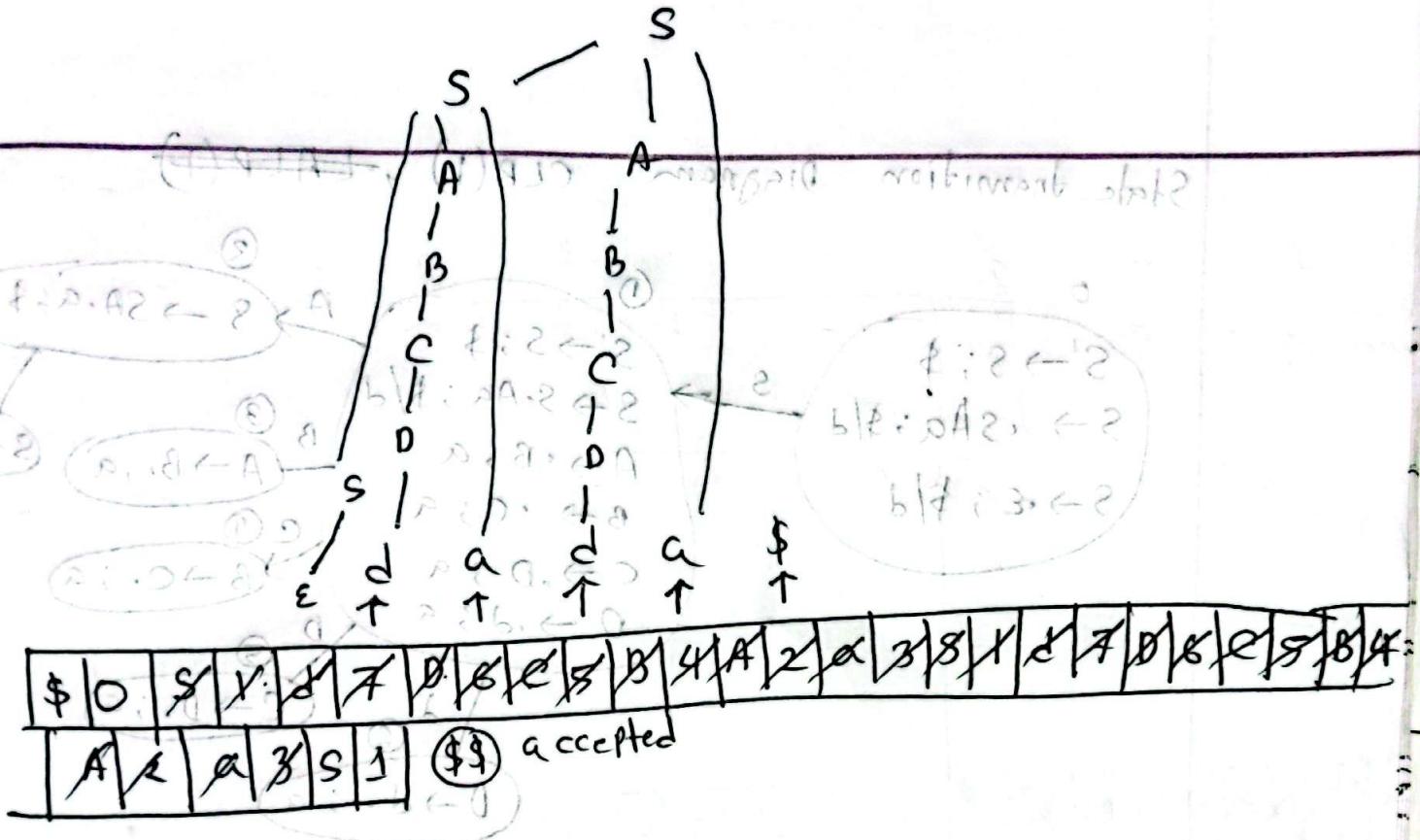
$$\text{Follow}(D) = \{a\}$$

LR(0) and SLR(1)

Transition Diagram



	a	d	\$	S	A	B	C	D.
6	n_2	n_2	n_2	1				
1		n_7	accept		2	4	5	6
2	n_3							
3	n_1	n_1	n_1					
4	n_3	n_3	n_3					
5	n_4	n_4	n_4					
6	n_5	n_5	n_5					
7	n_6	n_6	n_6					

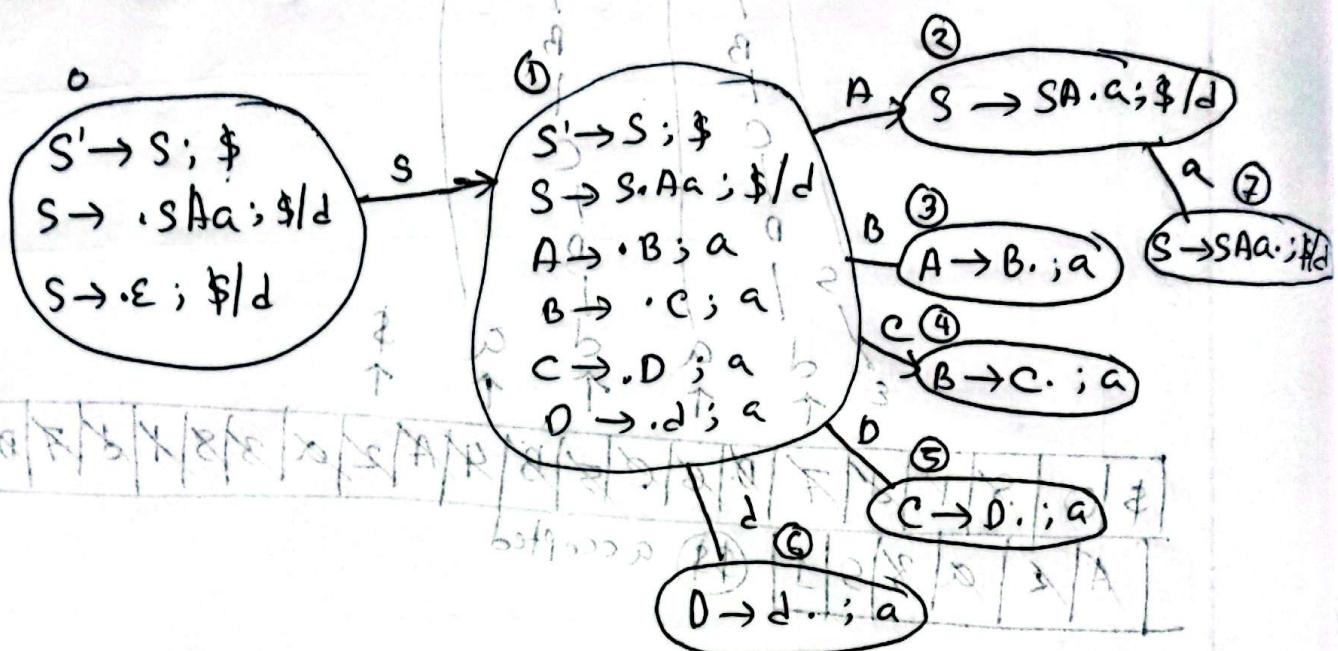


SLR(1) Table

	D	B	A	\$	S	AB	B	C	D
①	a	d							
②					n ₂				
③						n ₁			
④									
⑤									
⑥									
⑦									

(Dashed lines indicate transitions from state 0 to state 11)

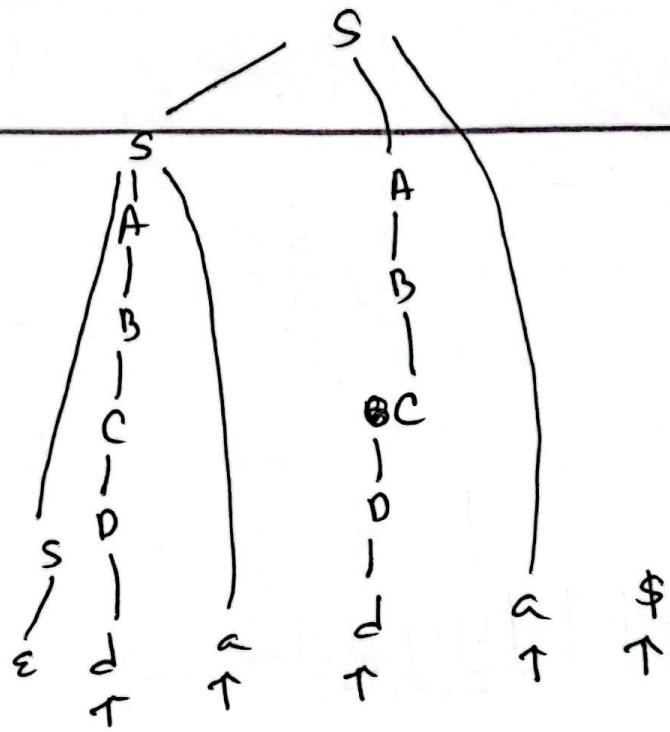
State transition Diagram CLR(1), ~~LALR(1)~~



CLR(1) Table

	a	dA	\$	S	A	B	C	D
0	n_2	n_2	n_2	1	2	3	4	5
1	s_c	accepted						
2	s_f	s						
3	n_3							
4	n_4							
5	n_5							
6	n_6							
7				n_1	n_1			

No state to merge so already in LALR(1)
parsing table



\$	0	8	1	5	6	8	2	4	8	3	A	1	2	0	7	8	1	4	6	0	8	1	A	B	3	A	2
a	f	T	S	I																							

(\$\$) accepted

Q.

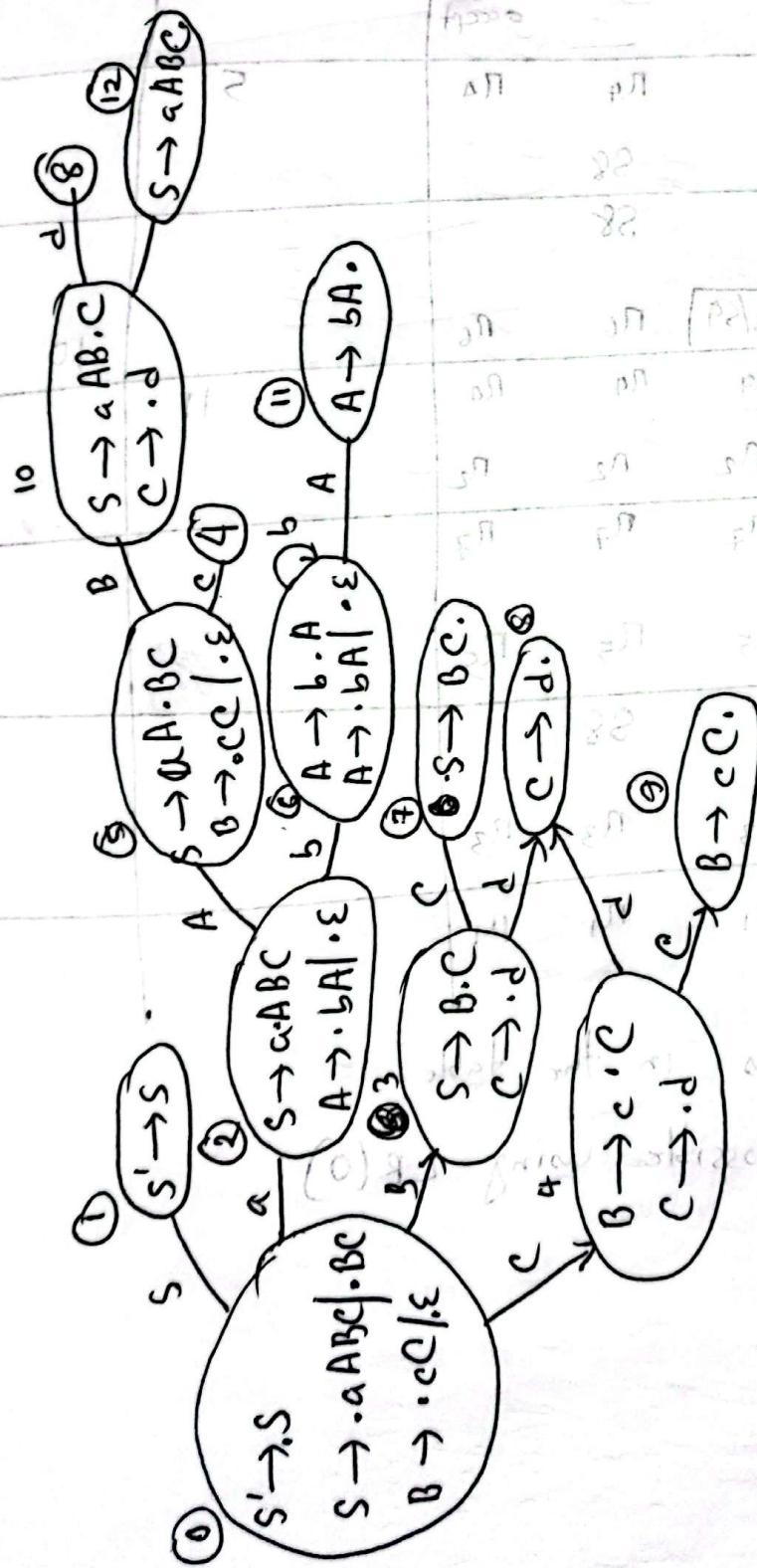
$$5. S \rightarrow aABC / B_2C$$

$$A \rightarrow bA / \epsilon$$

$$B \rightarrow cC / \epsilon$$

$$C \rightarrow d$$

(Q) is oldest derivation step



State transition Table LR(0)

	a	b	c	d	\$	s		
0	S_2/n_6	n_6	S_4/n_6	n_6	n_6	1	-3	
1						accept		
2	n_4	S_6/n_4	n_4	n_4	n_4	5	6	7
3					S_8			9
4					S_8			
5	n_6	n_6	n_6/S_9	n_6	n_6		10	
6	n_4	S_6/n_4	n_4	n_4	n_4		11	
7	n_2	n_2	n_2	n_2	n_2			
8	n_7	n_7	n_7	n_7	n_7			
9	n_5	n_5	n_5	n_5	n_5			
10				S_8				12
11	n_3	n_3	n_3	n_3	n_3			
12	n_1	n_1	n_1	n_1	n_1			

There are conflicts in the table.

So parsing not possible using LR(0)

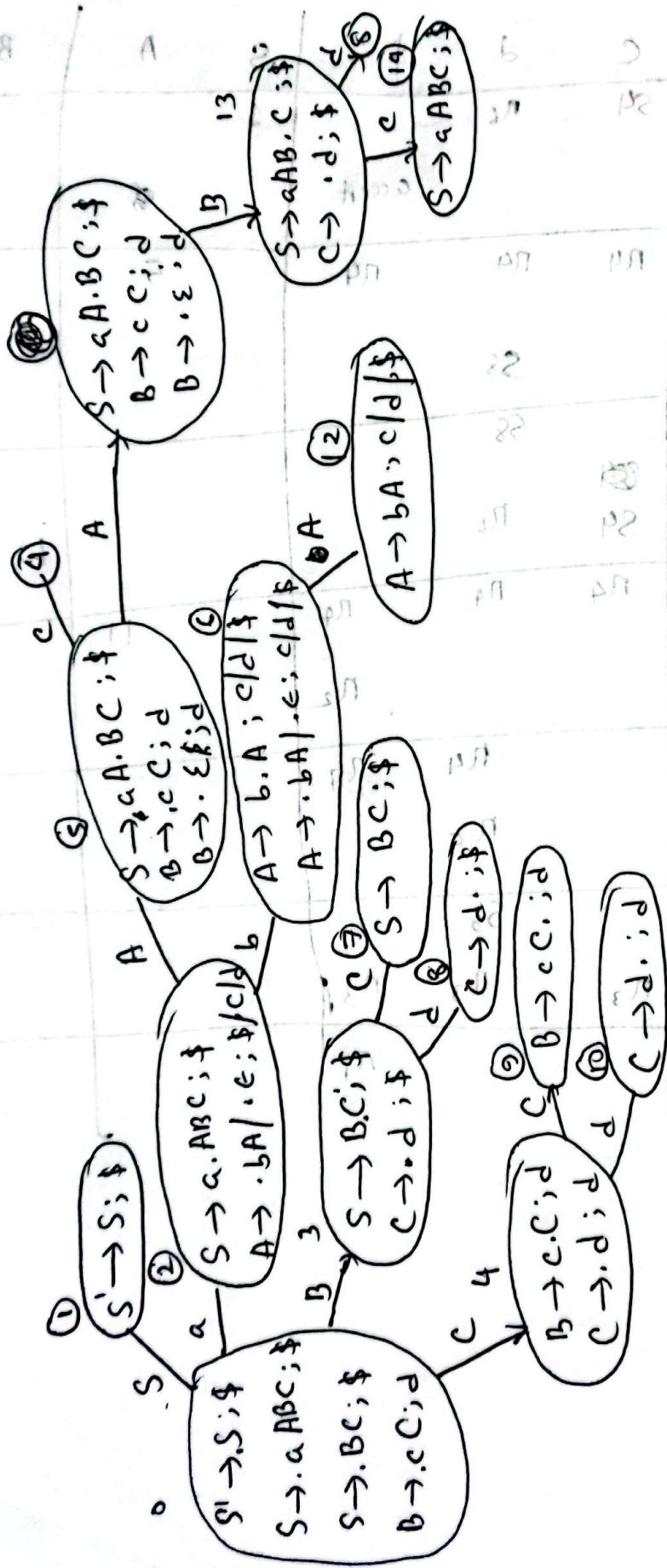
SLR(1)

(1) 9.1.1 (1) 9.2.2 accept state reached

	a	b	c	d	\$	s	A	B	C
0	s_2		s_4	n_6			1		
1					accept			6	
2		s_6	n_4	n_4	n_4		5		
3				s_8					7
4				s_8					9
5			s_4	n_6					10
6	*	s_6	n_4	n_4	n_4		11		
7					n_2				
8				n_4	n_7				
9				n_5					
10				s_8					12
11			n_3	n_3	n_3				
12					n_1				

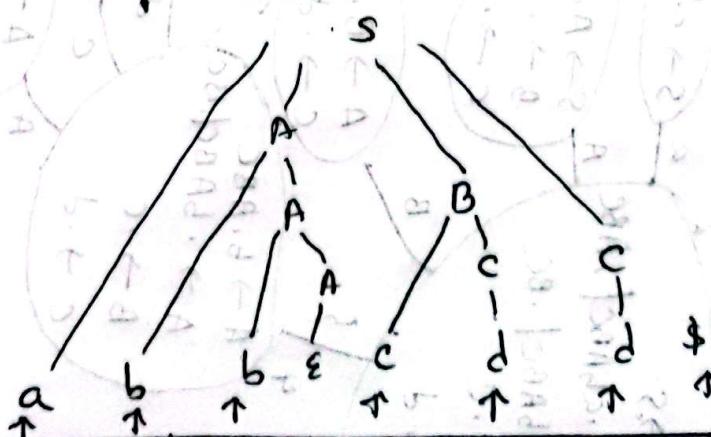
State Transition Table Diagram CLR(1) LALR(1)

(1) que



CLR(1) Table Also LALR(1) Table

	a	b	c	d	\$	s	A	B	C
0	S2		S9	n6		1		3	
1					accept				
2		S6	n4	n4	n4	5			
3					S810				
4					S108			7	
5			S4	n6				8	9
6		S2	n4	n4	n4		12		
7						n2			
8	10				n7	n7			
9					n5				
10					n7				
11					S810				13
12			n3	n3	n3				
13					n1				



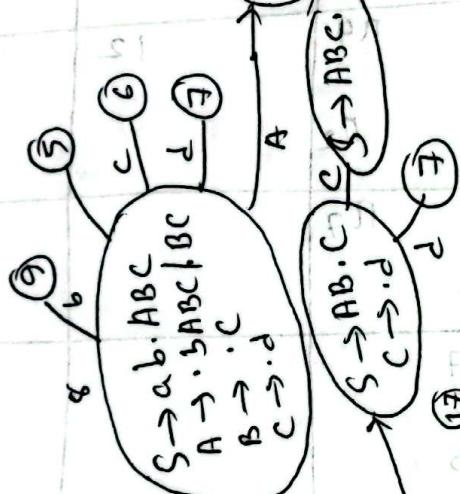
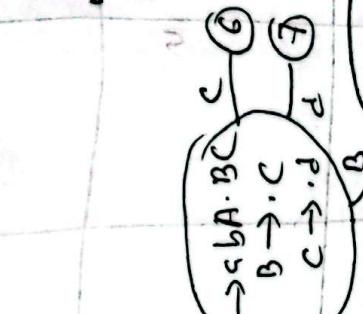
(\$)	0	1	2	b	6	b	3	ε	A	5	18	1	2	16	d	10	6	9	1	4	5	13	(\$)	Accept
------	---	---	---	---	---	---	---	---	---	---	----	---	---	----	---	----	---	---	---	---	---	----	------	--------

6. $S \rightarrow abABC / ABC$

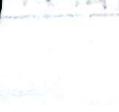
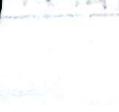
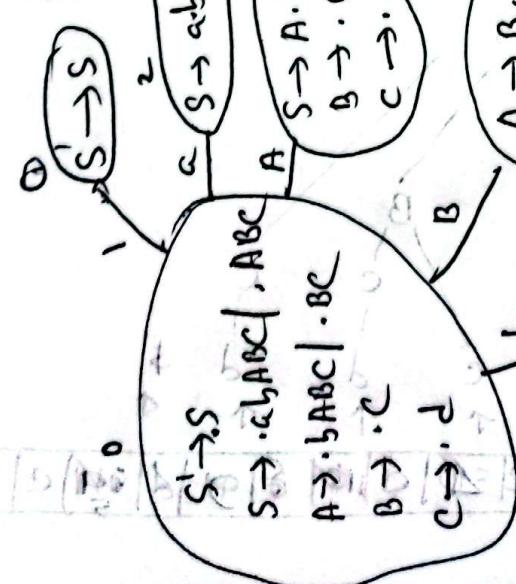
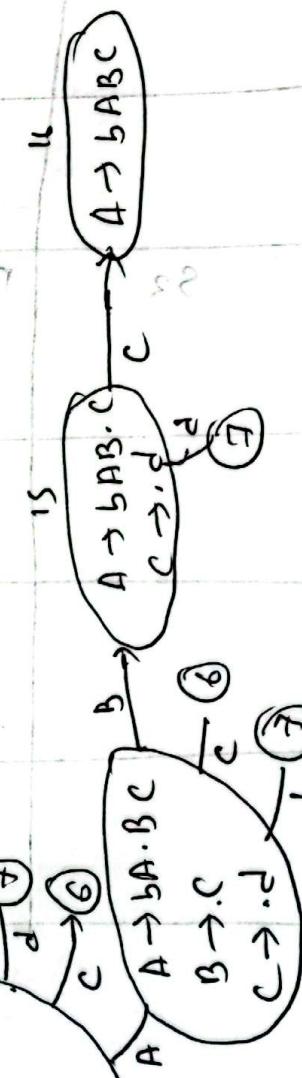
$A \rightarrow bABC / BC$

$B \rightarrow C$

$C \rightarrow d$



(1) TFAE also FAFR (1) 955



	a	b	d	\$	s	A	B	c
0	s ₂	s ₄	s ₇		1	3	5	6
1				accept				
2		s ₄					12	6
3				s ₇				
4				s ₇		14	5	6
5				s ₇				17
6	n ₅		n ₅	n ₅				
7	n _c		n _c	n ₆	n _c		9	5
8		s ₉	s ₇				10	6
9			s ₇					11
10			s ₇					
11	n ₁		n ₁	n ₁				13
12			s ₇					
13	n ₂		n ₂	n ₂				
14			s ₇			15		6
15	a		s ₇					16
16	n ₃		n ₃	n ₃				
17	n ₄		n ₄	n ₄				