

KESHAV MEMORIAL INSTITUTE OF TECHNOLOGY

(KMIT)

Narayanaguda, Hyderabad – 500029

(Affiliated to AICTE and JNTUH)



DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

LAB MANUAL

NAME OF THE LAB

COMPILER DESIGN LAB

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Department of Computer Science and Engineering

Vision & Mission of the Department

Vision of the Department

To be among the region's premier teaching and research Computer Science and Engineering departments producing globally competent and socially responsible graduates in the most conducive academic environment.

Mission of the Department

- To provide faculty with state of the art facilities for continuous professional development and research, both in foundational aspects and of relevance to emerging computing trends.
- To impart skills that transform students to develop technical solutions for societal needs and inculcate entrepreneurial talents.
- To inculcate an ability in students to pursue the advancement of knowledge in various specializations of Computer Science and Engineering and make them industry-ready.
- To engage in collaborative research with academia and industry and generate adequate resources for research activities for seamless transfer of knowledge resulting in sponsored projects and consultancy.
- To cultivate responsibility through sharing of knowledge and innovative computing solutions that benefit the society-at-large.
- To collaborate with academia, industry and community to set high standards in academic excellence and in fulfilling societal responsibilities.



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3-5-1026, Narayanaguda, Hyderabad-29. Ph: 040-23261407

Department of Computer Science and Engineering

PROGRAM OUTCOMES (POs)

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/Development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-Long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change



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PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: An ability to analyze the common business functions to design and develop appropriate Computer Science solutions for social upliftments.

PSO2: Shall have expertise on the evolving technologies like Python, Machine Learning, Deep Learning, Internet of Things (IOT), Data Science, Full stack development, Social Networks, Cyber Security, Big Data, Mobile Apps, CRM, ERP etc.



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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Graduates will endeavor to excel in their chosen careers as professionals, researchers and entrepreneurs on a global platform.

PEO 2: Graduates will demonstrate the ability to solve challenges in the fields of Engineering and Technology simultaneously catering to societal needs.

PEO 3: Graduates will strive to improve their learning curve by practising Continuing Professional Development (CPD)

PEO 4: Graduates will, at all times, adopt a professional demeanor by communicating effectively, working collaboratively, and maintaining the ethics & core values as befitting their education in interdisciplinary and emerging fields.

CS605PC: COMPILER DESIGN LAB

III Year B.Tech. CSE II-Sem

L T P C

0 0 3 1.5

Prerequisites

1. A Course on “Objected Oriented Programming through Java”

Co-requisites

1. A course on “Web Technologies”

Course Objectives

1. To provide hands-on experience on web technologies
2. To develop client-server application using web technologies
3. To introduce server-side programming with Java servlets and JSP
4. To understand the various phases in the design of a compiler.
5. To understand the design of top-down and bottom-up parsers.
6. To understand syntax directed translation schemes.
7. To introduce lex and yacc tools.

Course Outcomes

1. Design and develop interactive and dynamic web applications using HTML, CSS, JavaScript and XML
2. Apply client-server principles to develop scalable and enterprise web applications.
3. Ability to design, develop, and implement a compiler for any language.
4. Able to use lex and yacc tools for developing a scanner and a parser.
5. Able to design and implement LL and LR parsers.

List of Experiments

Compiler Design Experiments

1. Write a LEX Program to scan reserved word & Identifiers of C Language
2. Implement Predictive Parsing algorithm
3. Write a C program to generate three address code.
4. Implement SLR(1) Parsing algorithm
5. Design LALR bottom up parser for the given language

<program> ::= <block>

<block> ::= { <variabledefinition> <slist> }

| { <slist> }

<variabledefinition> ::= int <vardeflist> ;

<vardeflist> ::= <vardec> | <vardec> , <vardeflist>

<vardec> ::= <identifier> | <identifier> [<constant>]

<slist> ::= <statement> | <statement> ; <slist>

<statement> ::= <assignment> | <ifstatement> | <whilestatement>

 | <block> | <printstatement> | <empty>

<assignment> ::= <identifier> = <expression>

 | <identifier> [<expression>] = <expression>

<ifstatement> ::= if <bexpression> then <slist> else <slist> endif

 | if <bexpression> then <slist> endif

<whilestatement> ::= while <bexpression> do <slist> enddo

<printstatement> ::= print (<expression>)

<expression> ::= <expression> <addingop> <term> | <term> | <addingop> <term>

<bexpression> ::= <expression> <relop> <expression>

<relop> ::= < | <= | == | >= | > | !=

<addingop> ::= + | -

<term> ::= <term> <multop> <factor> | <factor>

<multop> ::= * | /

<factor> ::= <constant> | <identifier> | <identifier> [<expression>]

 | (<expression>)

<constant> ::= <digit> | <digit> <constant>

<identifier> ::= <identifier> <letterordigit> | <letter>

<letterordigit> ::= <letter> | <digit>

<letter> ::= a|b|c|d|e|f|g|h|i|j|k|l|m|n|o|p|q|r|s|t|u|v|w|x|y|z

<digit> ::= 0|1|2|3|4|5|6|7|8|9

<empty> has the obvious meaning

Comments (zero or more characters enclosed between the standard C/Java-style comment brackets /*...*/) can be inserted. The language has rudimentary support for 1-dimensional arrays. The

declaration `int a[3]` declares an array of three elements, referenced as `a[0]`, `a[1]` and `a[2]`. Note also that you should worry about the scoping of names.

A simple program written in this language is:

```
{ int a[3],t1,t2; t1=2; a[0]=1; a[1]=2;
a[t1]=3; t2=-(a[2]+t1*6)/(a[2]-t1); if t2>5
then print(t2); else { int t3; t3=99;
t2=-25; print(-t1+t2*t3); /* this is a
comment                on 2 lines */
}

endif

}
```



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Course Outcomes and CO-PO Mapping

Academic year: 2020-21

Subject Name: COMPILER DESIGN

Branch : CSE

Year&Sem:- III - II

Course Outcomes:

1. Demonstrate the ability to design a compiler given a set of language features.
2. Demonstrate the knowledge of patterns, tokens & regular expressions for lexical analysis.
3. Acquire skills in using lex tool & yacc tool for developing a scanner and parser.
4. Design and implement LL and LR parsers
5. Design algorithms to do code optimization in order to improve the performance of a program in terms of space and time complexity.
6. Design algorithms to generate machine code

CO-PO-PSO Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	1		2									2	
CO 2	2	3	3	2									1	
CO 3		2	3										2	
CO 4	2			2								2		
CO 5	3	2			2								1	

Signature of Faculty

Signature of Subject-Coordinator

CO – PO MAPPING JUSTIFICATION

MAPPING	LOW (1) MEDIUM (2) HIGH (3)	JUSTIFICATION
CO 1- PO 1	3	Knowledge is applied to understand the machines power to find the solutions for engineering problems.
CO 1- PO 2	1	Concept of abstract machines is useful to analyze the mathematical problems.
CO 1- PO 4	2	Concepts of abstract machines are used to design the complex problems.
CO 1- PSO 1	2	Engineering knowledge used to analyze the computer science problems.
CO 2- PO 1	2	FA model applied to find the solutions for computing problems.
CO 2- PO 2	3	FA machines are useful to identify and formulate the mathematical problems.
CO 2- PO 3	3	FA model applied to design and develop solutions for complex engineering problems.
CO 2- PO 4	2	Knowledge of finite state machines applied to analyze and solve complex problems.
CO 2- PSO 1	1	Finite automata model used to develop solutions for the computer science problems.
CO 3- PO 2	2	Knowledge of grammars is used to find the solutions of the engineering science problems.
CO 3- PO 3	3	Grammars information applied to design solutions for engineering problems.
CO 3- PSO 1	2	Information of grammars applied to analyze and model the computer science problems.

CO 4- PO 1	2	Knowledge applied to find differences between decidable and un-decidable problems.
CO 4- PO 4	2	Decidable and un-decidable knowledge applied to investigate complex problems.
CO 4- PO 12	2	Decidable and un-decidable knowledge applied to get solution for each engineering problems.
CO 5- PO 1	3	Mathematical and formal methods knowledge is applied to get the solutions for engineering problems.
CO 5- PO 2	2	Concepts of formal methods are useful to analyze the mathematical problems.
CO 5- PO 5	2	Proficiency of mathematical tools and formal methods are applied to predict and model the complex engineering activities.
CO 5- PSO 1	1	Modern tools are used to get solutions for the computer science problems.

Program 1:

AIM: To Write a LEX Program to scan reserved word & Identifiers of C Language.

```
/* program name is lexpl */
%{
/* program to recognize a c program */
int COMMENT=0;
%}
identifier [a-zA-Z][a-zA-Z0-9]*
%%

#.* { printf("\n%s is a PREPROCESSOR DIRECTIVE",yytext);}

int |
float |
char |
double |
while |
for |
do |
if |
break |
continue |
void |
switch |
case |
long |
struct |
const |
typedef |
return |
else |
goto { printf("\n\t%s is a KEYWORD",yytext);}
"/*" { COMMENT = 1;}
/*{ printf("\n\n\t%s is a COMMENT\n",yytext);}*/
```

```
"*/" { COMMENT = 0;}

/* printf("\n\n\t%s is a COMMENT\n",yytext); */

{ identifier }( { if(!COMMENT)printf("\n\nFUNCTION\n\t%s",yytext);}

\{ { if(!COMMENT) printf("\n BLOCK BEGINS");}

\} { if(!COMMENT) printf("\n BLOCK ENDS");}

{ identifier }\([[0-9]*\])? { if(!COMMENT) printf("\n %s IDENTIFIER",yytext);}

\."*\ " { if(!COMMENT) printf("\n\t%s is a STRING",yytext);}

[0-9]+ { if(!COMMENT) printf("\n\t%s is a NUMBER",yytext);}

\(\,;\)? { if(!COMMENT) printf("\n\t");ECHO;printf("\n");}

\ ( ECHO;

= { if(!COMMENT)printf("\n\t%s is an ASSIGNMENT OPERATOR",yytext);}

\<= |

\>= |

\< |

== |

\> { if(!COMMENT) printf("\n\t%s is a RELATIONAL OPERATOR",yytext);}

%%

int main(int argc,char **argv)

{

if (argc > 1)

{

FILE *file;

file = fopen(argv[1],"r");

if(!file)

{

printf("could not open %s \n",argv[1]);

exit(0);

}

yyin = file;

}

yylex();

printf("\n\n");

return 0;
```



```
} int yywrap()  
{  
return 0;  
}
```

Input:

```
$vi var.c  
#include<stdio.h>  
main()  
{  
int a,b;  
}  
$lex lex.l  
$cc lex.yy.c  
$./a.out var.c
```

OUTPUT:

```
#include<stdio.h> is a PREPROCESSOR DIRECTIVE  
FUNCTION  
main ()  
BLOCK BEGINS  
int is a KEYWORD  
a IDENTIFIER  
b IDENTIFIER  
BLOCK ENDS
```

Program 2:**AIM: To Implement Predictive Parsing algorithm.**

```

#include<stdio.h>
#include<conio.h>
char nt[]={ 'E','A','T','B','F'},ter[]={ 'i','+','*','(',')','$' };
char arr[20][20][20]={
    { "TA"," "," ","TA"," "," " },
    { " ","+TA"," "," ","#","#"},
    { "FB"," "," ","FB"," "," " },
    { " ","#","*FB"," ","#","#"},
    { "i"," "," ","(E)"," "," " }
};

void pop();
void push(char );
int resolve_nt(char );
int resolve_t(char );
void advance();
char a,x;
int len,temp,k;

stack[0]='$';
stack[1]='E';
printf("Enter the input string:\n");
printf("Enter $ as an end marker\n");
scanf("%s",ipstr);
printf("I/P String\t\tStack Contents\t\tProduction Used\n");
while(1)
{
    a=ipstr[i];
    x=stack[top];
    /*To display the input string*/
    for(k=i;ipstr[k]!='$';k++)
        printf("%c",ipstr[k]);
    printf("$\t\t");
    if(x==a)
    {
        if(x=='$')
        {
            printf("\ninput string is accepted");
            break;
        }
        else

```

```

        {
            pop();
            advance();
        }
    }
    else if(isupper(x))
    {
        ix=resolve_nt(x);
        ia=resolve_t(a);
        strcpy(prod,arr[ix][ia]);
        len=strlen(prod);
        pop();
        for(k=1;k<=len;k++)
            push(prod[len-k]);
        if(stack[top]=='#')
            pop();
    }
    else
    {
        printf("Error: Could not parse the input string");
        break;
    }
    /*To display the stack contents and the production used*/
    for(k=0;k<=top;k++)
        printf("%c",stack[k]);
    printf("\t\t\t\t\t%s\n",prod);
}
getch();
}
void push(char t)
{
    top+=1;
    stack[top]=t;
}
void pop()
{
    top--;
}
void advance()
{
    i++;
}
int resolve_nt(char t)
{
    int k,index;
    for(k=0;k<5;k++)
    {
        if(t==nt[k])
        {
            index=k;

```

```

        break;
    }
}
return index;
}
int resolve_t(char t)
{
    int k,index;
    for(k=0;k<6;k++)
    {
        if(t==ter[k])
        {
            index=k;
            break;
        }
    }
    return index;
}

```

INPUT:**Enter a string**

i+i\$

OUTPUT:

I/P String	Stack Contents	Production Used
i+i\$	\$AT	TÂ
i+i\$	\$ABF	FB
i+i\$	\$ABi	i
i+i\$	\$AB	i
+i\$	\$A	#
+i\$	\$AT+	+TÂ
+i\$	\$AT	+TÂ
i\$	\$ABF	FB
i\$	\$ABi	i
i\$	\$AB	i
\$	\$A	#
\$	\$	#
input string is accepted		

Program 3:

AIM: To write a C program to generate three address code.

```
#include<stdio.h>
#include<string.h>
#include<iostream>
void pm();
void plus();
void div();
int i,ch,j,l,addr=100;
char ex[10], exp[10],exp1[10],exp2[10],id1[5],op[5],id2[5];
int main()
{
while(1)
{
printf("\n1.assignment\n2.arithmetic\n3.relational\n4.Exit\nEnter the choice:");
scanf("%d",&ch);
switch(ch)
{
case 1:
printf("\nEnter the expression with assignment operator:");
scanf("%s",exp);
l=strlen(exp);
exp2[0]='\0';
i=0;
while(exp[i]!='=')
{
i++;
}
strncat(exp2,exp,i);
strrev(exp);
exp1[0]='\0';
strncat(exp1,exp,l-(i+1));
strrev(exp1);
printf("Three address code:\ntemp=%s\n%s=temp\n",exp1,exp2);
break;

case 2:
printf("\nEnter the expression with arithmetic operator:");
scanf("%s",ex);
strcpy(exp,ex);
l=strlen(exp);
exp1[0]='\0';

for(i=0;i<l;i++)
{
if(exp[i]=='+'||exp[i]=='-')
```

```


{
if(exp[i+2]=='/'||exp[i+2]=='*')
{
pm();
break;
}
else
{
plus();
break;
}
}
else if(exp[i]=='/'||exp[i]=='*')
{
div();
break;
}
}
break;

case 3:
printf("Enter the expression with relational operator");
scanf("%s%s%s",&id1,&op,&id2);
if(((strcmp(op,"<")==0)||strcmp(op,">")==0)||strcmp(op,"<=")==0)||strcmp(op,">=")==0)||strcmp(op,"==")==0)||strcmp(op,"!=")==0))
printf("Expression is error");
else
{
printf("\n%d\tif %s%s%s goto %d",addr,id1,op,id2,addr+3);
addr++;
printf("\n%d\tT:=0",addr);
addr++;
printf("\n%d\tgoto %d",addr,addr+2);
addr++;
printf("\n%d\tT:=1",addr);
}
break;
case 4:
exit(0);
}
}
}
void pm()
{
strrev(exp);
j=l-i-1;
strncat(exp1,exp,j);
strrev(exp1);
printf("Three address code:\ntemp=%s\ntemp1=%c%ctemp\n",exp1,exp[j+1],exp[j]);
}

```

```
void div()
{
    strcat(exp1,exp,i+2);
    printf("Three address code:\ntemp=%s\ntemp1=temp%c%c\n",exp1,exp[i+2],exp[i+3]);
}
void plus()
{
    strcat(exp1,exp,i+2);
    printf("Three address code:\ntemp=%s\ntemp1=temp%c%c\n",exp1,exp[i+2],exp[i+3]);
}
```

Output



```
1.assignment
2.arithmetic
3.relational
4.Exit
Enter the choice:
```

```
1.assignment
2.arithmetic
3.relational
4.Exit
Enter the choice:1

Enter the expression with assignment operator:a=45
Three address code:
temp=45
a=temp

1.assignment
2.arithmetic
3.relational
4.Exit
Enter the choice:_
```

```
3.relational
4.Exit
Enter the choice:2

Enter the expression with arithmetic operator:b+c
Three address code:
temp=b+c
temp1=temp

1.assignment
2.arithmetic
3.relational
4.Exit
Enter the choice:2

Enter the expression with arithmetic operator:b+c+d
Three address code:
temp=b+c
temp1=temp+d

1.assignment
2.arithmetic
3.relational
4.Exit
Enter the choice:_
```



```
1.assignment
2.arithmetic
3.relational
4.Exit
Enter the choice:3
Enter the expression with relational operator a < b

100    if a<b goto 103
101    T:=0
102    goto 104
103    T:=1
1.assignment
2.arithmetic
3.relational
4.Exit
Enter the choice:_
```

Program 4:

AIM: To Implement SLR(1) Parsing algorithm

```
#include<stdio.h>
#include<string.h>
int axn[][6][2]={

    {{100,5},{-1,-1},{-1,-1},{100,4},{-1,-1},{-1,-1}},

    {{-1,-1},{100,6},{-1,-1},{-1,-1},{-1,-1},{102,102}},

    {{-1,-1},{101,2},{100,7},{-1,-1},{101,2},{101,2}},

    {{-1,-1},{101,4},{101,4},{-1,-1},{101,4},{101,4}},

    {{100,5},{-1,-1},{-1,-1},{100,4},{-1,-1},{-1,-1}},

    {{-1,-1},{101,6},{101,6},{-1,-1},{101,6},{101,6}},

    {{100,5},{-1,-1},{-1,-1},{100,4},{-1,-1},{-1,-1}},

    {{100,5},{-1,-1},{-1,-1},{100,4},{-1,-1},{-1,-1}},

    {{-1,-1},{100,6},{-1,-1},{-1,-1},{100,1},{-1,-1}},

    {{-1,-1},{101,1},{100,7},{-1,-1},{101,1},{101,1}},

    {{-1,-1},{101,3},{101,3},{-1,-1},{101,3},{101,3}},

    {{-1,-1},{101,5},{101,5},{-1,-1},{101,5},{101,5}}

};//Axn Table

int gotot[12][3]={1,2,3,-1,-1,-1,-1,-1,-1,-1,-1,8,2,3,-1,-1,-1,
    -1,9,3,-1,-1,10,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1}; //GoTo table

int a[10];

char b[10];

int top=-1,btop=-1,i;
void push(int k)
```

```
{
    if(top<9)
        a[++top]=k;
}
void pushb(char k)
{
    if(btop<9)
        b[++btop]=k;
}

char TOS()

{

    return a[top];

}
void pop()
{
    if(top>=0)
        top--;
}
void popb()
{
    if(btop>=0)
        b[btop--]='\0';
}
void display()
{
    for(i=0;i<=top;i++)
        printf("%d%c",a[i],b[i]);
}
void display1(char p[],int m) //Displays The Present Input String
{
    int l;
    printf("\t\t");
    for(l=m;p[l]!='\0';l++)

        printf("%c",p[l]);
    printf("\n");
}
void error()
{
    printf("Syntax Error");
}
void reduce(int p)
{
    int len,k,ad;
    char src,*dest;
    switch(p)
    {
```

```
case 1:dest="E+T";
    src='E';
    break;
case 2:dest="T";
    src='E';
    break;
case 3:dest="T*F";
    src='T';
    break;
case 4:dest="F";
    src='T';
    break;
case 5:dest="(E)";
    src='F';

    break;
case 6:dest="i";
    src='F';
    break;
default:dest="\0";
src='\0';
break;
}
for(k=0;k<strlen(dest);k++)
{
    pop();
    popb();
}
pushb(src);
switch(src)
{
case 'E':ad=0;
    break;
case 'T':ad=1;
    break;
case 'F':ad=2;
    break;
default: ad=-1;
    break;
}
push(gotot[TOS()][ad]);
}

int main()
{
    int j,st,ic;
    char ip[20]="\0",an;
    // clrscr();
    printf("Enter any String\n");
    scanf("%s",ip);
    push(0);
```

```
display();
printf("\t%s\n",ip);
for(j=0;ip[j]!='\0';)
{
st=TOS();
an=ip[j];
if(an>='a'&&an<='z') ic=0;
else if(an=='+') ic=1;
else if(an=='*') ic=2;
else if(an=='(') ic=3;
else if(an=='') ic=4;
else if(an=='$') ic=5;
else {
error();
break;
}
if(axn[st][ic][0]==100)
{
pushb(an);
push(axn[st][ic][1]);
display();
j++;
display1(ip,j);
}
if(axn[st][ic][0]==101)
{
reduce(axn[st][ic][1]);
display();
display1(ip,j);
}
if(axn[st][ic][1]==102)
{
printf("Given String is accepted \n");
// getch();
break;
}
/* else
{
printf("Given String is rejected \n");
break;
}*/
}
return 0;
}
```

Output:

THE GRAMMAR IS AS FOLLOWS

```
S -> S+T
S -> T
T -> T*F
T -> F
F -> (S)
F -> t
```

I0 :

```
Z -> .S
S -> .S+T
S -> .T
T -> .T*F
T -> .F
F -> .(S)
F -> .t
```

I1 :

```
Z -> S.
S -> S.+T_
```

I2 :

```
S -> T.
T -> T.*F
```

I3 :

```
T -> F.
```

I4 :

```
F -> (.S)
S -> .S+T
S -> .T
T -> .T*F
T -> .F
F -> .(S)
F -> .t
```

I5 :

```
F -> t.
```

I6 :

```
S -> S+.T
T -> .T*F
T -> .F
F -> .(S)
F -> .t
```

```

T -> .T*F
T -> .F
F -> .(S)
F -> .t

I7 :
T -> T*.F
F -> .(S)
F -> .t

I8 :
F -> (S.)
S -> S.+T

I9 :
S -> S+T.
T -> T.*F

I10 :
T -> T*F.

I11 :
F -> (S).

PRESS ANY KEY FOR DFA TABLE

F -> .(S)
F -> .t

I5 :
F -> t.

I6 :
S -> S+.T
T -> .T*F
T -> .F
F -> .(S)
F -> .t

I7 :
T -> T*.F
F -> .(S)
F -> .t

I8 :
F -> (S.)
S -> S.+T

I9 :
S -> S+T.
T -> T.*F

```

Enter any String

a+a*a\$

0	a+a*a\$
0a5	+a*a\$
0F3	+a*a\$
0T2	+a*a\$
0E1	+a*a\$
0E1+6	a*a\$
0E1+6a5	*a\$
0E1+6F3	*a\$
0E1+6T9	*a\$
0E1+6T9*7	a\$
0E1+6T9*7a5	\$
0E1+6T9*7F10	\$
0E1+6T9	\$
0E1	\$

Given String is accepted

Program 5:

AIM: To Design LALR bottom up parser for the given language.

```
<parser.l>
% {
#include<stdio.h>
#include "y.tab.h"
% }
%%

[0-9]+ { yylval.dval=atof(yytext);
return DIGIT;
}
\n|. return yytext[0];
%%

<parser.y>
% {
/*This YACC specification file generates the LALR parser for the program
considered in experiment 4.*/
#include<stdio.h>
% }
%union
{
double dval;
}
%token <dval> DIGIT
%type <dval> expr
%type <dval> term
%type <dval> factor
%%

line: expr '\n' {
printf("%g\n", $1);
}
```



```
;
expr: expr '+' term {$$=$1 + $3 ;}
| term
;
term: term '*' factor {$$=$1 * $3 ;}
| factor
;
factor: '(' expr ')' {$$=$2 ;}
| DIGIT
;
%%
int main()
{
  yyparse();
}
yyerror(char *s)
{
  printf("%s",s);
}
```

INPUT:

\$lex parser.l

\$yacc -d parser.y

\$cc lex.yy.c y.tab.c -ll -lm

\$/a.out

OUTPUT:

2+3

5.0000