VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT on

COMPILER DESIGN

Submitted by

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

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B. M. S. College of Engineering,

Bull Temple Road, Bangalore 560019

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CERTIFICATE

This is to certify that the Lab work entitled "Compiler Design" carried out by **SAIKUMAR POLICE PATIL(1BM21CS182),** who is bonafide student of **B. M. S. College of Engineering.** It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2023. The Lab report has been approved as it satisfies the academic requirements in respect of a **Compiler Design course (21CS5PCCPD)** work prescribed for the said degree.

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Experiment No :01

Aim of the program

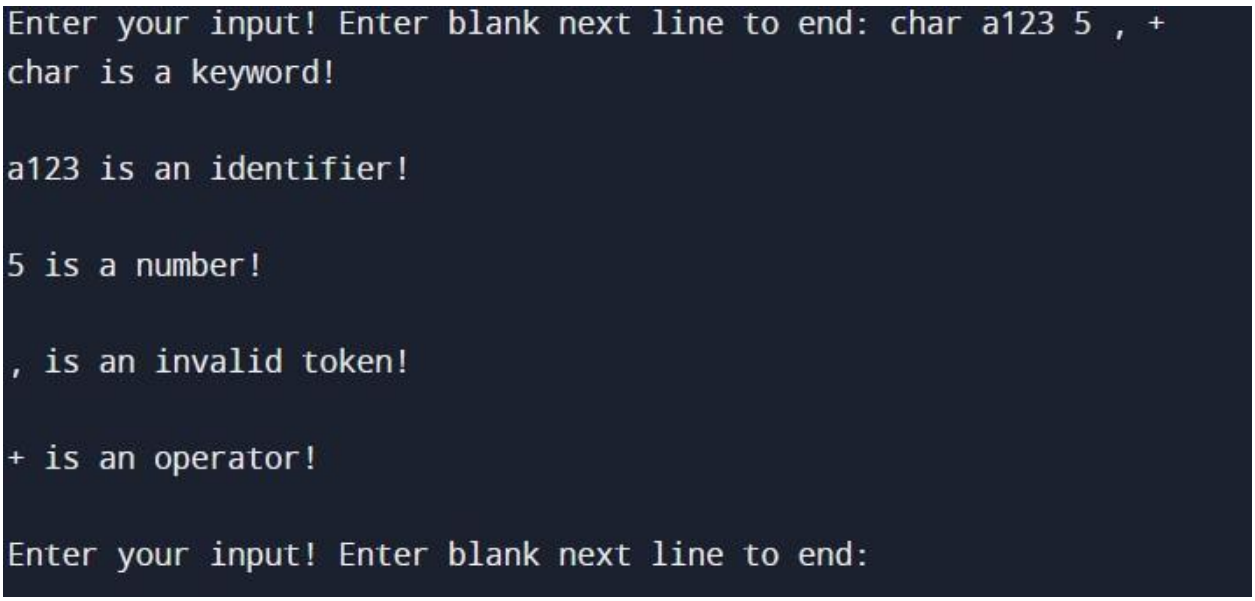
Write a program to design Lexical Analyzer in C/C++/Java/Python Language (to recognize any five keywords, identifiers, numbers, operators and punctuations)

Program

```
def analyze_input(input_text):     keywords = ["char", "float", "bool",
"int", "for", "break", "continue"]     punctuation = [".", "!", ";", "?"]
operators = ["+", "-", "*", "/", "%", "="]

   keys, ids, nums, ops, punct = 0, 0, 0, 0, 0

   for i in input_text.split():         if i
in keywords:             if keys < 5:
print(f'{i} is a keyword!\n')
keys += 1         elif i in punctuation:
          if punct < 5:                print(f'{i}
is a punctuation!\n')                punct +=
1         elif i in operators:
          if ops < 5:
             print(f'{i} is an operator!\n')
             ops += 1         elif
i.isnumeric():             if nums < 5:
print(f'{i} is a number!\n')
nums += 1         else:             if ids <
5:
```

```
            flag = False                if
i[0].isalpha() or i[0] == '_':
                flag = True                for j in i[1:]:
if j in operators or j in punctuation:
print(f'{i} is an invalid token!\n')
flag = False                        break                if
flag:
                print(f'{i} is an identifier!\n')
ids += 1                else:
                print(f'{i} is an invalid token!\n')


while True:
    user_input = input("Enter your input! Enter blank next line to end: ")
if not user_input.strip():
        break
    analyze_input(user_input)
```

Output – Screen shot



Experiment No :02

Aim of the program

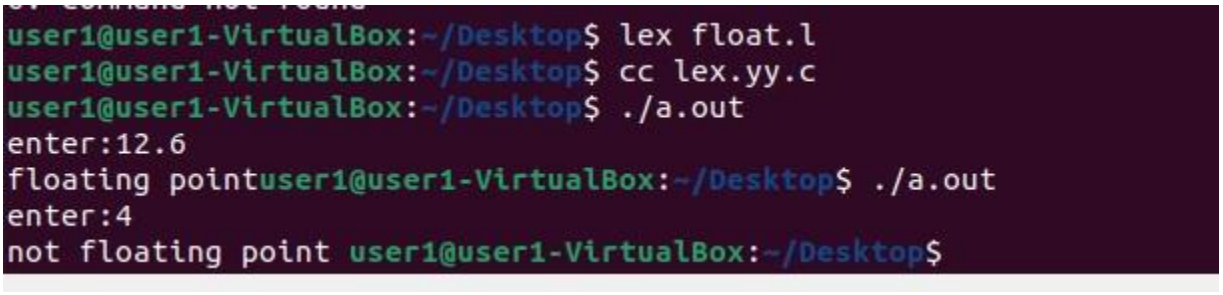
Write a program in LEX to recognize Floating Point Numbers.

Program

```
%{
#include<stdio.h> int
flag=0;
%} alpha[a-zA-Z]
digit[0-9]
decimal[.]
%%
[+|-]?({digit})*{decimal}({digit})* { flag=1;}
{alpha}({alpha}|{digit})* {printf("invalid number ");}
\n return 0;
%%
int yywrap(){} int main(){ printf("enter :");
yylex(); if(flag==1){  printf("floating point
```

```
number");} else{printf(" not a floating point
number");}
}

}
```

Output – Screen shot



Aim of the program

Experiment No :03

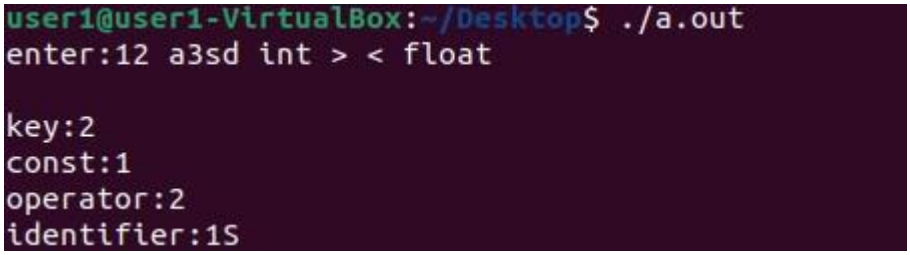
Write a program in LEX to recognize different tokens: Keywords, Identifiers, Constants, Operators and Punctuation symbols.

Program

```
%{
#include<stdio.h> int
x1=0,x2=0,x3=0,x4=0;
%}
alpha[a-zA-Z]
digit[0-9] d[.]
%%
int|float|char { x1++;} {digit}+
{x2++;}
[<|>|=|<=|>=|==] {x3++;}
{alpha}({digit}|{alpha})* {x4++;}
\n { printf("\nkey:%d",x1);
printf("\nconst:%d",x2);
printf("\noperator:%d",x3);
printf("\nidentifier:%d",x4);
}
%%
int yywrap(){} int
main(){
```

```
printf("enter:");
yylex();
}
```

Output – Screen shot



Aim of the program

Experiment No :04

Write a LEX program that copies a file, replacing each nonempty sequence of white spaces by a single blank.

Program

```
%{
#include<stdio.h>
%}
%%


[ ]([ ])* {fprintf(yyout," ");}
([ ])*(\n)([ ])* {fprintf(yyout," ");}
%%
int yywrap(){} int
main(){
printf("running");
yyin=fopen("txt","r");
yyout=fopen("txto","w");
yylex();
}
```

Output – Screen shot

```
1 hi friend happy new year welcome to 2024 .
```

Aim of the program

Experiment No :05

Write a LEX program to recognize the following tokens over the alphabets {0,1,..,9}

a) The set of all string ending in 00.

b) The set of all strings with three consecutive 222's.

c) The set of all string such that every block of five consecutive symbols contains at least two 5's.

d) The set of all strings beginning with a 1 which, interpreted as the binary representation of an integer, is congruent to zero modulo 5.

e) The set of all strings such that the 10th symbol from the right end is 1.

f) The set of all four digits numbers whose sum is 9

g) The set of all four digital numbers, whose individual digits are in ascending order from left to right.

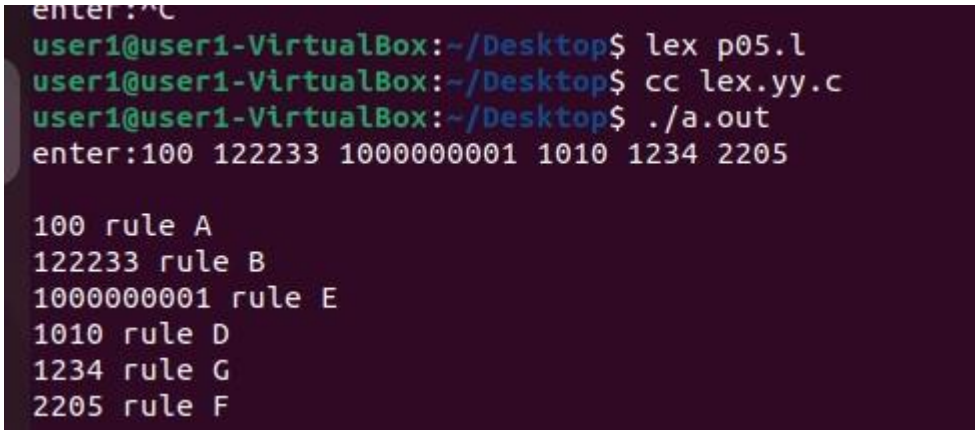
Program

```
%{
#include<stdio.h> int
x1=0,x2=0,x3=0,x4=0;
%}
alpha[a-zA-Z]
digit[0-9] d[.]
%%
({digit})*00 {printf("\n%s rule A",yytext);}
({digit})*222({digit})* {printf("\n%s rule B",yytext);}
(1(0)*(11|01)(01*01|00*10(0)*(11|1))*0)(1|10(0)*(11|01)(01*01|00*10(0)*(1
1|1))*10)* {printf("\n%s rule D",yytext);}
```

```
({digit})*1{digit}{9} {printf("\n%s rule E",yytext);}
{digit}{4} { int sum=0;
for(int i=0;i<4;i++){
sum=sum+yytext[i]-48;
} if(sum==9) {printf("\n%s rule
F",yytext);} sum=1; for(int j=0;j<3;j++){
if(yytext[j]>yytext[j+1]) sum=0;
} if(sum==1) {printf("\n%s rule
G",yytext);}

}

{d}* {int i=0; int c=0;
if(yyleng<5) {break;}
for(i=0;i<5;i++) { if(yytext[i]=='5')
c++;

} if(c<2)
{break;}
```

```
else{

for(;i<yyleng;i++){
if(yytext[i-5]=='5') c--;
if(yytext[i]=='5') c++; if(c<2)
break;

} if(i==yyleng) {printf("\n %s rule
C",yytext);}
}

}

%%



int yywrap(){} int
main(){
printf("enter:");
yylex();
}
```

Output – Screen shot



Part-B:

Experiment No :01

Aim of the program 1. Write a program to implement

(a) Recursive Descent Parsing with back tracking (Brute Force Method). S→ cAd , A →ab /a

(b) Recursive Descent Parsing with back tracking (Brute Force Method). S→ cAd , A → a / ab

Program

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
int A(); char str[15];
int isave,curr_ptr=0;
int main(void)
{
//clrscr();
printf("1.S->cAd\n2.A->ab/a\n");
printf("this is parser for the above grammar:\n");
printf("Enter any string:"); scanf("%s",str);
while(curr_ptr<strlen(str))
{
//S has only one immediate derivation which is cAd
//match with c
if (str[curr_ptr]=='c')
{
curr_ptr++;
//call function to match A
if (A()) //checking the productions of A->ab/a
{
curr_ptr++;
//match d
if (str[curr_ptr]=='d' && str[curr_ptr+1]=='\0')
{
//success
```

```
printf("string is accepted by the grammar");
getch(); return 1;
}
else break;
}
else break;
}
else break;
}
//incase any of them fail to match return negatively. printf("string
is not accepted by the grammar");
//getch(); return
0;
}
int A() //sub function A()
{
isave=curr_ptr;

if (str[curr_ptr]=='a')
{
curr_ptr++;
if(str[curr_ptr]=='b') return
1;
}
curr_ptr=isave; //return to start //check if a is
matched and return accordingly.
if(str[curr_ptr]=='a')
return 1; else
return 0;
}
```

Output – Screen shot

```
1.S->cAd
2.A->ab/a
this is parser for the above grammar:
Enter any string:cdd
string is not accepted by the grammar
```

```
1.S->cAd
2.A->ab/a
this is parser for the above grammar:
Enter any string:cabd
string is accepted by the grammar
```

Experiment No :02

Aim of the program Use YACC to Convert Binary to Decimal (including fractional numbers) Program p.y

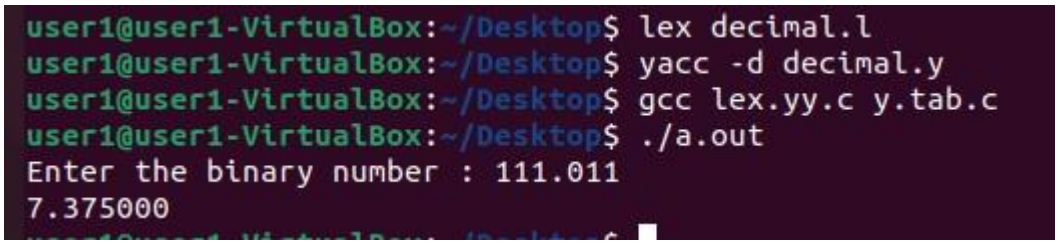
```
%{
#include<stdio.h>
#include<stdlib.h>
#include<math.h> void
yyerror(char *s); float
x = 0;
%}

%token ZERO ONE POINT
%%
L: X POINT Y {printf("%f",$1+x);}
| X {printf("%d", $$);}
X: X B {$$=$1*2+$2;}
| B {$$=$1;}
Y: B Y {x=$1*0.5+x*0.5;}
| {;}
B:ZERO {$$=$1;}
|ONE {$$=$1;};
%%

int main() { printf("Enter the binary
number : ");
```

```
while(yyparse()); printf("\n");
}

void yyerror(char *s)
{ fprintf(stdout,"\n%s",s);
}
```

p.l

```
%{

#include<stdio.h>  #include<stdlib.h>
#include"y.tab.h"

extern int yylval;
%}

%%
0 {yylval=0;return ZERO;}
1 {yylval=1;return ONE;}
"." {return POINT;}
[ \t] {;}
\n return 0;
%%
```

Output – Screen shot



Experiment No :03

Aim of the program Use YACC to implement, evaluator for arithmetic expressions (Desktop calculator)

Program

p.y

```
%{

        #include<stdio.h>

        int flag=0;

int yylex();
int yyerror();


%}

%token NUMBER



%left '+' '-'

%left '*' '/'
%left '%'
%right '^'
%left '(' ')'

%%

ArithmeticExpression: E{

        printf("\nResult=%d\n",$$);

        return 0;

        }
```

```
E:E'+'E {$$=$1+$3;}

 |E'-'E {$$=$1-$3;}

 |E'*'E {$$=$1*$3;}

 |E'/'E {$$=$1/$3;}

 |E'%'E {$$=$1%$3;}
 |E'^'E {$$=$1^$3;}

 |'('E')' {$$=$2;}

 | NUMBER {$$=$1;}

;

%%



void main()

{

   printf("\nEnter Any Arithmetic Expression which can have operations Addition,
Subtraction, Multiplication, Division, Modulus and Round brackets:\n");

   yyparse();

  if(flag==0)

   printf("\nEntered arithmetic expression is Valid\n\n");



}

int yyerror()
```

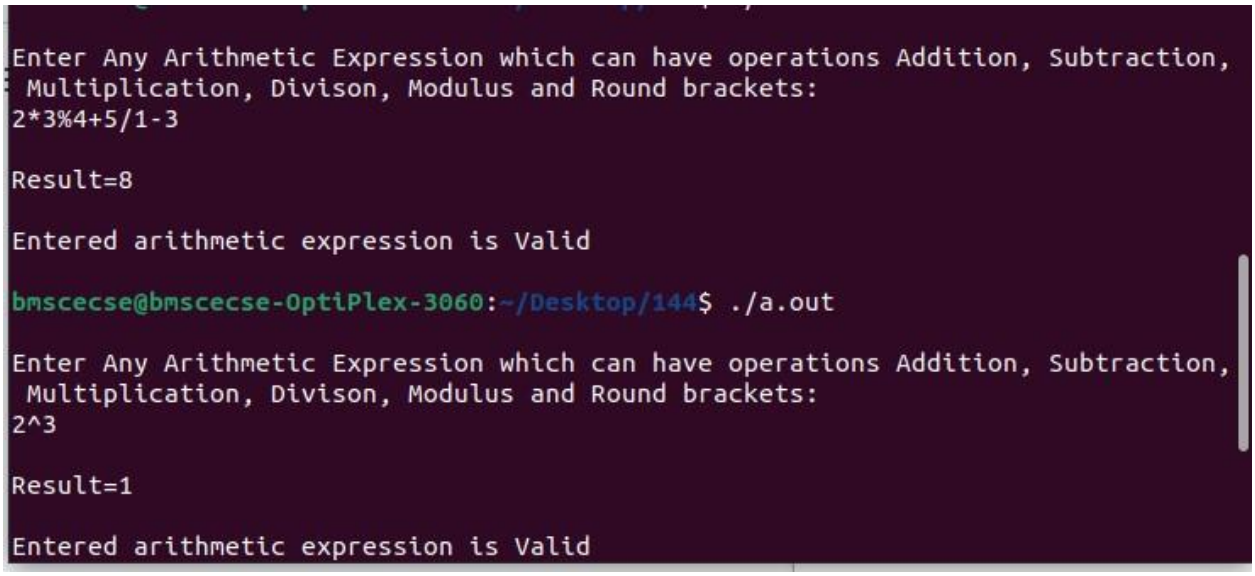
```
{
   printf("\nEntered arithmetic expression is Invalid\n\n");
   flag=1;
return 0;
}
```

P.l

```
%{
#include<stdio.h>
#include "y.tab.h"
extern int yylval;
%}

%%
[0-9]+ {
        yylval=atoi(yytext);
        return NUMBER;
        }
[\t] ;
[\n] return 0;
. return yytext[0];
```

```
%%

int yywrap()

{

return 1;
 }
```

Output – Screen shot



Experiment No :04

Aim of the program Use YACC to convert: Infix expression to Postfix expression. Program p.y %{

```
#include <ctype.h>
#include<stdio.h>
#include<stdlib.h> int
yylex();
%}
%token digit

%%
S: E {printf("\n\n");}
;
E: E '+' T { printf ("+");}
| E '-' T { printf ("-");}
| T
;
```

```
T: T '*' P { printf("*");}
| T '/' P { printf("/");}
| P
;

P: F '^' P { printf ("^");}
| F
;

F: '(' E ')'
 | digit {printf("%d", $1);}
 ;
%%


int main() {   printf("Enter infix
expression: ");   yyparse();  }
yyerror() {  printf("Error");
}
```

p.l

```
%{
 #include "y.tab.h"
 extern int yylval;
%}
%%
```

[0-9]+ {yylval=atoi(yytext); return digit;}

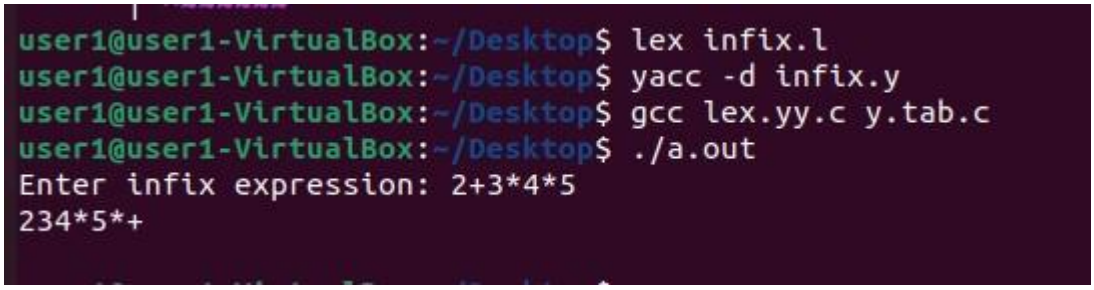
[\t] ;

[\n] return 0;

. return yytext[0];

%%

Output – Screen shot



Experiment No :05

Aim of the program Use YACC to generate Syntax tree for a given expression

Program p.y

```
%{
#include<math.h>
#include<ctype.h>
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
#include "y.tab.h"

struct tree_node {
        char val[10];
int lc;  int rc;
};

int ind;
struct tree_node syn_tree[100];

void my_print_tree(int cur_ind); int
mknode(int lc, int rc, const char *val);

int yylex(void); void
yyerror(const char *s);
%}

%token digit
%%
/* print the tree after evaluating E */
S: E { my_print_tree($1); }
;

E: E '+' T { $$= mknode($1, $3, "+"); }
 | E '-' T { $$= mknode($1, $3, "-"); }
 | T { $$= $1; }
 ;

T: T '*' F { $$= mknode($1, $3, "*"); }
 | T '/' F { $$= mknode($1, $3, "/"); }
```

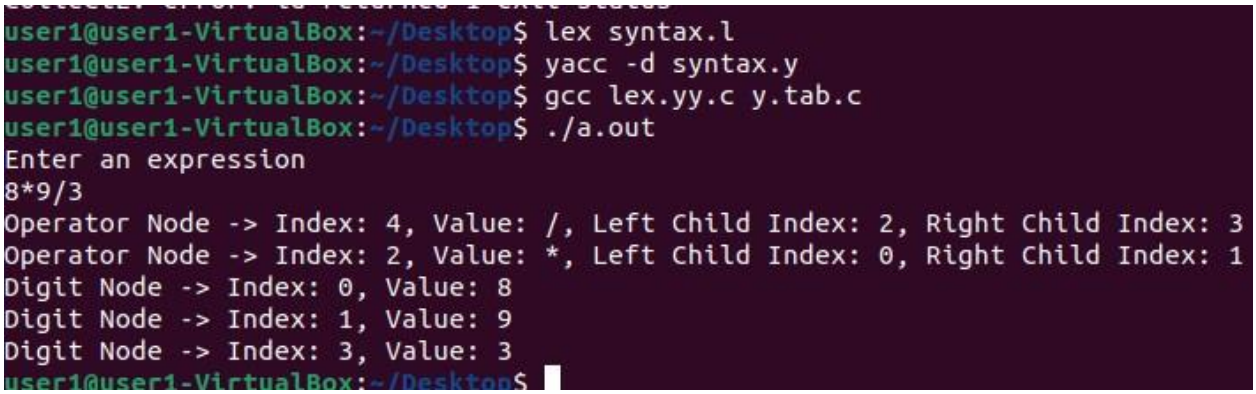
```
 | F { $$= $1; }
 ;

F: P '^' F { $$= mknode($1, $3, "^"); }
 | P { $$= $1; }
 ;

P: '(' E ')' { $$= $2; }
 | digit { char buf[10]; sprintf(buf, "%d", yylval); $$= mknode(-1, -1, buf); }
%%

int main() {
        ind=0;
        printf("Enter an expression\n");
yyparse();
        return 0;
}

void yyerror(const char *s) {
        printf("NITW Error: %s\n", s);
}

int mknode(int lc, int rc, const char *val) {
strcpy(syn_tree[ind].val, val);       syn_tree[ind].lc =
lc;
        syn_tree[ind].rc = rc;
        ind++;
        return ind-1;
}

void my_print_tree(int cur_ind) {
        if (cur_ind == -1) return;

        if (syn_tree[cur_ind].lc == -1 && syn_tree[cur_ind].rc == -1)
        printf("Digit Node -> Index: %d, Value: %s\n", cur_ind, syn_tree[cur_ind].val);
else
    printf("Operator Node -> Index: %d, Value: %s, Left Child Index: %d, Right Child
Index: %d\n",
                cur_ind, syn_tree[cur_ind].val, syn_tree[cur_ind].lc, syn_tree[cur_ind].rc);
```

```
        my_print_tree(syn_tree[cur_ind].lc);
my_print_tree(syn_tree[cur_ind].rc);
}
```

p.l

```
%{
#include "y.tab.h"
%}
%%
[0-9]+ { yylval=atoi(yytext); return digit; }
[\t] ;
[\n] return 0;
. return yytext[0];
%%
```

Output – Screen shot



Experiment No :06

Aim of the program Use YACC to generate 3-Address code for a given expression Program

p.y

```
%{
#include <math.h>
#include<ctype.h>
#include<stdio.h>
int var_cnt=0; char
iden[20];
%}
%token digit
%token id
%%

S:id '=' E { printf("%s = t%d\n",iden, var_cnt-1); }
E:E '+' T { $$=var_cnt; var_cnt++; printf("t%d = t%d + t%d;\n", $$, $1, $3 );
}
|E '-' T { $$=var_cnt; var_cnt++; printf("t%d = t%d - t%d;\n", $$, $1, $3 ); }
|T { $$=$1; }
;
T:T '*' F { $$=var_cnt; var_cnt++; printf("t%d = t%d * t%d;\n", $$, $1, $3 ); }
|T '/' F { $$=var_cnt; var_cnt++; printf("t%d = t%d / t%d;\n", $$, $1, $3 ); }
|F {$$=$1 ; }
;
```

```
F:P '^' F { $$=var_cnt; var_cnt++; printf("t%d = t%d ^ t%d;\n", $$, $1, $3 );}
| P { $$ = $1;}
;

P: '(' E ')' { $$=$2; }
|digit { $$=var_cnt; var_cnt++; printf("t%d = %d;\n",$$,$1); }
;
%%
int main() { var_cnt=0;
printf("Enter an expression : \n");
yyparse(); return 0; } yyerror() {
printf("NITW Error\n");
}
```

p.l

```
%{

#include<stdio.h>
#include<stdlib.h>
#include"y.tab.h"
extern int yylval; extern
char iden[20];
%}
```

d [0-9]+ a

[a-zA-Z]+

%%

{d} { yylval=atoi(yytext); return digit; }

{a} { strcpy(iden,yytext); yylval=1; return id; }

[\t] {;}

\n return 0;

. return yytext[0];

%%

Output – Screen shot

```
user1@user1-VirtualBox:~/Desktop$ lex code3.l
user1@user1-VirtualBox:~/Desktop$ yacc -d code3.y
user1@user1-VirtualBox:~/Desktop$ gcc lex.yy.c y.tab.c
user1@user1-VirtualBox:~/Desktop$ ./a.out
Enter an expression :
result=2+3*4
t0 = 2;
t1 = 3;
t2 = 4;
t3 = t1 * t2;
t4 = t0 + t3;
result = t4
```