Lab Manual

OF

Compiler Design

Bachelor of Technology (CSE)

By

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1. Write a program to recognize the string starting from ‘a’ over {a,b}.

   Code:

```
#include<stdio.h> int
main()
{
   char string[100];
printf("Enter the string: ");
scanf("%s", string);     int i=0,
state=0;
while(string[i]!='\0')
   {
      switch(state)
      {
         case 0: if(string[i]=='a') state=1;
else if(string[i]=='b')state=2;
else state=3;                   break;
case 1: if(string[i]=='a')
state=1;                  else
if(string[i]=='b')                    state=1;
else                       state=3;
break;            case 2: if(string[i]=='a')
state=2;                  else
if(string[i]=='b')                    state=2;
else                       state=3;
break;            case 3: break;
      }
i++;
   }
   if(state==1)
      printf("String accepted\n");
else if(state==2)        printf("String
not accepted\n");     else
printf("String not recognized\n");
return 0;
}
```

   Output:

2. Write a program to recognize the string ending on ‘a’ over {a,b}.

   Code:

```
#include<stdio.h> int
main()
```

```
{
   char string[100];     int
state=0, i=0;
printf("Enter a string: ");
scanf("%s", string);

   while (string[i]!='\0')
   {
      switch(state)
      {
case 0:
            if(string[i]=='a') state=1;
else if(string[i]=='b') state=0;
else state=2;             break;
case 1:
            if(string[i]=='a') state=1;
else if(string[i]=='b') state=0;
else state=2;             break;
case 2:           break;

      }
i++;
   }
   if(state==1)       printf("String
accepted\n");    else if(state==0)
printf("String not accepted\n");
else       printf("String not
recognized\n");

return 0;
}
```

Output:

3. Write a program to recognize strings end with ‘ab’. Take the input from text file.

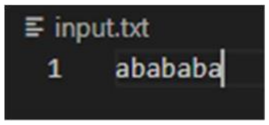
Code:

```
#include <stdio.h>

#include <string.h>
```

```
int main() {     char
string[100];
   FILE *file = fopen("input.txt", "r");
if (file == NULL) {

      printf("Could not open file input.txt\n");
return 1;
   }
   while (fgets(string, sizeof(string), file))
   {
      int i = 0, state = 0;
while (string[i] != '\0')
      {
         switch (state) {
case 0:
               if (string[i] == 'a') state = 1;
else if (string[i] == 'b') state = 0;
else state = 3;                break;
case 1:
               if (string[i] == 'a') state = 1;
else if (string[i] == 'b') state = 2;
else state = 3;                break;
case 2:
               if (string[i] == 'a') state = 1;
else if (string[i] == 'b') state = 0;
```

```
            else state = 3;                    break;

            case 3:

                         state = 3;

            break;

                  }

            i++;

                }

                if (state == 2)            printf("String accepted:

            %s\n", string);        else if (state == 0 || state ==

            1)            printf("String not accepted: %s\n",

            string);

                else            printf("String not recognized:

            %s\n", string);

              }

              fclose(file);

            return 0;

            }
```

Input:



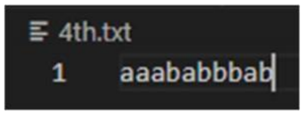
```
input.txt
abababa
```

4. Write a program to recognize strings contains ‘ab’. Take the input from text file.

Code:

```
#include<stdio.h> int
main()
{
   char string[100];
   FILE *file = fopen("4th.txt", "r");     if (file
== NULL) {        printf("Could not open file
input.txt\n");        return 1;
   }
   while(fgets(string, sizeof(string), file))
   {
      int i=0, state=0;
while(string[i]!='\0')
      {
         switch(state)
         {
case 0:
               if(string[i]=='a') state=1;
else if(string[i]=='b') state=0;
break;              case 1:
               if(string[i]=='a') state=1;
else if(string[i]=='b') state=2;
break;              case 2:
               if(string[i]=='a') state=1;
else if(string[i]=='b') state=2;
break;
         }
i++;
      }
      if(state==2)           printf("String
accepted: %s\n", string);        else if(state==0
|| state==1)
         printf("String not accepted: %s\n", string);
else           printf("String not recognized: %s\n",
string);
   }
}
```

Input:



```
4th.txt
aaababbbab
```

5. Single line comment

Code:

```
#include <stdio.h>
#include <string.h>

int main()
{
   char string[100];
   FILE *file = fopen("comment.txt", "r");
if (file == NULL) {
      printf("Could not open file input.txt\n");
return 1;
   }
   while (fgets(string, sizeof(string), file))
   {
      int i=0, state=0;
while(string[i]!='\0')
      {
         switch(state)
         {
case 0:
               if(string[i]=='/') state=1;
else state=2;                 break;
case 1:
               if(string[i]=='/') state=3;
else state=2;                 break;
case 2:
               break;
case 3:
break;
         }
i++;
      }
      if(state==3)           printf("Comment
valid: %s\n", string);        else
         printf("Comment not valid: %s\n", string);
```

```
    }

}
```

6. Multiline Comment

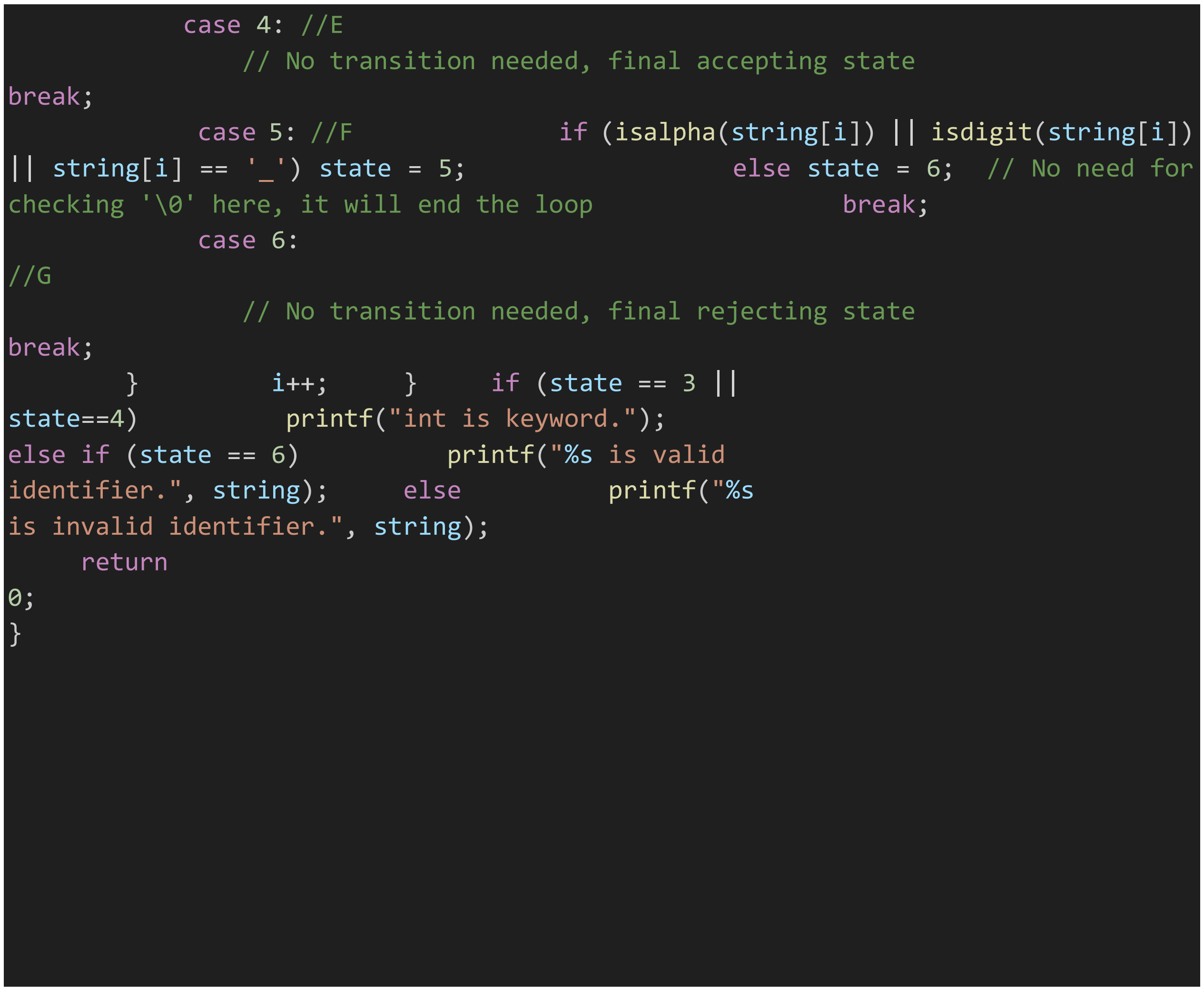
```
Code:
#include <stdio.h>
#include <string.h>

int main()
{
    char string[1000];
    FILE *file = fopen("comment2.txt", "r");
if (file == NULL) {         printf("Could not open
file input.txt\n");         return 1;
    }
    while (fgets(string, sizeof(string), file))
    {
        int i=0, state=0;
while(string[i]!='\0')
        {
            switch(state)
            {
case 0:
                    if(string[i]=='/') state=1;
                    else state=2;
break;                  case 1:
                    if(string[i]=='/') state=3;
else if (string[i]=='*') state=4;
else state=2;                    break;
case 2:                    break;                case
3:                    break;                case 4:
                    if (string[i]=='*') state=5;
else state=4;                case 5:
                    if(string[i]=='/') state=6;
else state=4;                case 6:
break;
            }
i++;
```

```
        }
        if(state==3)             printf("Singleline Comment
valid: %s\n", string);         else if(state==6)
printf("Multiline Comment valid: %s\n", string);
else
            printf("Comment not valid: %s\n", string);
    }

}
```

2(a). Write a program to recognize the valid identifiers.

Code:

```
#include<stdio.h>
#include<string.h>
#include<ctype.h>
#include<stdbool.h>

int main()
{     char string[1000];     printf("Enter the
string: ");     scanf("%s", string);  // Prevents
buffer overflow     int i = 0, state = 0;     int
num=1;     while (num>0)
    {         switch
(state)
        {             case 0: //A                 if (string[i] == 'i')
state = 1;                 else if (isalpha(string[i]) || string[i] ==
'_') state = 5;                 break;
             case 1: //B                 if (string[i] == 'n')
state = 2;                 else if (isalpha(string[i]) ||
string[i] == '_' || isdigit(string[i])) state = 5;
else state = 6;                 break;

            case 2: //C                 if (string[i] == 't')
state = 3;                 else if (isalpha(string[i]) ||
string[i] == '_' || isdigit(string[i])) state = 5;
else state = 6;                 break;

            case 3: //D
                if (string[i] == '\0') state = 4;                 else if
(isalpha(string[i]) || isdigit(string[i]) || string[i] ==
'_') state = 5;
num--;
break;
```



```
            case 4: //E
                // No transition needed, final accepting state
break;
             case 5: //F              if (isalpha(string[i]) || isdigit(string[i])
|| string[i] == '_') state = 5;                  else state = 6;  // No need for
checking '\0' here, it will end the loop                   break;
             case 6:
//G
                // No transition needed, final rejecting state
break;
        }         i++;     }     if (state == 3 ||
state==4)          printf("int is keyword.");
else if (state == 6)          printf("%s is valid
identifier.", string);     else          printf("%s
is invalid identifier.", string);
     return
0;
}
```

2(b). Write a program to recognize the valid operators.

Code:

```
#include<stdio.h>
#include<string.h>

int main()
{      char string[1000];      printf("Enter the
string: ");      scanf("%s", string);  // Prevents
buffer overflow      int i = 0, state = 0;      int
num=1;      while (num>0)
    {
switch(state)
        {
case 0:
                if (string[i] == '+') state = 51;
else if(string[i] == '*') state = 51;
else if(string[i] == '/') state = 60;
else if(string[i] == '=') state = 53;
else if(string[i] == '-') state = 54;
else if(string[i] == '?') state = 55;
else if(string[i] == '<') state = 56;
else if(string[i] == '>') state = 59;
else if(string[i] == '!') state = 57;
else if(string[i] == '&') state = 58;
else if(string[i] == '|') state = 61;
                else if(string[i] == '~' || string[i] == '^') state = 62;
break;

            case 51: // Arithmetic                 if
(string[i] == '\0') state = 51;                 else
if (string[i] == '+') state = 52;
else if (string[i] == '=') state = 53;
else state = 0;                 num--;
break;
            case 52: // Unary
break;
             case 53: //
Assignment
```

```
                if(string[i] == '=') state =
56;                 else state = 0;
num--;                 break;
            case 54: // -                  if
(string[i] == '\0') state = 51;                 else
if (string[i] == '-') state = 52;
else if (string[i] == '=') state = 53;
else state = 0;                 num--;
break;

           case 55: // Ternary                  if
(string[i] == ':') state = 55;                 else
if(string[i] == '\0') state = 0;
else state = 0;                 num--;
break;
            case 56: //Relational
if (string[i] == '=') state = 56;
else if(string[i] == '<') state = 58;
else state = 0;                 num--;
break;
                        case 59: // >
if (string[i] == '>') state = 58;
else if (string[i] == '=') state = 56;
else state = 0;                 num--;
break;

           case 57: // Logical
                if (string[i] == '=') state = 56;
else if(string[i] == '\0') state = 57;
else state = 0;                 num--;
break;

           case 58: // Bitwise
                if (string[i] == '&') state = 57;
else if(string[i] == '\0') state = 58;
else state = 0;
```

```
                num--;
break;
                         case 60: // "/"
if (string[i] == '\0') state = 51;                 else
state = 0;                 num--;                 break;
             case 61: // "|"                   if (string[i]
== '|') state = 57;                 else if(string[i] ==
'\0') state = 58;                 else state = 0;
num--;                 break;
             case 62: // ~ ^                   if
(string[i] == '\0') state = 58;                   else
state = 0;                 num--;                   break;
        }
i++;
    }       if (state == 51) printf("%s is an Arithmatic operator.", string);
else if(state == 52) printf("%s is an Unary operator.", string);    else if(state
== 53) printf("%s is an Assignment operator.", string);     else if(state == 55)
printf("%s is ternary or conditional operator.", string);
    else if(state == 56) printf("%s is a Relational Operator.", string);
else if(state == 57) printf("%s is a Logical operator.", string);     else
if(state == 58) printf("%s is a Bitwise operator.", string);     else
        printf("Processing....");
     return 0;


}
```

2(c). Write a program to recognize the valid number.

Code:

```
#include <stdio.h>
#include <string.h>
#include <ctype.h>
#include <stdbool.h>

int main() {
FILE *file;      char
buffer[100];
char lexeme[100];
char c;
    int f, i, state;
     file = fopen("numbers.txt", "r");
if (file == NULL) {
printf("Error opening file.\n");
return 1;
    }      while (fgets(buffer, 100,
file)) {          buffer[strcspn(buffer,
"\n")] = 0;          f = 0;          i =
0;         state = 0;
         while (buffer[f] !=
'\0')               switch
(state) {                  case
0:
                    c = buffer[f];                     if
(isdigit(c)) { state = 40; lexeme[i++] = c; }
else { state = 0; }                       break;
                 case
40:
                    c = buffer[f];                     if (isdigit(c))
{ state = 40; lexeme[i++] = c; }                       else if (c ==
'.') { state = 41; lexeme[i++] = c; }
                    else if (c == 'E' || c == 'e') { state = 43; lexeme[i++] = c;
}                     else
{
                        lexeme[i] = '\0';
printf("%s is a valid number\n", lexeme);
```

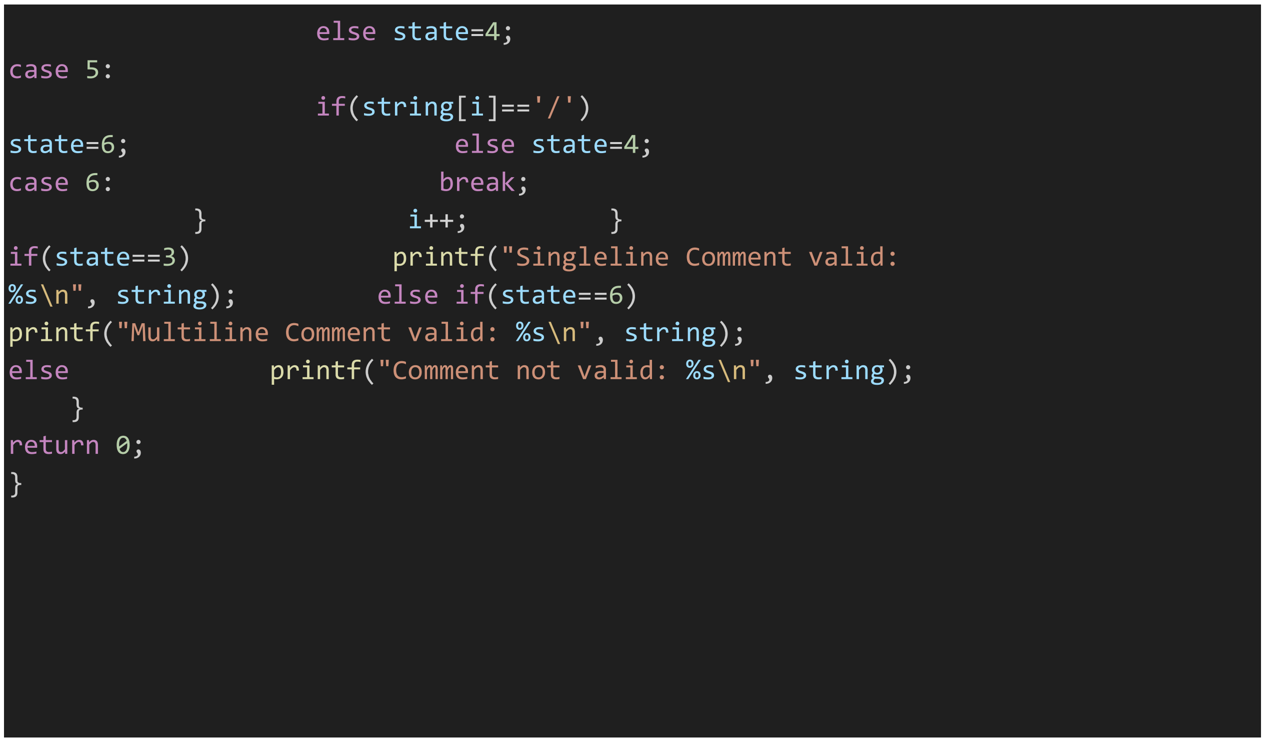
```
                        i = 0;
state = 0;
f--;                     }
break;
                 case
41:
                    c = buffer[f];                     if (isdigit(c)) {
state = 42; lexeme[i++] = c; }                     else {
lexeme[i] = '\0';                          printf("%s is an invalid number
(expected digit after decimal)\n", lexeme);                        i = 0;
state = 0;                          f--;                     }
break;
                 case
42:
                    c = buffer[f];                     if (isdigit(c)) { state =
42; lexeme[i++] = c; }                    else if (c == 'E' || c == 'e') {
state = 43; lexeme[i++] = c;
}                        else {                         lexeme[i] =
'\0';                          printf("%s is a valid number\n",
lexeme);                         i = 0;
state = 0;                          f--;                     }
break;
                 case
43:
                    c = buffer[f];
                    if (c == '+' || c == '-') { state = 44; lexeme[i++] = c; }
else if (isdigit(c)) { state = 45; lexeme[i++] = c; }                    else
{
                        lexeme[i] = '\0';
                        printf("%s is an invalid number (expected digit or
sign after 'E'/'e')\n", lexeme);                        i = 0;
state = 0;                          f--;
                    }
                    break;
```

```
                case 44:
                    c = buffer[f];                            if (isdigit(c)) {
state = 45; lexeme[i++] = c; }                          else {
lexeme[i] = '\0';                             printf("%s is an invalid number
(expected digit after sign in exponent)\n", lexeme);
i = 0;                             state = 0;                                f--;
}                      break;
                case
45:
                    c = buffer[f];                            if
(isdigit(c)) { state = 45; lexeme[i++] = c; }
else {                            lexeme[i] = '\0';
printf("%s is a valid number\n", lexeme);                           i
= 0;                            state = 0;
f--;                      }                     break;
            }
f++;
        }

        if (state == 40 || state == 41 || state == 42 || state == 45)
{              lexeme[i] = '\0';              printf("%s is a valid
number\n", lexeme);
        } else {
            printf("%s is an invalid number\n", buffer);
        }
    }
    fclose(file);
return 0;
}
```

2(d). Write a program to recognize the valid comments.

Code:

```
#include <stdio.h>
#include <string.h>
 int
main()
{
    char string[1000];
    FILE *file = fopen("comment2.txt", "r");
if (file == NULL) {          printf("Could not
open file input.txt\n");          return 1;
    }     while (fgets(string, sizeof(string),
file))
    {          int i=0,
state=0;
while(string[i]!='\0')
        {
switch(state)
            {
case 0:
                    if(string[i]=='/')
state=1;                     else state=2;
break;                 case 1:
                    if(string[i]=='/') state=3;
else if (string[i]=='*') state=4;
else state=2;                       break;
case 2:                       break;
case 3:                       break;
                case 4:                     if
(string[i]=='*') state=5;
```


```
                    else state=4;
case 5:
                    if(string[i]=='/')
state=6;                     else state=4;
case 6:                     break;
            }              i++;         }
if(state==3)             printf("Singleline Comment valid:
%s\n", string);         else if(state==6)
printf("Multiline Comment valid: %s\n", string);
else             printf("Comment not valid: %s\n", string);
    }
return 0;
}
```

2(e) . Program to implement Lexical Analyzer.

Code:

```
#include <stdio.h>
#include <stdlib.h>
#include <ctype.h>
#include <string.h>
#define BUFFER_SIZE 1000
void check(char *lexeme);

int main() {
FILE *f1;
    char buffer[BUFFER_SIZE], lexeme[50]; // Static buffer for input and
lexeme storage     char c;     int f = 0, state = 0, i = 0;     f1 =
fopen("Input.txt", "r");     fread(buffer, sizeof(char), BUFFER_SIZE - 1, f1);
buffer[BUFFER_SIZE - 1] = '\0'; // Null termination     fclose(f1);
     while (buffer[f] != '\0')
{         c = buffer[f];
switch (state) {
case 0:
                if (isalpha(c) || c == '_')
{                     state = 1;
lexeme[i++] = c;
                }
                else if (c == ' ' || c == '\t' || c == '\n') {
state = 0;
                }
                else if(isdigit(c)) {
state = 13;                         lexeme[i++]
= c;
                }
                else if (c == '/') {
state = 11;   // For comment
                }                 else if (c == ';' || c == ',' || c ==
'{' || c == '}') {                     printf(" %c is a symbol\n", c);
state = 0;
                }                 else if (strchr("+-
*/=%?<>!&|~^", c)) {
```

```
                    state = 0;
                }
break;
            case
1:
                if (isalpha(c) || isdigit(c) || c == '_')
{                         state = 1;
lexeme[i++] = c;
                } else {
                    lexeme[i]   =   '\0';   //   Null-terminate   the   lexeme
check(lexeme);  // Check if it's a keyword or identifier                    state
= 0;                    i = 0;                    f--; // Step back to reprocess
the current non-alphanumeric character
                }
break;
            case
13:
                if(isdigit(c)) {
state = 13;
lexeme[i++] = c;
                }
else if(c=='.') {
state=14;
lexeme[i++]=c;
                }
                else if(c=='E'||c=='e') {
state=16;
lexeme[i++]=c;
                }                 else {
lexeme[i]='\0';                    printf("%s is a valid
number\n", lexeme);                    i=0;
state=0;                    f--;
                }
```

```
                    state = 50;

lexeme[i++] = c;                  }

else {                break;

             case 50: // Operator
Handling                   switch
(lexeme[0]) {                        case
'+':
                        if (c == '+') {
printf("%s is a Unary operator\n", lexeme);
```

```
                             state = 0;
                         }                          else if (c == '=') {
printf("%s is an Assignment operator\n", lexeme);
state = 0;
                         }                          else {
printf("%s is an Arithmetic operator\n", lexeme);
state = 0;                              f--;                            }
break;
                     case '-
':
                         if (c == '-') {
printf("%s is a Unary operator\n", lexeme);
state = 0;
                         }                          else if (c == '=') {
printf("%s is an Assignment operator\n", lexeme);
state = 0;
                         }                          else {
printf("%s is an Arithmetic operator\n", lexeme);
state = 0;                              f--;                            }
break;
                     case
'*':
case '/':
case '%':
                         if (c == '=') {
printf("%s is an Assignment operator\n", lexeme);
state = 0;
                         }                          else {
printf("%s is an Arithmetic operator\n", lexeme);
                             state = 0;
f--;
                         }
```

```
                        break;
                              case '=':
                        if (c == '=') {
                            printf("%s  is  a  Relational  operator\n",  lexeme);
state = 0;
                        }                         else {
printf("%s is an Assignment operator\n", lexeme);
state = 0;                            f--;                         }
break;
                     case
'<':
case '>':
                        if (c == '=' || c == lexeme[0]) {
printf("%s is a Relational operator\n", lexeme);
state = 0;
                        }                         else {
printf("%s is a Relational operator\n", lexeme);
state = 0;                            f--;                         }
break;
                     case
'!':
case '&':
case '|':
                        if (c == '=') {
                            printf("%s  is  a  Logical  operator\n",  lexeme);
state = 0;
                        }
                        else if (c == lexeme[0]) {
                            printf("%s  is  a  Logical  operator\n",  lexeme);
state = 0;
                        }
else {
                            printf("%s is a Logical operator\n", lexeme);
state = 0;                            f--;
```

```
                         }
break;
```

```
                    case '~':                          case '^':
printf("%s is a Bitwise operator\n", lexeme);
                        state = 0;
f--;
break;
                     case
'?':
                        if (c == ':') {                                printf("%s
is a Ternary or conditional operator\n", lexeme);                              state
= 0;
                        }
else {
state = 0;
f--;                         }
break;
                     default:
state = 0;
break;
             }
lexeme[0] = '\0';
i = 0;                 break;
             default:
state = 0;
break;
        }
f++;
    }
}
void check(char *lexeme) {
char *keywords[] = {
    "auto", "break", "case", "char", "const", "continue", "default", "do",
    "double", "else", "ef", "extern", "float", "for", "goto", "if",
    "inline", "int", "long", "register", "restrict", "return", "short", "signed",
    "sizeof", "static", "struct", "switch", "typedef", "union", "unsigned",
"void", "volatile", "while"
```

```
};
    for (int i = 0; i < 32; i++) {          if
(strcmp(lexeme, keywords[i]) == 0) {
printf("%s is a keyword\n", lexeme);
return;
        }     }      printf("%s is an
identifier\n", lexeme);
}
```

Output:

4. Implement following programs using Lex.

a. Write a Lex program to take input from text file and count no of characters, no. of lines & no. of words.

Code:

```
%{

#include<stdio.h> int

words=0,characters=0,no_of_lines=0;

%}

%%

\n {no_of_lines++,words++;}

. characters++;

[\t ]+ words++;

%%

void main(){ yyin = fopen("4_1.txt","r"); yylex(); printf("This

file is containing %d words.\n",words); printf("This file is

containing %d characters.\n",characters); printf("This file is

containing %d no_of_lines.\n",no_of_lines);

}
```

int yywrap(){ return(1);} Output:

b. Write a Lex program to take input from text file and count number of vowels and consonants.

Code:

```
%{

#include<stdio.h> int

vowels=0, consonant=0;

%}

%%

[aeiouAEIOU] vowels++;

[a-zA-Z] consonant++;

.  ;

\n  ;

%%

void main(){ yyin = fopen("input.txt","r"); yylex();

printf("This file is containing %d vowels.\n",vowels);

printf("This file is containing %d consonants.\n",consonant);

}

int yywrap(){ return(1);} Output:
```

c. Write a Lex program to print out all numbers from the given file.

Code:

```
%{

  #include<stdio.h>

%}

%%
```

```
[0-9]+(.[0-9]+)?([eE][+-]?[0-9]+)?  printf("%s is valid number \n",yytext);

\n        ;

.           ;

%%


void main() { yyin =

fopen("input.txt","r");

yylex();

}

int yywrap(){return(1);} Output:
```

d. Write a Lex program which adds line numbers to the given file and display the same into different file.

Code:

```
%{
int line_number = 1;
%}
%%
.+ {fprintf(yyout,"%d: %s",line_number,yytext);line_number++;}
%%
int main() { yyin =
fopen("input.txt","r"); yyout
= fopen("op.txt","w");
yylex(); printf("Done");
return 0;
}
```

```
int yywrap(){return(1);}
```

e. Write a Lex program to printout all markup tags and HTML comments in file.

Code:

```
%{
#include<stdio.h> int
num=0;
%}
%%
"<"[A-Za-z0-9]+">"|"<"[/A-Za-z0-9]+">" printf("%s is valid markup tag \n",yytext);
"<!--"[A-Za-z ]*"-->" num++;
.|\n ;
%%
int main() {
yyin = fopen("htmlfile.txt","r"); yylex();
printf("%d comment",num);
return 0;
}
int yywrap(){return(1);}
```

5(a). Write a Lex program to count the number of C comment lines from a given C program. Also eliminate them and copy that program into separate file.

Code:

```
%{
#include <stdio.h> int
comment_count = 0;
FILE *outfile;
%}
%%
"//".*                    { comment_count++; /* Skip single-line comment */ }
"/*"([^*]*\*+)*?"/"             { comment_count++; /* Skip multi-line comment */ }
```

```
.|\n                        { fputc(yytext[0], outfile); }
%%
int main(int argc, char **argv) {
if (argc < 2) {
        printf("Usage: %s <input_file>\n", argv[0]);
return 1;
    }
    FILE *infile = fopen("sample.c", "r");
if (!infile) {
        perror("Cannot open input file");
        return 1;
    }
    outfile = fopen("cleaned_code.c", "w");
if (!outfile) {
        perror("Cannot open output file");
return 1;
    }
    yyin = infile;
yylex();
fclose(infile);
fclose(outfile);
    printf("Total number of comments: %d\n", comment_count);
return 0;
}
int yywrap(){
    return 1;
}
```

Sample.c :

```
#include <stdio.h>

int main() {
    // This is a single-line comment
    int x = 10;
    float y = 20.5;

    /*
        This is a multi-line comment
        It should be removed
    */

    if (x < y) {
        printf("x is less than y\n");
    } else {
        printf("x is not less than y\n");
    }

    char c = 'A';   // Character literal
return 0;
}
```

5(b). Write a Lex program to recognize keywords, identifiers, operators, numbers, special symbols, literals from a given C program.

Code:

```
%{

#include <stdio.h>

#include <string.h>

#include <ctype.h>

FILE *outfile; // C

keywords list char

*keywords[] = {

    "int", "float", "return", "if", "else", "while", "for", "char", "double",

    "do", "switch", "case", "break", "continue", "void", "long", "short",

    "unsigned", "signed", "static", "struct", "union", "typedef", "const",

    "goto", "enum", "default", "sizeof", "volatile", "register", NULL

};
int is_keyword(const char *word) {    for
(int  i  =  0;  keywords[i];  i++)  {              if
(strcmp(keywords[i], word) == 0)
            return 1;
    }
    return 0;
}
%}

%%
\"([^"\\]|\\.)*\"       { fprintf(outfile, "String literal: %s\n", yytext); }
\'([^'\\]|\\.)\'        { fprintf(outfile, "Character literal: %s\n", yytext); }
[0-9]+\.[0-9]+          { fprintf(outfile, "Float number: %s\n", yytext); }
[0-9]+                  { fprintf(outfile, "Integer number: %s\n", yytext); }
[a-zA-Z_][a-zA-Z0-9_]*   {
                            if (is_keyword(yytext))
fprintf(outfile, "Keyword: %s\n", yytext);
                            else                                fprintf(outfile,
"Identifier: %s\n", yytext);
                        }
"=="|"!="|"<="|">="|"="|"+"|"-"|"*"|"/"|"<"|">" {
                            fprintf(outfile, "Operator: %s\n", yytext);
                        }
[{}()[\];,]             { fprintf(outfile, "Special symbol: %s\n", yytext); }
```

```
[ \t\n]+                ; // Skip whitespace
.                       { fprintf(outfile, "Unknown token: %s\n", yytext); }
%%
int main(int argc, char **argv) {
    if (argc < 2) {         printf("Usage: %s
<input_file>\n", argv[0]);         return 1;
    }

    FILE *infile = fopen("sample.c", "r");
    if (!infile) {
        perror("Cannot open input file");
return 1;
    }
    outfile = fopen("tokens.txt", "w");
    if (!outfile) {         perror("Cannot
open output file");         return 1;
    }
    yyin = infile;     yylex();     fclose(infile);     fclose(outfile);
printf("Tokenization complete. Output written to tokens.txt\n");
return 0;
}
int yywrap() {
return 1;
}
```

Sample.c :

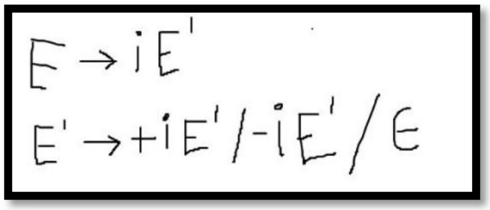
```c
#include <stdio.h>
 int main() {     int a = 10;
float b = 20.5;     char c = 'Z';
const char *str = "Hello, World!";
     if (a < b) {         printf("a
is less than b\n");
    } else {
        printf("a is not less than b\n");
    }
return 0;
}
```

```
Unknown token: #

Identifier: include

Operator: <

Identifier: stdio

Unknown token: .

Identifier: h

Operator: >

Keyword: int

Identifier: main

Special symbol: (
Special symbol: )
Special symbol: {

Keyword: int

Identifier: a Operator:

=

Integer number: 10

Special symbol: ;

Keyword: float

Identifier: b

Operator: =

Float number: 20.5

Special symbol: ;

Keyword: char

Identifier: c Operator:

=

Character literal: 'Z'

Special symbol: ;

Keyword: const

Keyword: char

Operator: *

Identifier: str

Operator: =

String literal: "Hello, World!"

Special symbol: ;
```

```
Keyword: if
Special symbol: (

Identifier: a

Operator: < Identifier:

b

Special symbol: ) Special

symbol: {

Identifier: printf

Special symbol: (

String literal: "a is less than b\n"

Special symbol: )

Special symbol: ; Special

symbol: }

Keyword: else

Special symbol: {

Identifier: printf

Special symbol: (

String literal: "a is not less than b\n"

Special symbol: ) Special

symbol: ;

Special symbol: }

Keyword: return

Integer number: 0

Special symbol: ;
```

Special symbol: }

6.Program to implement Recursive Descent Parsing in C.



$E \rightarrow iE'$

$E' \rightarrow +iE' / -iE' / \epsilon$

Code:

```
#include <stdio.h>
#include <string.h>

char inp[100];
int l = 0;

void match(char t) {
   if (inp[l] == t) {
l++;     } else {
printf("Error\n");
      exit(0);
   }
}

void E(); void
E_prime();

void E() {     if
(inp[l] == 'i') {
match('i');
E_prime();
   }
}
void E_prime() {
   if (inp[l] == '+') {
match('+');        match('i');
E_prime();     } else if
(inp[l] == '-') {
match('-');        match('i');
E_prime();     } else {
return; // epsilon case     }
}
```

```
int main() {
   printf("Enter expression: ");
scanf("%s", inp);

   E();

   if (inp[l] == '$') { // End of input
printf("Success\n");
   } else {
      printf("Error\n");
   }

   return 0;
}
```

7(a). To Study about Yet Another Compiler-Compiler(YACC).

YACC (Yet Another Compiler Compiler) is a parser generator tool used in compiler design to produce syntax analyzers for context-free grammars. It works closely with Lex, where Lex handles lexical analysis and YACC performs syntax analysis based on grammar rules. YACC generates efficient LALR(1) parsers and allows grammar specification in a structured format with declarations, grammar rules, and associated C actions. It interprets token streams from Lex to understand program structure and syntax. Widely used in building compilers and interpreters, YACC simplifies the implementation of parsing logic for programming languages.

7(b). Create Yacc and Lex specification files to recognizes arithmetic expressions involving +, -, * and / .

Code:

Lex:

```
%{
#include<stdlib.h> void
yyerror(char *);
#include "1.tab.h"
%}
%%
[0-9]+ return num;
[-/+*\n] return *yytext;
[ \t] ;
. yyerror("invalid");
%%
int yywrap(){
return 1;
}
```

Yacc:

```
%{
#include<stdio.h>
int yylex(void); void
yyerror(char *);
%}
%token num
```

```
%%

S:E'\n' {printf("Valid syntax."); return 0;}

E:E'-'T {}

 |E'+'T {}

 |T {}

T:T'/'F {}

 |T'*'F {}

|F {}

F:num {}

%%

void yyerror(char *s){

printf("%s\n",s);

}

int main(){

yyparse(); return 0;

}
```

7(c). Create Yacc and Lex specification files are used to generate a calculator which accepts integer type arguments.

Code:

Lex:

```
%{

#include<stdlib.h>

#include "1.tab.h" void

yyerror(char *);

%}
```

```
%%

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

[-+*/\n] {return *yytext;}

[()/] {return *yytext;}

[ \t] ;

. {yyerror("invalid");}

%%

int yywrap(){

return 1;

}
```

Yacc:

```
%{

#include<stdio.h>

void yyerror(char

*); int yylex(void);

%}

%token num

%%

S:E'\n' {printf("%d\n",$1); return 0;}

E:E'-'T {$$=$1-$3;}

 |T {$$=$1;}

T:T'+'F {$$=$1+$3;}

 |F {$$=$1;}

F:F'*'G {$$=$1*$3;}

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

```
G:G'/'H {$$=$1/$3;}

 |H {$$=$1;}

H:'('E')' {$$=$2;}

 |num {$$=$1;}

%%

void yyerror(char *s){

printf("%s\n",s);

}

int main(){

yyparse(); return 0;

}
```

7(d). Create Yacc and Lex specification files are used to convert infix expression to postfix expression.

Code:

Lex:

```
%{

#include<stdlib.h>

#include "1.tab.h" void

yyerror(char *);

%}

%%

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

[A-Za-z_][A-Za-z_0-9]* {yylval.str=yytext; return ID;}
```

```
[-+*/\n] {return *yytext;}

[ \t] ;

. {yyerror("Invalid character.");}

%%

int yywrap(){

return 1;

}

Yacc:

%{

#include<stdio.h>

int yylex(void); void

yyerror(char *);

%}

%union{

   char *str;

int num;

}

%token <num> INTEGER

%token <str> ID

%%

S:E'\n' {printf("\n");}

E:E'-'T {printf("-");}

 |T {}

T:T'+'F {printf("+");}

 |F {}
```

```
F:F'*'G {printf("*");}
 |G {}
G:G'/'H {printf("/");}
 |H {}
H:INTEGER {printf("%d",$1);}
 |ID {printf("%s",$1);}
%%
void yyerror(char *s){
printf("%s\n",s);
}
int main(){
yyparse(); return 0;
}
```