GURU TEGH BAHADUR

INSTITUTE OF TECHNOLOGY

NEW DELHI

COMPUTATIONAL METHODS

LAB MANUAL

ES-251

List of Experiments

No.	Name of Experiments
1	*Write a program to find the sum and average of numbers.*
2	*Write a program to find the Fibonacci series up to n numbers*.
3	*Write a program to find the product of two 3x3 Matrices*
4	*Write a program to find root of an equation using Bisection Method.*
5	*Write a program to find root of an equation using Secant Method.*
6	*Write a program to find roots of an equation using Newton-Raphson method.*
7	*Write a program to find integral of function using Trapezoidal rule.*
8	*Write a program to find integral of function using Simpsons 1/3rd Rule.*
9	*Write a program to find integral of function using Simpsons 3/8th Rule*
10	*To find the value of a function using Lagrange's Interpolation.*
11	*Write a program to solve differential equation using Runge-Kutta's Method.*

PROGRAM 1

Write a program to find the sum and average of numbers.

```c
#include<stdio.h>
#include<conio.h>
void main() {
int num[100];
int i, j, n, ch, sum = 0;
float avg;
clrscr();
printf("Enter number of elements : ");
scanf("%d", &n);
printf("Enter elements of array :");
for(i = 0; i < n; i++) {
scanf("%d", &num[i]);
}
for(i = 0; i < n; i++) {
sum = sum + num[i];
}
printf("Sum of elements are : ");
printf("%d", sum);
avg = float(sum) / float(n);
printf("\nAverage of elements are : ");
printf("%f", avg);
getch();
}
```

PROGRAM 2

Write a program to find the Fibonacci series upto n numbers.

```c
#include<stdio.h>
#include<conio.h>
void main() {
int i, n;
int t1 = 0, t2 = 1;
int newterm = t1 + t2;
clrscr();
printf("Enter number of terms : ");
scanf("%d", &n);
printf("Fibonacci Series : %d\t%d", t1, t2);
for(i = 3; i <= n; ++i) {
printf("\t%d", nt);
t1 = t2;
t2 = newterm;
newterm = t1 + t2;
}
getch();
}
```

PROGRAM 3

Write a program to find the product of two 3x3 Matrices.

```c
#include<stdio.h>
#include<conio.h>
int main() {
int m1[3][3];
int m2[3][3];
int product[3][3];
int i, j, k;
clrscr();

printf("Enter elements of m1 : \n");
for(i = 0; i < 3; i++){
printf("\n");
for(j = 0; j < 3; j++){
scanf("\t%d", &m1[i][j]);
}}
printf("\n");

printf("Enter elements of m2 : \n");
for(i = 0; i < 3; i++){
printf("\n");
for(j = 0; j < 3; j++){
scanf("\t%d", &m2[i][j]);
}}
```

```c
for(i = 0; i < 3; i++){
for(j = 0; j < 3; j++){
product[i][j] = 0;
for(k = 0; k < 3; k++){
product[i][j] += m1[k][j] * m2[i][k];
}}}

printf("Product of m1 and m2 is :\n");
for(i = 0; i < 3; i++){
printf("\n");
for(j = 0; j < 3; j++){
printf("\t%d", product[i][j]);
}}
getch();
return 0;
}
```

PROGRAM 4

Write a program to find out root of given function using Bisection Method.

```c
#include<stdio.h>
#include<math.h>
#include<conio.h>
#define f(x) log(x)-sin(x)
#define e 0.001
int main()  {
float a, b, x1, fa, fb, fx1;
int i = 0;
clrscr();
printf("\nEnter two initial guess: ");
scanf("%f %f", &a, &b);
fa = f(a);
fb = f(b);
if (fa * fb > 0){
printf("\nincorrect initial guess.");
}
else {
do {
x1 = (a + b)/2;
fx1 = f(x1);
if (f(x1) < 0) {
```

```c
        a = x1;}
    else {
        b = x1;}
    i++;
    printf("\nNumber of iterations are %d\t", i);
    printf("Root is %f \t", x1);
    printf("\n value of function is %f \t", fx1);
    } while (fabs(b-a) > e);
}
getch();
return 0;
}
```

PROGRAM 5

Write a program to find out number of iterations and root of given function using Secant Method.

```c
#include<stdio.h>
#include<math.h>
#include<conio.h>
#define e 0.001
#define f(x) log(x)-cos(x)
int main() {
float x0,x1,x2,f0,f1,f2;
int i = 0;
clrscr();
printf("\nEnter value of x0 and x1 : ");
scanf("%f %f", &x0, &x1);
do{
f0 = f(x0);
f1 = f(x1);
x2 = ((x0*f1)-(x1*f0))/(f1-f0);
f2 = f(x2);
f0 = f1;
f1 = f2;
x0 = x1;
x1 = x2;
i++;
```

```c
printf("\n Number of iterations:%d\t", i);
printf("Root is: %f\t", x2);
printf("Value of function is:%f\t\n", f2);
} while(fabs(f2)>e);
getch();
return 0;
}
```

PROGRAM 6

Write a program to find the roots of an equation using Newton-Raphson method.

```c
#include<stdio.h>
#include<conio.h>
#include<math.h>
#define e 0.001
#define f(x) x-exp(-x)
#define g(x) 1+exp(-x)

int main(){
float x0,x1,x2,f0,f1,f2,g0;
int i=1,N;
Printf("Enter initial guess: ");
Scanf("%f%f",&x1,&x2);
Printf("\nEnter maximum iterations: ");
Scanf("%d",&N);
F1=f(x1);
F2=f(x2);
If(f1*f2>0.0)
{
Printf("\nWrong initial guess.");
Exit(0);
}
```

```c
do
{
f0=f(x0);
g0=g(x0);
x1=x0-(f0/g0);
Printf("\nIteration number= %d\t",i);
Printf("\nApproximation Root= %f\t",x1);
x0=x1;
i++;
if(i>N)
{
Printf("\nNot Convergent");
exit(0);
}
Printf("\nValue of function is: %f\t",f0);
}
while(fabs(f0/g0)>e);
Printf("\nHence root is: %f\n",x1);
getch();
return 0;
}
```

PROGRAM 7

Write a program to find integral of function using Trapezoidal rule.

```c
#include<stdio.h>
#include<conio.h>
#include<math.h>
#define e 0.001
#define f(x) 1/(x*x*x*x + 10*x -5)
int main(){
float a,b,fa,fb,h,k,m,I=0.0;
int i,n;
clrscr();
printf("Enter lower limit integration : ");
scanf("%f", &a);
printf("Enter upper limit of integration : ");
scanf("%f", &b);
printf("Enter number of sub intervals : ");
scanf("%d", &n);
h = (b-a)/n;
fa = f(a);
fb = f(b);
m = fa + fb;
for(i=1; i <= n; i++) {
k = a + i*h;
m = m + 2*f(k);
}
```

```c
I = m*(h/2);
printf("\n Required value of integration is : %f", I);
getch();
return 0;
}
```

PROGRAM 8

Write a program to find integral of function using Simpsons 1/3rd Rule.

```c
#include<stdio.h>
#include<conio.h>
#include<math.h>
#define e 0.001
#define f(x) 1/(x*x*x*x + 10*x -5)
int main(){
float a,b,l,h,k,m,p=0.0,q=0.0;
int i,n;
clrscr();
printf("Enter lower limit integration : ");
scanf("%f", &a);
printf("Enter upper limit of integration : ");
scanf("%f", &b);
printf("Enter number of sub intervals : ");
scanf("%d", &n);
h = (b-a)/n;
l = f(a) + f(b);
for(i=1; i <= n-1; i++) {
k = a + (i*h);
if(i%2 == 0) {
p = p + 2*f(k);
```

```c
    }
    else {
    q = q + 4*f(k);
    }
    m = (h/3)*(l+p+q);
    }
    printf("\n Required value of integration is : %f", m);
    getch();
    return 0;}
```

PROGRAM 9

Write a program to find integral of function using Simpsons 3/8ᵗʰ Rule.

```c
#include<stdio.h>
#include<conio.h>
#include<math.h>
#define e 0.001
#define f(x) 1/(x*x*x*x + 10*x -5)
int main(){
float a,b,l,h,k,m,p=0.0,q=0.0;
int i,n;
clrscr();
printf("Enter lower limit integration : ");
scanf("%f", &a);
printf("Enter upper limit of integration : ");
scanf("%f", &b);
printf("Enter number of sub intervals : ");
scanf("%d", &n);
h = (b-a)/n;
l = f(a) + f(b);
for(i=1; i <= n-1; i++) {
k = a + (i*h);
if(i%2 == 0) {
```

```c
p = p + 2*f(k);
}
else {
q = q + 4*f(k);
}
m = (3*h/8)*(l+p+q);
}
printf("\n Required value of integration is : %f", m);
getch();
return 0;
}
```

PROGRAM 10

To find the value of a function using Lagrange's Interpolation.

```c
#include<stdio.h>
#include<conio.h>
#include<math.h>

int main() {
float xp,x[20],y[20],yp = 0.0,p;
int i,j,n;
clrscr();
printf("Enter the number of data : ");
scanf("%d", &n);
printf("Enter the value to be found : ");
scanf("%f", &xp);
printf("Enter the data : ");
for(i = 0; i < n; i++) {
printf("x[%d] = ", i);
scanf("%f", &x[i]);
printf("y[%d] = ", i);
scanf("%f", &y[i]);
}
for(i = 0; i < n; i++) {
p = 1;
```

```c
for(j = 0; j < n; j++) {
if(j!=i)
p = p*((xp - x[j])/(x[i] - x[j]));
}
yp = yp+p*y[i];
}
printf("Interpolated value at %.3f is %.3f",xp,yp);
getch();
return 0;
}
```

PROGRAM 11

Write a program to solve differential equation using Runge-Kutta's Method.

```c
#include<stdio.h>
#include<conio.h>
#include<math.h>

float f(float x, float y) {
return (x*x - y*y + y);
}

int main() {
float x0,y0,xn,h,x,y,k1,k2,k3,k4;
clrscr();
printf("Enter the initial values of x and y : ");
scanf("%f %f", &x0, &y0);
printf("Enter last value of x : ");
scanf("%f", &xn);
printf("Enter step value of h : ");
scanf("%f", &h);
y = y0;
printf("X-value    Y-value\n");
for(x = x0; x < xn; x+=h) {
```

```c
k1 = h*f(x,y);
k2 = h*f(x+h/2,y+k1/2);
k3 = h*f(x+h/2,y+k2/2);
k4 = h*f(x+h,y+k3);
y = y + (k1 + 2*(k2+k3) + k4)/6;
printf("%f    %f\n", x+h, y);
}
getch();
return 0;
}
```