KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University Established Under Section 3 of UGC Act, 1956)

SEMESTER - I

MATHEMATICAL PHYSICS - I

17PHU103		**L T P C**
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Objective: The main objective of this course is to provide the student with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering. In addition, this course is intended to prepare the student with mathematical tools and techniques that are required in advanced courses offered in the applied physics

UNIT - I

Euler's formula, RK Method (II & IV), Linear interpolation: Newton forward interpolation formula and backward interpolation formula - Bessel's Formula. Interpolation with unequal intervals: Lagrange's interpolation formula.

Trapezoidal rule - Simpson's 1/3 rule and 3/8 rule- Bisection method - method of successive approximations - Regula Falsi method - Newton-Raphson method

UNIT - II

Basic of C language: Introduction, Data types, Operators and Expressions, Conditional Statements, Input and output Statements (Exclude Program)

UNIT - III

Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality. Simple recurrence relations.

UNIT - IV

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry.

UNIT - V

Complex Analysis: Brief revision of Complex numbers & their graphical representation. Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity. Integration of a function of a complex variable. Cauchy’s Integral formula.

SUGGESTED READINGS:

TEXT BOOKS

1. Mathematical Physics by By Shigeji Fujita, Salvador V. Godoy, 2010, Wiley VCH Verlag GmbH & Co. KGaA, ISBN- 978-3-527-40808-5.
2. Mathematical Physics by Pavan Kumar Chaurasya, Campus Books International publisher, 2013, ISBN - 8180303160, 9788180303166.

REFERENCE BOOKS:

3. Introduction to Mathematical Physics: Methods & Concepts, By Chun Wa Wong, 2013, Oxford University press, ISBN -978-0-19-964139-0.
4. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
5. Essential Mathematical Methods, K.F.Riley and M.P.Hobson, 2011, Cambridge University Press.

SYLLABUS:

LIST OF PROGRAMS:

- AREA OF A CIRCLE AND RECTANGLE
- NUMERICAL INTEGRATION USING SIMPSON'S 1/3 RULE
- EULER'S METHOD
- NUMERICAL INTEGRATION USING TRAPEZOIDAL RULE
- RUNGE KUTTA METHOD
- NEWTON RAPHSON METHOD

PRG.NO:1
DATE: **AREA OF A CIRCLE AND RECTANGLE**

(A) AREA OF A CIRCLE

AIM:

Write a C program to find an area of circle and rectangle.

PROGRAM:

```
#include<stdio.h>

int main()
{
  float radius, area;

  printf("\nEnter the radius of Circle : ");
  scanf("%d", &radius);

  area = 3.14 * radius * radius;
  printf("\nArea of Circle : %f", area);

  return (0);
}
```

Output :

Enter the radius of Circle : 2.0
Area of Circle : 6.14

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(B) AREA OF THE RECTANGLE

PROGRAM:

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

int main() {
   int length, breadth, area;

   printf("\nEnter the Length of Rectangle : ");
   scanf("%d", &length);

   printf("\nEnter the Breadth of Rectangle : ");
   scanf("%d", &breadth);

   area = length * breadth;
   printf("\nArea of Rectangle : %d", area);

   return (0);
}
```

Output :

```
Enter the Length of Rectangle  : 5
Enter the Breadth of Rectangle : 4
Area of Rectangle : 20
```

RESULT:

The above program is done successfully and the output is verified

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PRG.NO:2
DATE:

NUMERICAL INTEGRATION USING SIMPSON'S 1/3 RULE

AIM:

Write a C program to evaluate the integral by using Trapezoidal rule.

PROGRAM:

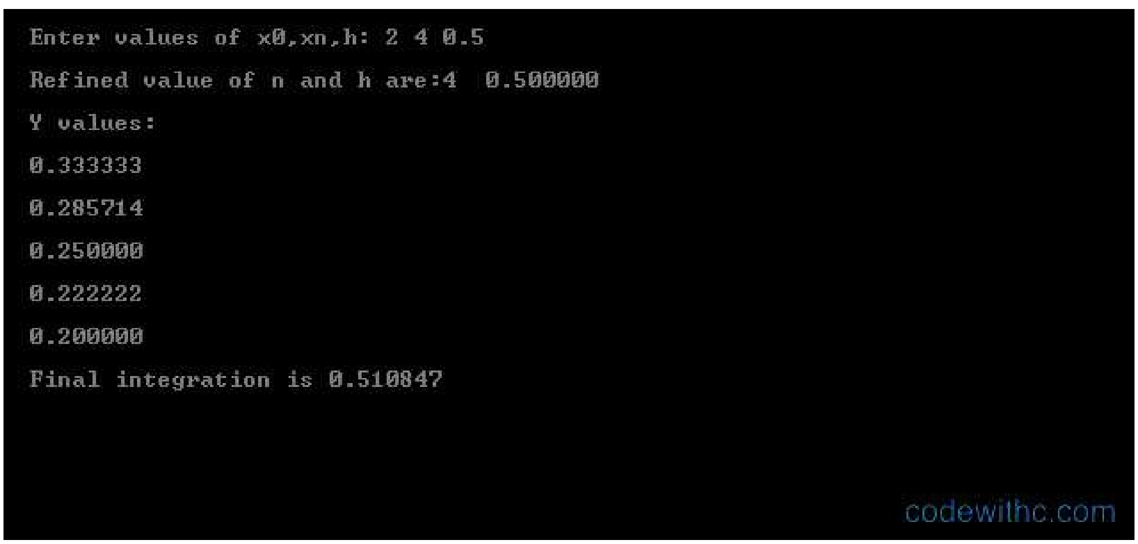
```
#include<stdio.h>
#include<conio.h>
float f(float x)
{
   return(1/(1+x));
}
void main()
{
   int i,n;
   float x0,xn,h,y[20],so,se,ans,x[20];
   printf("\n Enter values of x0,xn,h: ");
   scanf("%f%f%f",&x0,&xn,&h);
   n=(xn-x0)/h;
   if(n%2==1)
   {
      n=n+1;
   }
   h=(xn-x0)/n;
   printf("\n Refined value of n and h are:%d %f\n",n,h);
   printf("\n Y values: \n");
   for(i=0; i<=n; i++)
   {
      x[i]=x0+i*h;
      y[i]=f(x[i]);
      printf("\n %f\n",y[i]);
   }
   so=0;
   se=0;
   for(i=1; i<n; i++)
   {
      if(i%2==1)
      {
         so=so+y[i];
```

```
    }
    else
    {
      se=se+y[i];
    }

  }
  ans=h/3*(y[0]+y[n]+4*so+2*se);
  printf("\n Final integration is %f",ans);

  getch();
}
```

OUTPUT:



RESULT:

The above program is done successfully and the output is verified.

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PRG.NO:3
DATE:

EULER'S METHOD

AIM:

Write a C program to obtain the solution of first order differential equation using Euler's method.

PROGRAM:

```
#include<stdio.h>
float fun(float x,float y)
{
   float f;
   f=x+y;
   return f;
}
main()
{
   float a,b,x,y,h,t,k;
   printf("\nEnter x0,y0,h,xn: ");
   scanf("%f%f%f%f",&a,&b,&h,&t);
   x=a;
   y=b;
   printf("\n  x\t  y\n");
   while(x<=t)
   {
      k=h*fun(x,y);
      y=y+k;
      x=x+h;
      printf("%0.3f\t%0.3f\n",x,y);
   }
}
```


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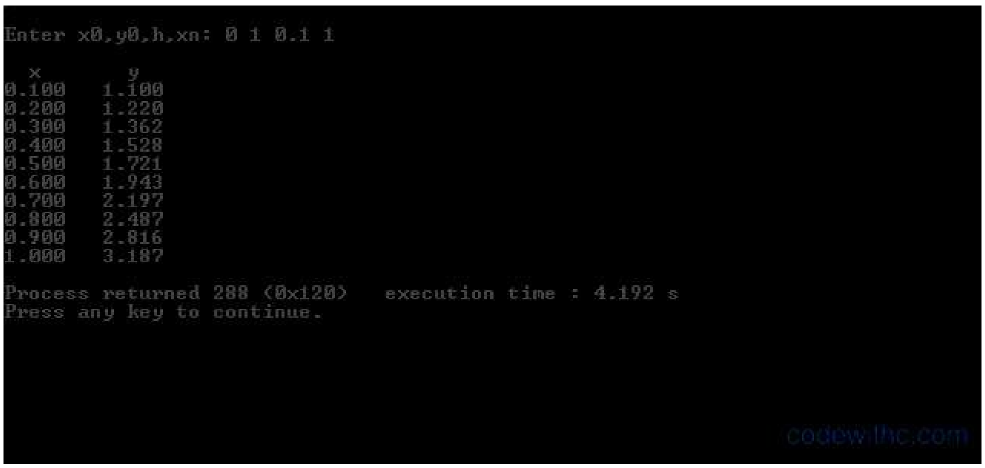
OUTPUT:



```
Enter x0,y0,h,xn: 0 1 0.1 1

  x       y
0.100   1.100
0.200   1.220
0.300   1.362
0.400   1.528
0.500   1.721
0.600   1.943
0.700   2.197
0.800   2.487
0.900   2.816
1.000   3.187

Process returned 288 (0x120)   execution time : 4.192 s
Press any key to continue.
```


RESULT:

The above program is done successfully and the output is verified.

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PRG.NO:4
DATE:

NUMERICAL INTEGRATION USING TRAPEZOIDAL RULE

AIM:

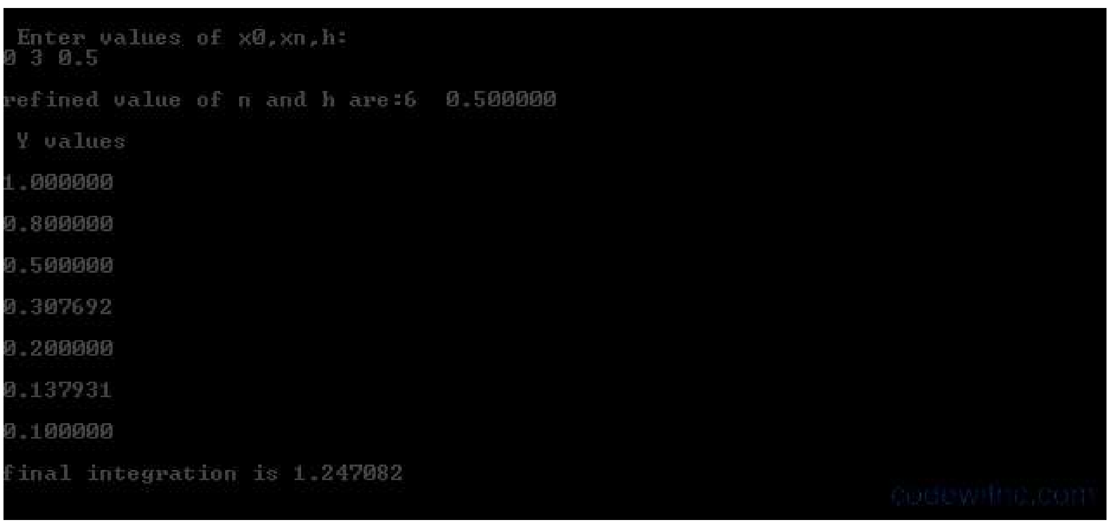
Write a C program to evaluate the integral by using Trapezoidal rule.

PROGRAM:

```
#include<stdio.h>
#include<conio.h>
#include<math.h>
float f(float x)
{
   return(1/(1+pow(x,2)));
}
void main()
{
   int i,n;
   float x0,xn,h,y[20],so,se,ans,x[20];
   printf("\n Enter values of x0,xn,h:\n");
   scanf("%f%f%f",&x0,&xn,&h);
   n=(xn-x0)/h;
   if(n%2==1)
   {
      n=n+1;
   }
   h=(xn-x0)/n;
   printf("\nrefined value of n and h are:%d  %f\n",n,h);
   printf("\n Y values \n");
   for(i=0; i<=n; i++)
   {
      x[i]=x0+i*h;
      y[i]=f(x[i]);
      printf("\n%f\n",y[i]);
   }
   so=0;
   se=0;
   for(i=1; i<n; i++)
   {
```

```
      if(i%2==1)
      {
         so=so+y[i];
      }
      else
      {
         se=se+y[i];
      }
   }
   ans=h/3*(y[0]+y[n]+4*so+2*se);
   printf("\nfinal integration is %f",ans);
   getch();
}
```

OUTPUT:



RESULT:

The above program is done successfully and the output is verified.

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PRG.NO:5
DATE:

RUNGE KUTTA METHOD

AIM:
Write a C program to obtain the solution of numerical differential equation using Runge Kutta Method.

PROGRAM:

```
#include<stdio.h>
#include<math.h>
float f(float x,float y);
int main()
{
   float x0,y0,m1,m2,m3,m4,m,y,x,h,xn;
   printf("Enter x0,y0,xn,h:");
   scanf("%f %f %f %f",&x0,&y0,&xn,&h);
   x=x0;
   y=y0;
   printf("\n\nX\t\tY\n");
   while(x<xn)
   {
      m1=f(x0,y0);
      m2=f((x0+h/2.0),(y0+m1*h/2.0));
      m3=f((x0+h/2.0),(y0+m2*h/2.0));
      m4=f((x0+h),(y0+m3*h));
      m=((m1+2*m2+2*m3+m4)/6);
      y=y+m*h;
      x=x+h;
      printf("%f\t%f\n",x,y);
   }
}
float f(float x,float y)
{
   float m;
   m=(x-y)/(x+y);
   return m;
}
```


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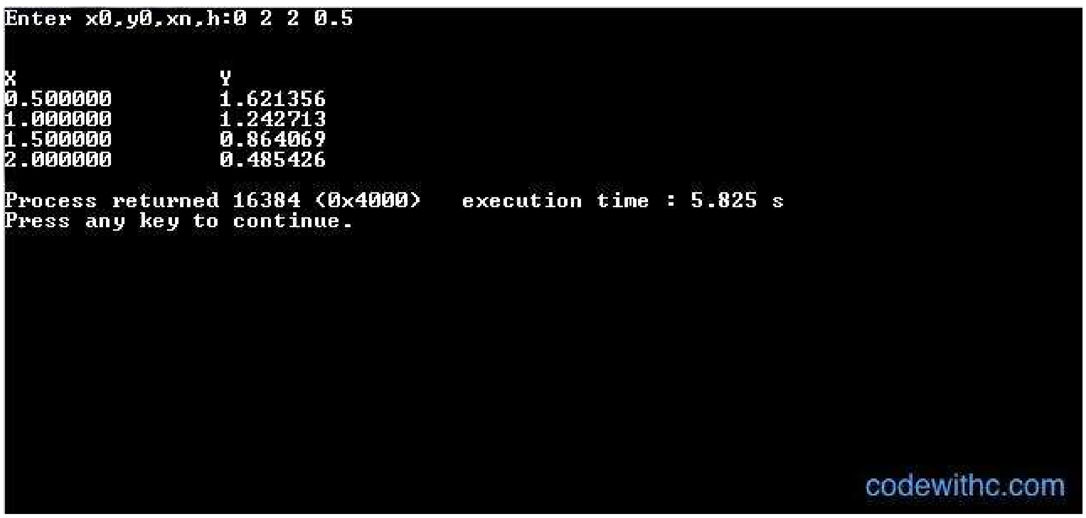
OUTPUT:



```
Enter x0,y0,xn,h:0 2 2 0.5

X               Y
0.500000        1.621356
1.000000        1.242713
1.500000        0.864069
2.000000        0.485426

Process returned 16384 (0x4000)   execution time : 5.825 s
Press any key to continue.
```


RESULT:

The above program is done successfully and the output is verified

PRG.NO:6
DATE: **NEWTON RAPHSON METHOD**

AIM:
Write a C program to obtain the solution of numerical differential equation using Newton Raphson Method.

PROGRAM:

```
#include<stdio.h>
#include<math.h>
float f(float x)
{
  return x*log10(x) - 1.2;
}
float df (float x)
{
  return log10(x) + 0.43429;
}
void main()
{
  int itr, maxmitr;
  float h, x0, x1, allerr;
  printf("\nEnter x0, allowed error and maximum iterations\n");
  scanf("%f %f %d", &x0, &allerr, &maxmitr);
  for (itr=1; itr<=maxmitr; itr++)
  {
    h=f(x0)/df(x0);
    x1=x0-h;
    printf(" At Iteration no. %3d, x = %9.6f\n", itr, x1);
    if (fabs(h) < allerr)
    {
      printf("After %3d iterations, root = %8.6f\n", itr, x1);
      return 0;
    }
    x0=x1;
  }
  printf(" The required solution does not converge or iterations are insufficient\n");
  return 1;
}
```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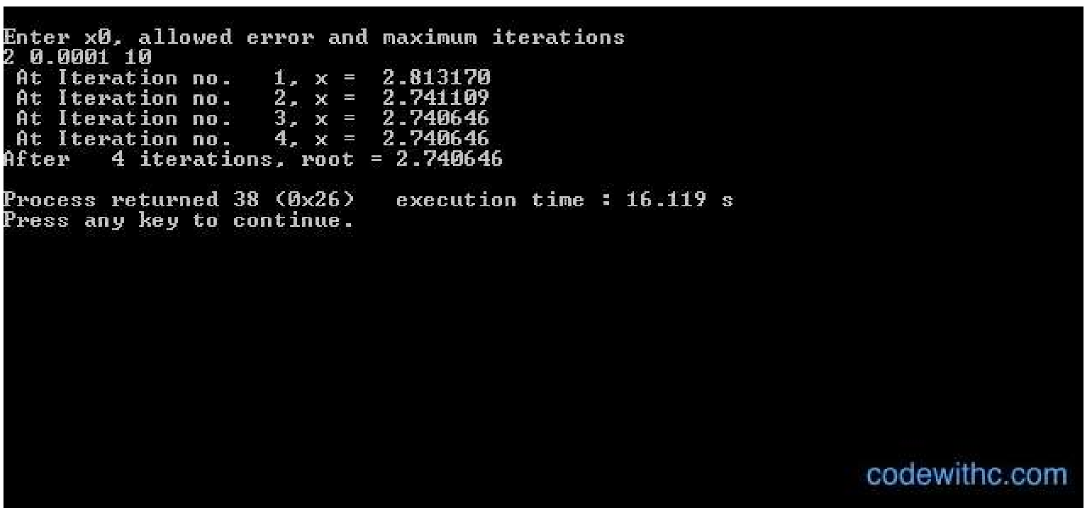
OUTPUT:



RESULT:

The above program is done successfully and the output is verified.