EXPERIMENT:1

QR method-

```
Clc

clear

a=[2 -%i 2*%i;%i 4 3;-2*%i 3 5]
b=spec(a)
for i=1:20
   [Q,R]=qr(a)
   a=R*Q
   disp(a,R)
end
```

output:

```
    column 1 to 2
 -7.6955887 + 0.i   0.       - 0.0000216i
  0.       + 0.i  -3.6916109 + 0.i
  0.       + 0.i   0.       + 0.i
       column 3
  0.       - 1.108D-17i
  3.852D-16 + 0.i
 -0.3871996 + 0.i
```

POWER SERIES:-

```
clc
a=[1 -%i 3+4*%i;%i 2 4;3-4*%i 4 3]
x0=[1 1 1]
tol=0.0001
err=1
k=1
lambda0=1
while (abs(err)>tol)
   x1=x0*a
   lambda1=max(abs(x1))
   x0=x1/lambda1
   err=abs(lambda0-lambda1)
   lambda0=lambda1
   disp(k,lambda1,x0/norm(x0))
   k=k+1
end
[E,d]=spec(a)
disp("Eigen vector ",E)
disp("Eigen value ",d)
```

OUTPUT:

1.

10.770330

column 1 to 2

0.2998127 - 0.2248595i 0.449719 - 0.0749532i

column 3

0.7495317 + 0.2998127i

2.

7.3748174

column 1 to 2

0.4648674 - 0.2278762i 0.4466373 + 0.0911505i

column 3

0.7109737 + 0.1367257i

3.

9.0110533

column 1 to 2

0.3671302 - 0.2663064i 0.4219257 + 0.0317814i

column 3

0.7485072 + 0.2345249i

4.

8.0083256

column 1 to 2

0.4219304 - 0.2559702i 0.4282376 + 0.0760815i

column 3

0.731381 + 0.1798887i

5.

8.5542724

column 1 to 2

0.3905099 - 0.2651991i 0.4224358 + 0.0538868i

column 3

0.7424033 + 0.2113124i

6.

8.2369856

column 1 to 2

0.4083212 - 0.2609216i 0.425114 + 0.0673747i

column 3

0.736527 + 0.1935468i

7.

8.4152163

column 1 to 2

0.3981836 - 0.2636352i 0.423418 + 0.0599561i

column 3

0.7399889 + 0.2036791i

8.

8.3132518

column 1 to 2

0.4039451 - 0.2621744i 0.4243341 + 0.0642455i

column 3

0.7380584 + 0.1979289i

9.

8.3710200

column 1 to 2

0.4006698 - 0.2630286i 0.4238 + 0.0618277i

column 3

0.7391676 + 0.2012009i

10.

8.3381199

column 1 to 2

0.4025319 - 0.2625499i 0.4241 + 0.0632082i

column 3

0.7385407 + 0.1993418i

11.

8.3568046

column 1 to 2

0.4014735 - 0.2628241i   0.4239285 + 0.0624251i

column 3

0.7388982 + 0.2003989i

12.

8.3461770

column 1 to 2

0.4020752 - 0.2626688i   0.4240257 + 0.0628708i

column 3

0.7386953 + 0.1997981i

13.

8.3522168

column 1 to 2

0.4017332 - 0.2627573i   0.4239704 + 0.0626176i

column 3

0.7388108 + 0.2001397i

14.

8.3487828

column 1 to 2

0.4019276 - 0.262707i   0.4240018 + 0.0627616i

column 3

0.7387452 + 0.1999455i

15.

8.3507348

column 1 to 2

0.4018171 - 0.2627356i 0.4239839 + 0.0626797i

column 3

0.7387825 + 0.2000559i

16.

8.3496251

column 1 to 2

0.4018799 - 0.2627194i 0.4239941 + 0.0627263i

column 3

0.7387613 + 0.1999931i

17.

8.3502559

column 1 to 2

0.4018442 - 0.2627286i 0.4239883 + 0.0626998i

column 3

0.7387733 + 0.2000288i

18.

8.3498973

column 1 to 2

0.4018645 - 0.2627234i 0.4239916 + 0.0627148i

column 3

0.7387665 + 0.2000085i

19.

8.3501011

column 1 to 2

0.401853 - 0.2627263i 0.4239897 + 0.0627063i

column 3

0.7387704 + 0.2000201i

20.

8.3499852

column 1 to 2

0.4018595 - 0.2627246i 0.4239908 + 0.0627112i

column 3

0.7387682 + 0.2000135i

21.

8.3500511

column 1 to 2

0.4018558 - 0.2627256i 0.4239902 + 0.0627084i

column 3

0.7387694 + 0.2000172i

"Eigen vector "

column 1 to 2

-0.3404771 - 0.5212558i -0.2734105 + 0.5541666i

-0.4539695 + 0.0504648i -0.3645474 - 0.6890355i

0.6353997 + 0.i 0.1023784 + 0.i

column 3

-0.3192331 - 0.3586139i

-0.4256442 - 0.0502727i

-0.7653665 + 0.i

"Eigen value "

-4.746829 0. 0.

0. 2.3968018 0.

0. 0. 8.3500273

INVERSE POWER:-

```
clc
a=[2 1 1;1 3 2;3 1 4]
b=inv(a)
u=[1 1 1]
x0=u'
tol=0.0001
err=1
k=1
lam0=1
while(abs(err)>tol)
   x1=b*x0
   lam1=max(abs(x1))
   x0=x1/lam1
   err=abs(lam0-lam1)
   lam0=lam1
   disp("iteration ",k)
   disp("eigen value",1/lam1)
   disp(x0/norm(x0))
   k=k+1
end
[E,d]=spec(a)
disp(E,d)
```

OUTPUT:

"iteration "

266.

"eigen value"

1.6082542

0.2445533

0.7180401

-0.6516227

column 1 to 2

0.3243216 + 0.i 0.3899937 - 0.1875413i

0.5849985 + 0.i 0.5379993 + 0.2718959i

0.7433655 + 0.i -0.6703451 + 0.i

column 3

0.3899937 + 0.1875413i

0.5379993 - 0.2718959i

-0.6703451 + 0.i

column 1 to 2

6.095824 + 0.i 0. + 0.i

0. + 0.i 1.452088 + 0.4336988i

0. + 0.i 0. + 0.i

column 3

0. + 0.i

0. + 0.i

1.452088 - 0.4336988i

```
clear;
A=[2 1 1;1 3 2;3 1 4]
X0=[1;1;1];
lmb0=1;
tol=1e-4;err=1;k=1;
while(abs(err)>tol)
   X=inv(A)*X0;
   lmb=max(abs(X));
   X0=X/lmb;
   err=lmb-lmb0;
   lmb0=lmb;
   disp("iter    lambda",[k,1/lmb],"Eigenvector",X0/norm(X0));
   k=k+1;
end
[v,d]=spec(A);
disp(v,d)
```

OUTPUT:

"iter lambda"

263. 1.3482917

"Eigenvector"

0.4683579

0.5093367

-0.7219536

"iter lambda"

264. 1.4761086

"Eigenvector"

0.4002879

0.5831895

-0.7068661

"iter lambda"

265. 1.6082254

"Eigenvector"

0.3295203

0.6497755

-0.6849878

"iter lambda"

266. 1.6082542

"Eigenvector"

0.2445533

0.7180401

-0.6516227

column 1 to 2

0.3243216 + 0.i 0.3899937 - 0.1875413i

0.5849985 + 0.i 0.5379993 + 0.2718959i

0.7433655 + 0.i -0.6703451 + 0.i

column 3

0.3899937 + 0.1875413i

0.5379993 - 0.2718959i

-0.6703451 + 0.i

column 1 to 2

6.095824 + 0.i 0. + 0.i

0. + 0.i 1.452088 + 0.4336988i

0. + 0.i 0. + 0.i

column 3

0. + 0.i

0. + 0.i

1.452088 - 0.4336988i

EXPERIMENT:2

```
clc
m = [2; 1; 3];
r = [1, -1, 2;
    1, 1, -2;
    2, -2, 2];
I = zeros(3, 3);
for i = 1:3
   Ixx = m(i) * (r(i, 2)^2 + r(i, 3)^2);
   Iyy = m(i) * (r(i, 1)^2 + r(i, 3)^2);
   Izz = m(i) * (r(i, 1)^2 + r(i, 2)^2);
   Ixy = m(i) * r(i, 1) * r(i, 2);
   Ixz = m(i) * r(i, 1) * r(i, 3);
   Iyz = m(i) * r(i, 2) * r(i, 3);

   I = I + [Ixx, -Ixy, -Ixz;
         -Ixy, Iyy, -Iyz;
         -Ixz, -Iyz, Izz];
end

disp(I);
[f,e]=spec(I)
disp(f,e)
```

OUTPUT:

39. 13. -14.

13. 39. 18.

-14. 18. 30.

-0.4913199 0.8145894 0.3082999

0.549112 0.0149395 0.8356152

-0.6760775 -0.5798456 0.4546409

5.2062517 0. 0.

```
  0.        49.203977   0.

  0.        0.          53.589772
```

```
clc
m = [2;3;0];
r = [2.1213, 0, 2.1213;
    -2.1213, 0, -2.1213;
     0, 0, 0];
I = zeros(3, 3);
for i = 1:3
   Ixx = m(i) * (r(i, 2)^2 + r(i, 3)^2);
   Iyy = m(i) * (r(i, 1)^2 + r(i, 3)^2);
   Izz = m(i) * (r(i, 1)^2 + r(i, 2)^2);
   Ixy = m(i) * r(i, 1) * r(i, 2);
   Ixz = m(i) * r(i, 1) * r(i, 3);
   Iyz = m(i) * r(i, 2) * r(i, 3);

   I = I + [Ixx, -Ixy, -Ixz;
         -Ixy, Iyy, -Iyz;
         -Ixz, -Iyz, Izz];
end

disp(I);
[f,e]=spec(I)
disp(f,e)
```

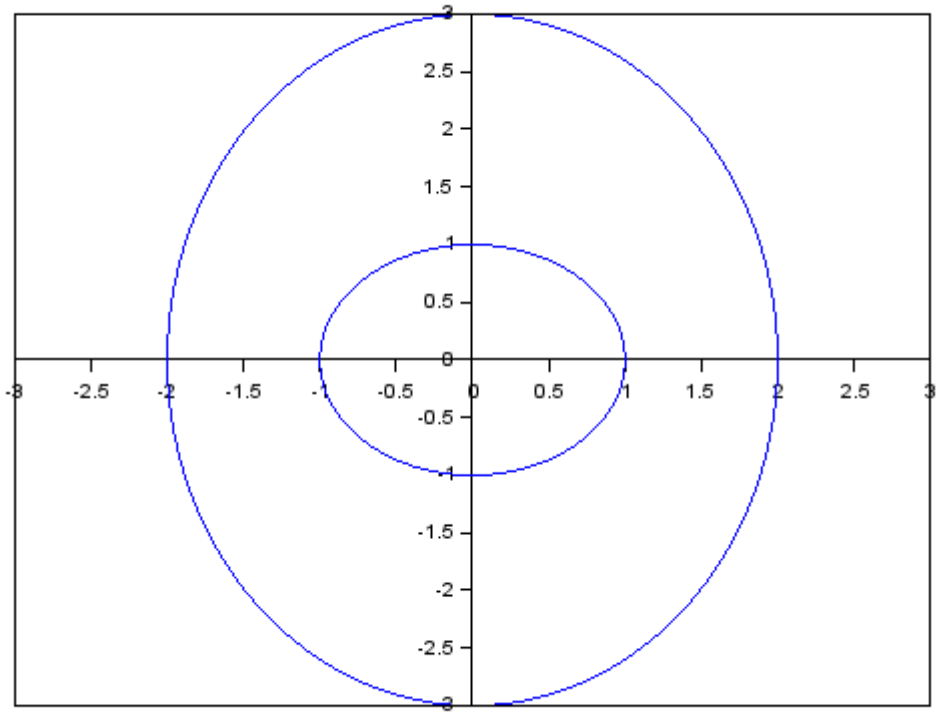
OUTPUT:

```
22.499568   0.        -22.499568

  0.        44.999137   0.

 -22.499568   0.        22.499568


 -0.7071068   0.2038503  -0.6770857

  1.517D-16  -0.9575438  -0.2882878

 -0.7071068  -0.2038503   0.6770857


  7.105D-15   0.         0.

  0.        44.999137   0.

  0.        0.          44.999137
```

EXPERIMENT-3

```
//scaling
```

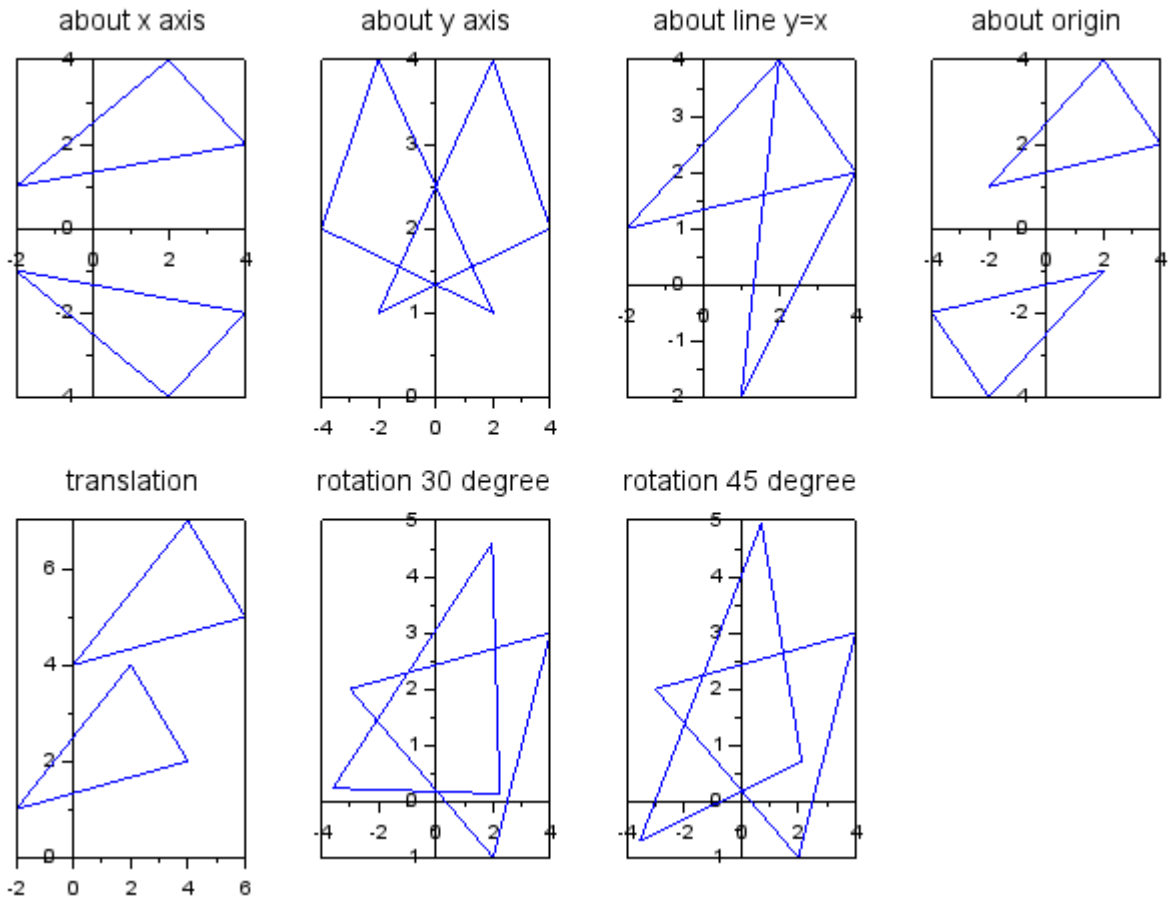
```
clc
clear
clf
s=[2 0;0 3]
xc=0;
yc=0;
r=1;
a=linspace(0,2*%pi,100)
x=xc+r*cos(a);
y=yc+r*sin(a);
plot(x,y)
X=[x' y']
b=X*s
x1=b(:,1)
x2=b(:,2)
plot(x1,x2)
a=gca()
a.x_location="origin"
a.y_location="origin"
a.data_bounds=[-3 -3;3 3]
```




```
//reflection transformations
clc
clf
x=[-2 2 4 -2]
y=[1 4 2 1]
subplot(2,4,1)
plot(x,y)
a=[1 0;0 -1]
```

```
b=[x' y']
c=b*a
plot(c(:,1),c(:,2))
a=gca()
a.x_location="origin"
a.y_location="origin"
title("about x axis")

subplot(2,4,2)
plot(x,y)
a=[-1 0;0 1]
c=b*a
plot(c(:,1),c(:,2))
a=gca()
a.x_location="origin"
a.y_location="origin"
title("about y axis")

subplot(2,4,3)
plot(x,y)
a=[0 1;1 0]
c=b*a
plot(c(:,1),c(:,2))
a=gca()
a.x_location="origin"
a.y_location="origin"
title("about line y=x")

subplot(2,4,4)
plot(x,y)
a=[-1 0;0 -1]
c=b*a
plot(c(:,1),c(:,2))
a=gca()
a.x_location="origin"
a.y_location="origin"
title("about origin")

subplot(2,4,5)
plot(x,y)
a=ones(4,1)
A=2*a
B=3*a
c=[A B]
d=b+c
plot(d(:,1),d(:,2))
a=gca()
a.x_location="origin"
a.y_location="origin"
title(" translation ")

x=[2 4 -3 2]
y=[-1 3 2 -1]
subplot(2,4,6)
plot(x,y)
a=[cos(%pi/6) sin(%pi/6);-sin(%pi/6) cos(%pi/6)]
```

```
b=[x' y']
c=b*a
plot(c(:,1),c(:,2))
a=gca()
a.x_location="origin"
a.y_location="origin"
title(" rotation 30 degree ")

subplot(2,4,7)
plot(x,y)
a=[cos(%pi/4) sin(%pi/4);-sin(%pi/4) cos(%pi/4)]
c=b*a
plot(c(:,1),c(:,2))
a=gca()
a.x_location="origin"
a.y_location="origin"
title(" rotation 45 degree ")
```



EXPERIMENT:4

```
//solving legendre diff. eq and proving orthogonality
scf(2);clc;clear;clf(2);
a=-1; b=1; beeta=1; nmax=5;
n1=500; g=n1-1; h=(b-a)/n1;
y1=zeros(g,nmax+1);
```

```
x=linspace(a+h,b-h,n1-1); plegend=[]
for n=0:nmax
    alpha=-2*modulo(n,2)+1;
    for i=1:g
        t=(1-x(i)^2);
        p(i)=-2*x(i)/t;
        q(i)=n*(n+1)/t;
        k(i)=2-h*p(i);
        m(i)=2*h*h*q(i)-4;
        l(i)=2+h*p(i);
        r(i)=0;
        B(i)=2*h*h*r(i);
    end
    A=zeros(g,g)+diag(m)+diag(l(1:g-1),1)+diag(k(2:g),-1)
    B(g)=B(g)-l(g)*beeta;
    B(1)=B(1)-k(1)*alpha;
    y=A\B;
    y1(:,n+1)=y(:,1);
    plegend(n+1)="P"+string(n)+"(x) (n = "+string(n)+")"
    for j=0:n
        I=0
        I=I+4*y1(1:2:g,n+1)'*y1(1:2:g,j+1);//sum(h*y1(:,n+1)'*y1(:,j+1))
        I=I+2*y1(2:2:g,n+1)'*y1(2:2:g,j+1);
        I=(h/3)*(I-2*(modulo(n-j,2)-1));
        disp("Integration of P"+string(n)+"(x)*P"+string(j)+"(x) : "+string(I))
    end
end
func=y1(1:g,1:nmax+1)
plot(x',func,style=1:nmax+1)
legend(plegend,4)
title("Solution of Legendre Differential equation for n = 0 to "+string(nmax))
```

OUTPUT:

"Integration of P0(x)*P0(x) : 2"

"Integration of P1(x)*P0(x) : -1.169D-13"

"Integration of P1(x)*P1(x) : 0.6666667"

"Integration of P2(x)*P0(x) : -1.095D-14"

"Integration of P2(x)*P1(x) : -2.961D-18"

"Integration of P2(x)*P2(x) : 0.4"

"Integration of P3(x)*P0(x) : -1.175D-16"

"Integration of P3(x)*P1(x) : 0.0000053"

"Integration of P3(x)*P2(x) : 1.127D-15"

"Integration of P3(x)*P3(x) : 0.2857097"

"Integration of P4(x)*P0(x) : 0.0000093"

"Integration of P4(x)*P1(x) : -3.527D-15"

"Integration of P4(x)*P2(x) : 0.0000133"

"Integration of P4(x)*P3(x) : 1.497D-14"

"Integration of P4(x)*P4(x) : 0.2222053"

"Integration of P5(x)*P0(x) : -1.984D-15"

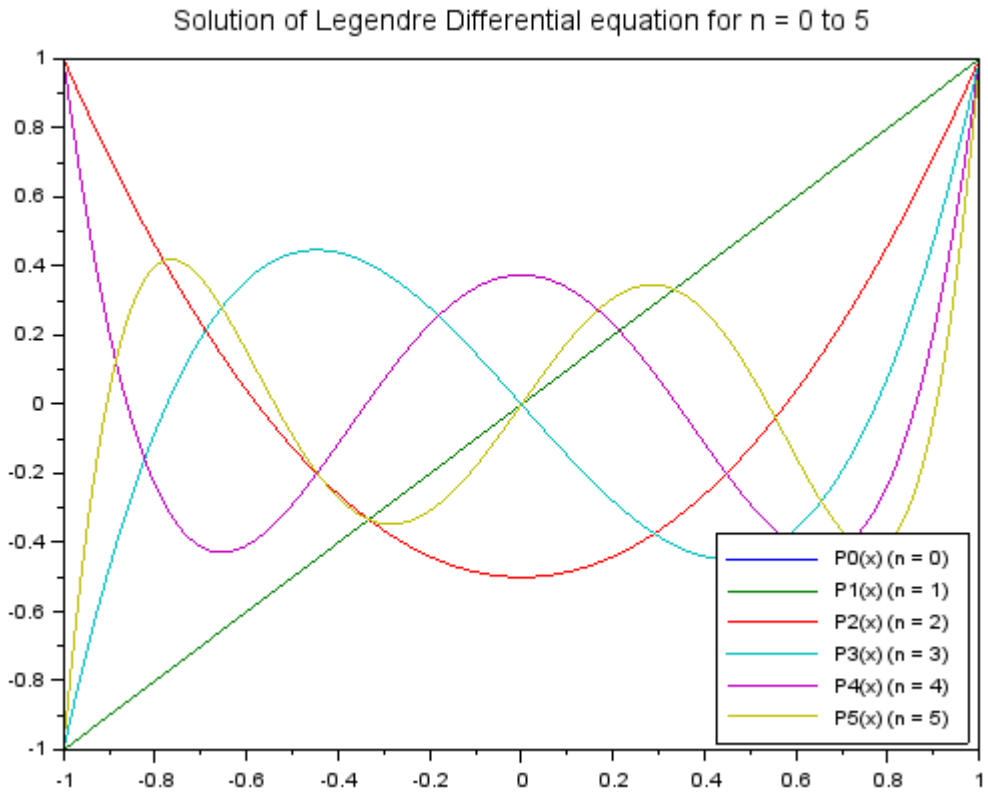
"Integration of P5(x)*P1(x) : 0.0000173"

"Integration of P5(x)*P2(x) : -2.984D-16"

"Integration of P5(x)*P3(x) : 0.000024"

"Integration of P5(x)*P4(x) : -4.833D-15"

"Integration of P5(x)*P5(x) : 0.1817782"




```
//Hermite
clc;clear;clf();
a=-5;  b=5;  nmax=5 ;
n1=500;  g=n1-1;  h=(b-a)/n1;
y1=zeros(g,nmax+1);
x=linspace(a+h,b-h,n1-1); plegend=[] ;
H(1)=1;H(2)=2*a;
for n=0:nmax
   if n>0&n<=nmax-1 then
      H(n+2)=2*a*H(n+1)-2*n*H(n)
```

```
    end
    alpha=H(n+1)
    beeta=alpha*((-1)^n);
    for i=1:g
        p(i)=-2*x(i);
        q(i)=2*n;
        k(i)=2-h*p(i);
        m(i)=2*h*h*q(i)-4;
        l(i)=2+h*p(i);
        r(i)=0;
        B(i)=2*h*h*r(i);
    end
    A=zeros(g,g)+diag(m)+diag(l(1:g-1),1)+diag(k(2:g),-1)
    B(g)=B(g)-l(g)*beeta;
    B(1)=B(1)-k(1)*alpha;
    y=A\B;
    y1(:,n+1)=y(:,1);
    plegend(n+1)="H"+string(n)+"(x) (n = "+string(n)+")"
end
for n=0:nmax
    for j=0:n
        I=0;
        I=I+4*exp(-(x(1:2:g).^2))*(y1(1:2:g,n+1).*y1(1:2:g,j+1));
        I=I+2*exp(-(x(2:2:g).^2))*(y1(2:2:g,n+1).*y1(2:2:g,j+1));
        I=(h/3)*(I+alpha+beeta);
        disp("Integration of H"+string(n)+"(x)*H"+string(j)+"(x) : "+string(I))
    end
end
func=y1(1:g,1:nmax+1)
plot(x',func,style=1:nmax+1)
legend(plegend,4)
title("Solution of Hermite Differential equation for n = 0 to "+string(nmax))
a=gca()
a.data_bounds=[-5 -150;5 150]
```

OUTPUT:

"Integration of H0(x)*H0(x) : 1.7727106"

"Integration of H1(x)*H0(x) : 0"

"Integration of H1(x)*H1(x) : 3.5447201"

"Integration of H2(x)*H0(x) : -2.963D-10"

"Integration of H2(x)*H1(x) : 0"

"Integration of H2(x)*H2(x) : 14.179652"

"Integration of H3(x)*H0(x) : 1.940D-13"

"Integration of H3(x)*H1(x) : 0.0028358"

"Integration of H3(x)*H2(x) : -9.701D-14"

"Integration of H3(x)*H3(x) : 85.076329"

"Integration of H4(x)*H0(x) : 0.002836"

"Integration of H4(x)*H1(x) : 0"

"Integration of H4(x)*H2(x) : 0.0453704"

"Integration of H4(x)*H3(x) : -2.910D-13"

"Integration of H4(x)*H4(x) : 680.57349"

"Integration of H5(x)*H0(x) : -6.791D-13"

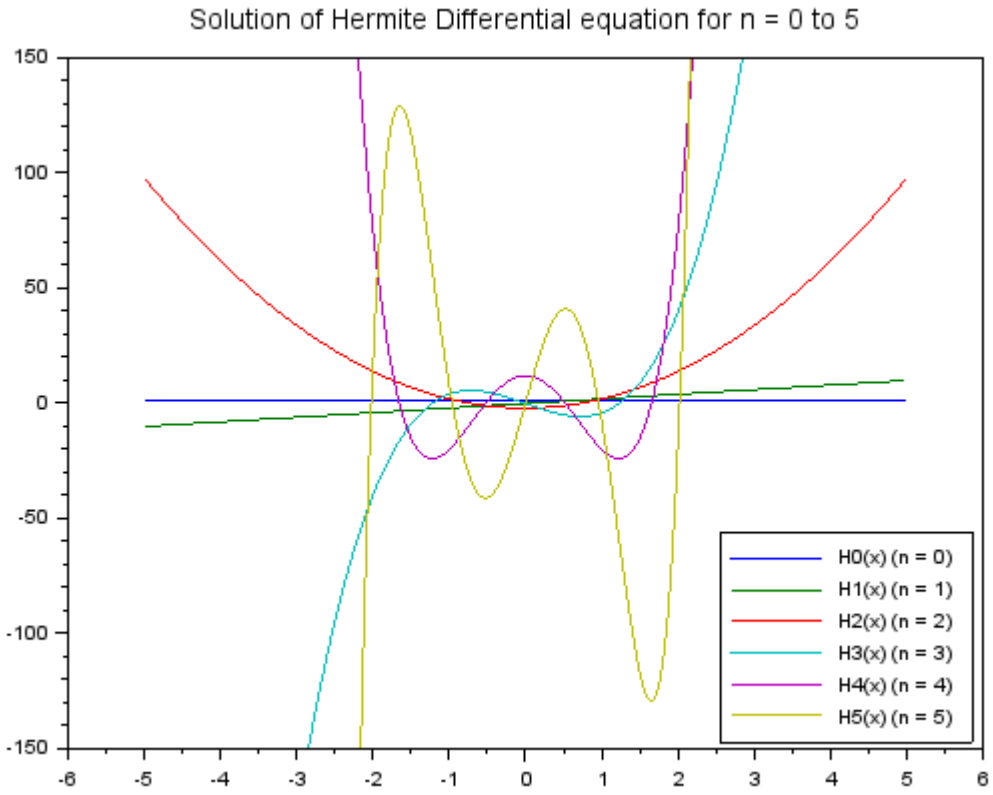
"Integration of H5(x)*H1(x) : 0.0283668"

"Integration of H5(x)*H2(x) : 1.358D-12"

"Integration of H5(x)*H3(x) : 0.6803149"

"Integration of H5(x)*H4(x) : -1.242D-11"

"Integration of H5(x)*H5(x) : 6804.9216"



EXOERIMENT-5
Reflection-

```
scf(1);clc;clear;clf(1);
x1=[1 6]
x2=[2 4]
n=1000;
x=linspace(x1(1,1),x2(1,1),n);
```

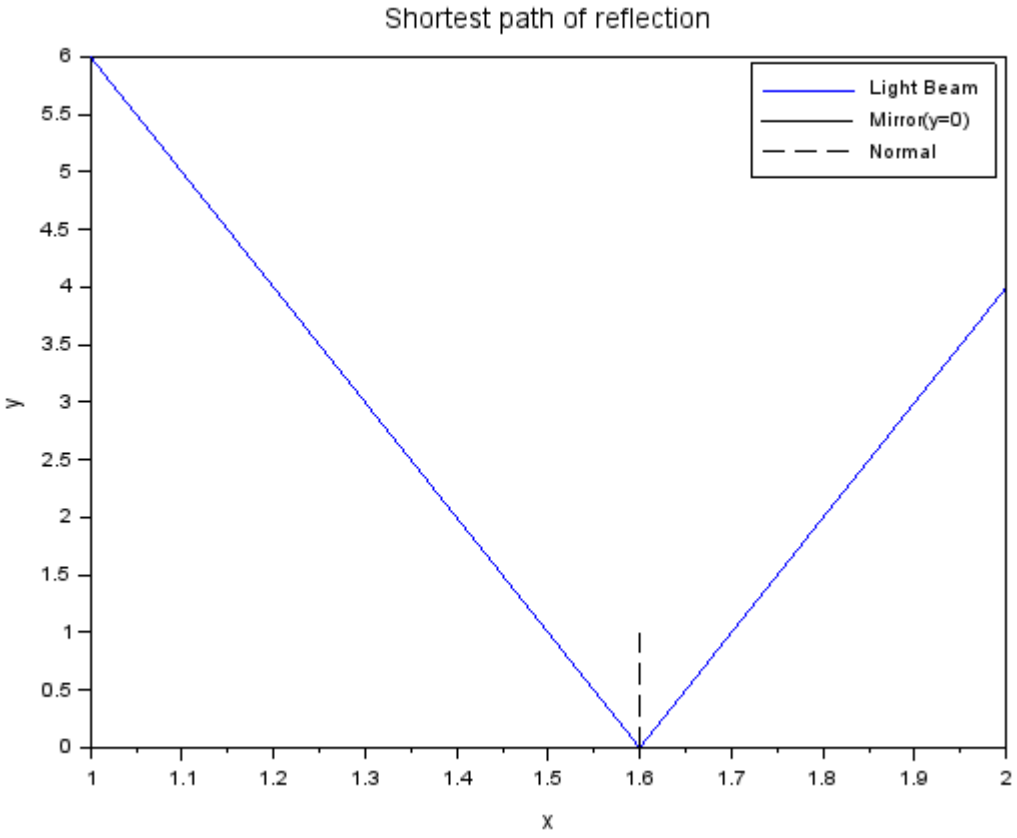
```
d=sqrt((x1(1,1)-x)^2 +(x1(1,2)-0)^2)+sqrt((x-x2(1,1))^2 +(0-x2(1,2))^2);
[m,k]=min(d)
disp("Point of reflection : ("+string(x(1,k))+",0)")
disp("Angle of incidence(deg) : "+string(90-180*atan(x1(1,2)/(x(1,k)-x1(1,1)))/%pi))
disp("Angle of reflection(deg) : "+string(90-180*atan(x2(1,2)/-(x(1,k)-x2(1,1)))/%pi))
plot([x1(1,1) x(1,k) x2(1,1)],[x1(1,2) 0 x2(1,2)])
plot(x,0,'k')
plot(x(1,k)*ones(x),x-x1(1,1),'--k')
legend('Light Beam','Mirror(y=0)','Normal')
title('Shortest path of reflection')
xlabel('x')
ylabel('y')
```

OUTPUT:

"Point of reflection : (1.5995996,0)"

"Angle of incidence(deg) : 5.7068074"

"Angle of reflection(deg) : 5.7162716"



Refraction-

```
scf(0);clc;clear;clf(0);
x1=[1 6]
x2=[2 -4]
n=[1.5 1]
v1=1;v2=v1*n(1,1)/n(1,2);
np=1000;
x=linspace(x1(1,1),x2(1,1),np);
d1=sqrt((x1(1,1)-x)^2 +(x1(1,2)-0)^2)
d2=sqrt((x-x2(1,1))^2 +(0-x2(1,2))^2);
t=d1/v1 +d2/v2;
```

```
[m,k]=min(t)
i=90-180*atan(x1(1,2)/(x(1,k)-x1(1,1)))/%pi
r=90-180*atan(x2(1,2)/(x(1,k)-x2(1,1)))/%pi
disp("Point of refraction : ("+string(x(1,k))+",0)")
disp("Angle of incidence i(deg) : "+string(i))
disp("Angle of refraction r(deg) : "+string(r))
disp("Ratio sin(i)/sin(r) = "+string(sind(i)/sind(r))+" , Ratio n2/n1 = "+string(n(1,2)/n(1,1)))
plot([x1(1,1) x(1,k) x2(1,1)],[x1(1,2) 0 x2(1,2)])
plot(x,0,'k')
plot(x(1,k)*ones(x),x-4.5,'--k')
legend('Light Beam','Media Boundary(y=0)','Normal')
title('Shortest path of refraction')
xlabel('x')
ylabel('y')
```

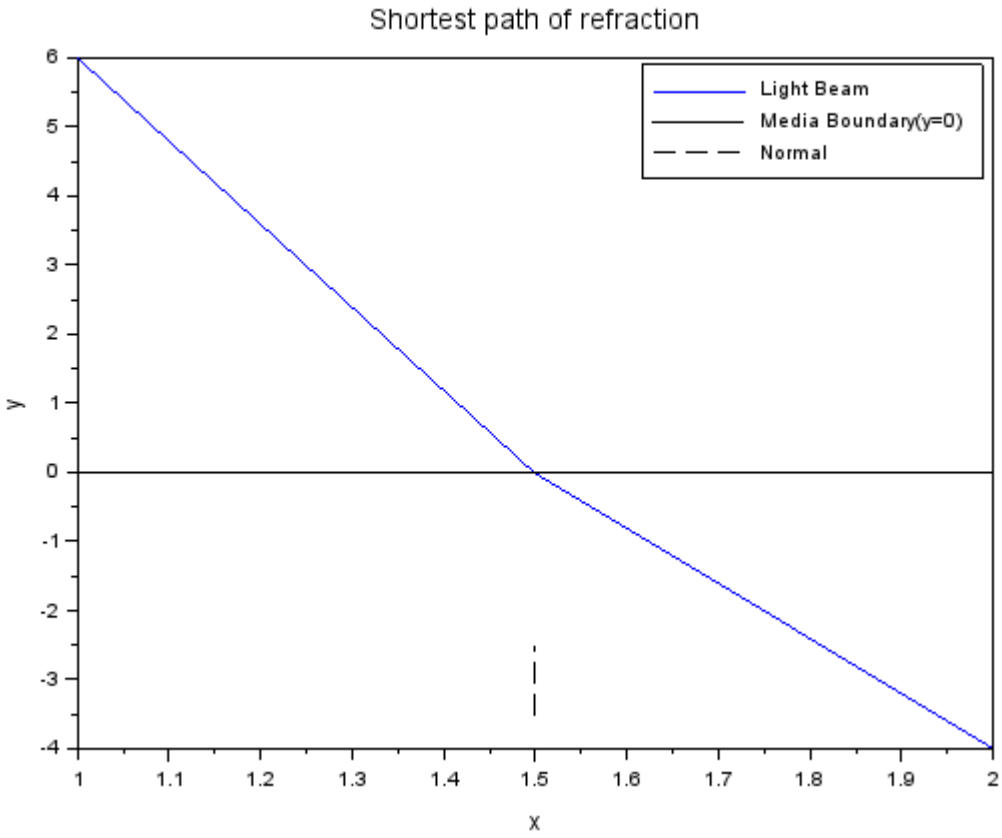
output:

"Point of refraction : (1.4984985,0)"

"Angle of incidence i(deg) : 4.749402"

"Angle of refraction r(deg) : 7.1461919"

"Ratio sin(i)/sin(r) = 0.6655694 , Ratio n2/n1 = 0.6666667"




```
scf(0);clc;clear;clf(0);
```

```
x1=[1 6]
x2=[2 -4]
n=[1. 1.5]
v1=1;v2=v1*n(1,1)/n(1,2);
np=1000;
x=linspace(x1(1,1),x2(1,1),np);
d1=sqrt((x1(1,1)-x)^2 +(x1(1,2)-0)^2)
d2=sqrt((x-x2(1,1))^2 +(0-x2(1,2))^2);
t=d1/v1 +d2/v2;
[m,k]=min(t)
i=90-180*atan(x1(1,2)/(x(1,k)-x1(1,1)))/%pi
r=90-180*atan(x2(1,2)/(x(1,k)-x2(1,1)))/%pi
disp("Point of refraction : ("+string(x(1,k))+",0)")
disp("Angle of incidence i(deg) : "+string(i))
disp("Angle of refraction r(deg) : "+string(r))
disp("Ratio sin(i)/sin(r) = "+string(sind(i)/sind(r))+" , Ratio n2/n1 = "+string(n(1,2)/n(1,1)))
plot([x1(1,1) x(1,k) x2(1,1)],[x1(1,2) 0 x2(1,2)])
plot(x,0,'k')
plot(x(1,k)*ones(x),x-4.5,'--k')
legend('Light Beam','Media Boundary(y=0)','Normal')
title('Shortest path of refraction')
xlabel('x')
ylabel('y')
```

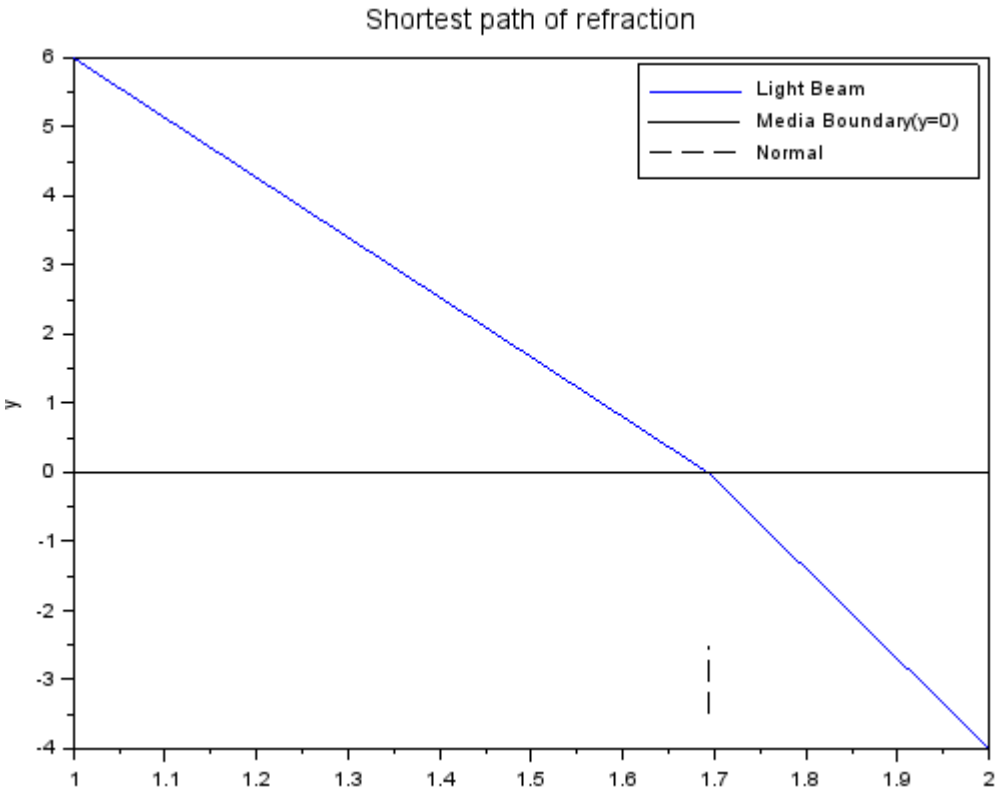
output:

"Point of refraction : (1.6926927,0)"

"Angle of incidence i(deg) : 6.5855728"

"Angle of refraction r(deg) : 4.393223"

"Ratio sin(i)/sin(r) = 1.4971981 , Ratio n2/n1 = 1.5"



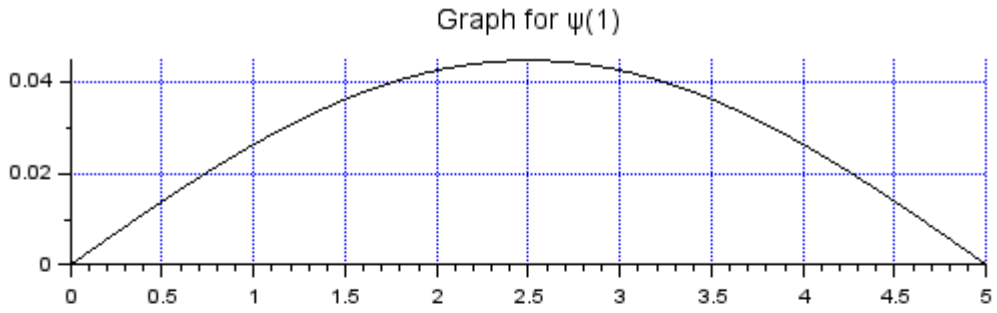
EXPERIMENT-6

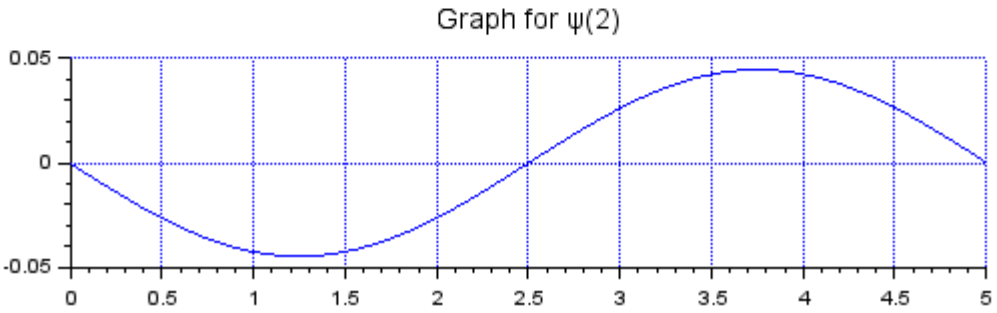
```
//infinite potential well
clf
hbar = 1973
m = 0.511e6
xmin = 0
xmax = 5
n = 1000
x = linspace(xmin, xmax, n)
d = x(2) - x(1)
V = zeros(n, 1)
V_inf = 1e10
V(x < xmin | x > xmax) = V_inf
K = eye(n, n) * (-2)
for i = 1:(n - 1)
   K(i, i + 1) = 1
   K(i + 1, i) = 1
end
H = (-(hbar^2) / (2 * m * d^2)) * K + diag(V)
[U, EV] = spec(H)
E = diag(EV);
disp("ground state energy "+string(E(1))+" eV ","1st excited state energy " +string(E(2))+" eV")
for i = 1:2
   subplot(3, 1, 2*i-1)
   plot2d(x', U(:,i),i)
   xtitle("Graph for ψ(" + string(i) + ")")
   xgrid(2)
end
```

OUTPUT:

"ground state energy 1.4977022 eV "

"1st excited state energy 5.9907942 eV"





EXPERIMENT-7

```
//harmonic oscillator
clf;clc;
hbar = 1973
m = 0.511e6;
k=1;

xmin = -5;
xmax = 5;
n = 1500;

x = linspace(xmin, xmax, n)
d = (xmax-xmin)/n
```

```
V=zeros(n,n)
for i = 1:n

      V(i, i) = (0.5*k*x(i)^2)
end

K = eye(n, n) * (-2)

for i = 1:(n-1)
   K(i, i + 1) = 1
   K(i + 1, i) = 1
end
H = (-(hbar^2) / (2 * m * d^2)) * K + V
[U, EV] = spec(H)
E = diag(EV)
z=0.4
disp("ground state energy "+string(E(1))+" eV ","1st excited state energy "+string(E(2))+" eV ","2nd
excited state energy "+string(E(3))+" eV ","3RD excited state energy "+string(E(4))+" eV ")
subplot(1,2,1)
plot(x,0.5*k*x^2/10,'linewidth',2)
xlabel('x')
ylabel('1/2kx^2')
xgrid(5)
subplot(1,2,2)
plot(x',[U(:,1),U(:,2),U(:,3),U(:,4)],'linewidth',2)
xlabel('x')
ylabel('wavefunction')
xgrid(5)
```

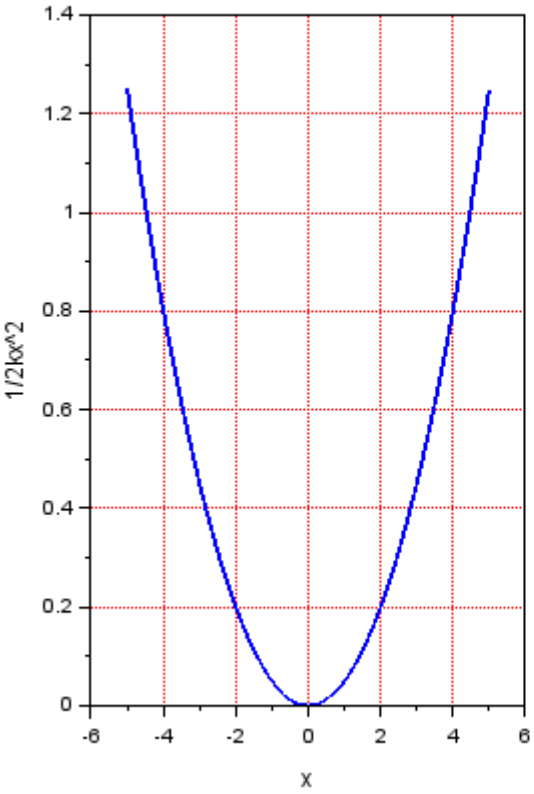
OUTPUT:

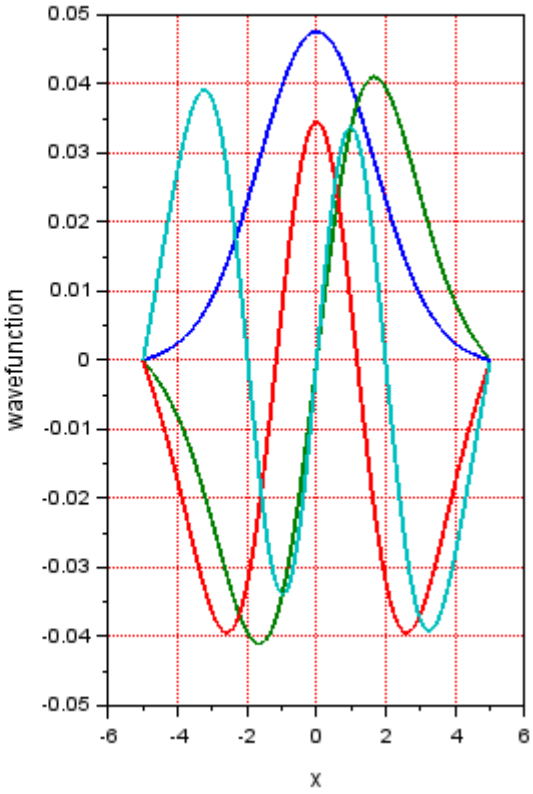
"ground state energy 1.3819492 eV "

"1st excited state energy 4.1586229 eV "

"2nd excited state energy 7.0126126 eV "

"3RD excited state energy 10.10147 eV "


1/2kx^2
x
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-6
-4
-2
0
2
4
6


wavefunction
x
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
-0.05
-6
-4
-2
0
2
4
6