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Course:B.Sc(H)Physics,Sem5

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Aim:To prove orthogonality of wave functions for stationary state of Harmonic Oscillator and also to plot them

Source Code:

clc

clear

clf

n1=input("Enter the order of first stationary state=")

n2=input("Enter the order of second stationary state=")

m1=0;m2=0

H11=0;H12=0

function **y**=f(**x**)

for m1=0:int(n1/2)

H11= H11 + (((-1)^m1)\*(factorial(n1))\*((2\***x**)^(n1-2\*m1)))/((factorial(m1))\*(factorial(n1-2\*m1)))

m1=m1+1

end

for m2=0:int(n2/2)

H12= H12 + (((-1)^m2)\*(factorial(n2))\*((2\***x**)^(n2-2\*m2)))/((factorial(m2))\*(factorial(n2-2\*m2)))

m2=m2+1

end

H21 = (1/((2^n1)\*(factorial(n1))\*(sqrt(%pi)))^(0.5))\*(exp(-**x**^2)/2)\*H11

H22 = (1/((2^n2)\*(factorial(n2))\*(sqrt(%pi)))^(0.5))\*(exp(-**x**^2)/2)\*H12

**y**=H21.\*H22

endfunction

i=intg(-1,1,f)

disp(i)

if i==0 then

disp("wavefunctions are orthogonal")

else disp("wavefunctions are not orthogonal")

end

for a=0:4

x=-4:0.01:4

for m1=0:int(a/2)

H11= H11 + (((-1)^m1)\*(factorial(a))\*((2\*x)^(a-2\*m1)))/((factorial(m1))\*(factorial(a-2\*m1)))

end

H21 = (1/((2^a)\*(factorial(a))\*(sqrt(%pi)))^(0.5))\*(exp(-x^2)/2).\*H11

H11=0

plot2d(x,H21,a+1)

end

a=gca()

a.y\_location="origin"

a.x\_location="origin"

xtitle("Plot for stationary states of a harmonic oscillator:")

xlabel("x")

ylabel("y")

for a=0:4

legends(["n="+string(a)+":"],[a+1])

end

Output:

Enter the order of first stationary state=1

Enter the order of second stationary state=2

0.

Wavefunctions are orthogonal.

Enter the order of first stationary state=1

Enter the order of second stationary state=1

0.065278

wavefunctions are not orthogonal

