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AIM: To check commutator relation between position, Momentum and Energy for a given wavefuntion.

Source Code:

clc

clear

n=input("Enter the order of Hermite polyomial=")

m=0

H=0

x=poly(0,'x')

for m=0:int(n/2)

H= H + (((-1)^m)\*(factorial(n))\*((2\*x)^(n-2\*m)))/((factorial(m))\*(factorial(n-2\*m)))

m=m+1

end

disp(H,"H"+string(n)+"(x)=")

xp=x\*(-%i\*derivat(H))

px=-%i\*derivat(x\*H)

disp(xp-px,"Value of commutator between Position & Momentum: ")

if xp-px~=0 then

disp("hence, Position and momentum do not commute and cannot be measuured simultaneously")

else disp("Position and Momentum are commutative and hence independent to each other")

end

pe=(-%i\*derivat(((-1/2)\*(derivat(derivat(H))))))

ep=((-1/2)\*(derivat(derivat((-%i\*derivat(H))))))

disp(pe-ep,"Value of commutator between Momentum & Energy:" )

if pe-ep~=0 then

disp("hence, Momentum and Energy do not commute and cannot be measuured simultaneously")

else disp("Momentum and Energy are commutative and hence independent to each other")

end

xe=x\*((-1/2)\*derivat(derivat(H)))

ex=((-1/2)\*derivat(derivat(x\*H)))

disp(xe-ex,"Value of commutator between Momentum & Energy:" )

if xe-ex~=0 then

disp("hence, Position and Energy do not commute and cannot be measuured simultaneously")

else disp("Position and Energy are commutative and hence independent to each other")

end

Output:

Enter the order of Hermite polyomial=4

H4(x)= 12 -48x^2 +16x ^4

Value of commutator between Position & Momentum:

Real part

0

Imaginary part

12 -48x^2 +16x ^4

hence, Position and momentum do not commute and cannot be measuured simultaneously

Value of commutator between Momentum & Energy:

Real part

0

Imaginary part

0

Momentum and Energy are commutative and hence independent to each other

Value of commutator between Momentum & Energy:

-96x +64x ^3

hence, Position and Energy do not commute and cannot be measuured simultaneously