WAVE MECHANICS APPLIED IN CASE OF MATERIAL PARTICLE

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Abstract

Quantum mechanics deals with the complex wave function (Ψ). For analysis of complex wave Fourier gave Fourier technique and then Fourier transform, Laplace transform and fast Fourier transform have been applied to solve the complex problem

1. Introduction.

Quantum mechanics is a systematic theory of the behaviour of matter and light, In particular of atomic and sub atomic phenomena.

It is established on a set of self consistence mathematical rules aided by suitable physical Interpretation.

It is different in many respects from Newtonian mechanics (classical mechanics), however in the limit when the masses and energies of the particles are masses relatively large, the results of Quantum Mechanics reduce to those of Newtonian mechanics.

In Quantum mechanics the nature of a materials particle is like a wave i.e. Quantum mechanical explains the wave nature of a material particle. To explain the concept of wave of a material particle, the wave function (Ψ) appears on most important Theoretical tool. It creates not only a revolution in the Quantum mechanics but also plays a very important role in the explanation of important physical theory and problems from beginning to the end in the entire text of Quantum mechanics the wave function (Ψ) speaks about complex wave nature. In order to analyse the complex periodic function, fourier gave fourier's technique, the fourier's technique in wholes fouriers expension, Integral transform, fouriers transform, laplace transform and convolution theorem.

A fouriers series is a representation employed to express a periodic function f(x) defined in an Interval say (−π, π) a linear relation between the sines and the consines of the same period.

$f(x) = a_0 + \sum_{n=1}^{\infty} a_{n\ Cos\ nx} + \sum_{n=1}^{\infty} b_{n\ Sin\ nx}$

Periodic functions – A functions f(x) is said to be periodic

if

f(x+l) = f(s) for every value of x.

If l is the smallest positives number such that.

f(x+l) = f(s) for every value of x.

then the function f(x) is called periodic function with period l.

An improper integral of the form

$\int_{-\infty}^{\infty} K(s,t)F(t)dt$ is called integral transform of F(t) if it is convergent. Sometimes it is denoted by f(x) or T{F(t)}. Thus

f(x) = T{F(t)}= $\int_{-\infty}^{\infty} K(s,t)F(t)dt$ ....(1) The function K(s,t) appearing in the integrand is called Kernal of the transform. Here is parameter and is independent of t, s may be real or complex number.

if we take $K(s,t) = \{e^{-st} \quad ,t \geq 0,$

$K\,(s,t) = \{0 \quad ,t < 0$

Then equation 1 become

$$f(s) = T\{F(t)\} = \int_0^{\infty} F(t)\, e^{-st} dt$$

This transform is known as Laplace transform.

Fourier transform of F(t) is

$$f(s) = \int_{-\infty}^{\infty} F(t)\, e^{-ist} dt$$

Suppose F(t) is a reveal valued function defined over the interval $(-\infty, \infty)$ s.t. F(t) = 0, for every value of $t < 0$

The lapse transform of F(t), denoted by L{F(t)} is defined as

$L\{F(t)\} = \int_0^{\infty} F(t)\, e^{-st} dt$ .... (1)

We also write

$$L\{F(t)\} = f(s) = \int_0^{\infty} F(t)\, e^{-st} dt$$

Here L is called Laplase Transformation Operator. The parameter s is a real or complex number. In gernal, the parameter s is taken to be a real positive number.

The Lapse transform is said to exist if the intergral (1) is convergent for some value of s.

The operation of multiflyiong F(t) by e^{-st} and integrating from 0 to ∞ is called Laplace Transformation.

2. Inverse Laplace Transform

If the Laplace of a function F(t) is f(s) i.e. L{F(t)} = f(s) then F(t) is called an Inverse Laplace Transform of f(s).

We also write F(t) = L^{-1} {f(s)}.

L^{-1} is called the Inverse Laplace Transform operator.

The infinite Fourier transform of F(x). –∞ < x < ∞ denoted by f(s) or F{(x)} and is defined as F(s)=F{F(x)}=$\int_{-\infty}^{\infty} e - isx\, ds$ ....(1)

The complex fourier transform of a function F(x) for). – < x < ∞ is denoted by f(n) and is defined

$F(n) = \int_{-\infty}^{\infty} F(x)\, e^{inx}\ dx$ .... (1)

Where e^{inx} is aid to be the Kernal of the transform.

The inversion formula is

$$F(x) = \frac{1}{2\pi}\int_{-\infty}^{\infty} F(s)\, e^{-inx}\ dn$$

The Convolution Theorem or the convolution Property

If L^{-1} {f(s)}=F(t) and L^{-1} {g(s)} = G(t) then

L–1 {f(s) g(s)} = $\int_0^t F(u)G\,(t-u)du = F * G$

Where

F ∗ G

is known as Convoluation or flautung of F and G and this convoluation is commuataive i.e. F ∗ G = G ∗ F

3. Summary and Conclusion:

Since the wave function (Ψ) is complex, the real and imaginary components always appear in the explanation of physical problems. The differential equation is used only in the case. When the problem concludes continuous discussion. When the problems is discourteous (discussion) The differential equation fails and then matrix formulation has been introduced. Also in complex wave analysis, Fourier expansion Fourier transform and Laplace transform and conclusion have been adopted.

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