Assignment-1

**Q3. What is the energy of sinc function**

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**Q4.What is the most suitable distribution to model the additive noise at the receiver end?**

The most commonly used distribution to model additive noise at the receiver end is the Gaussian (or normal) distribution. The Gaussian distribution is widely adopted because of its mathematical properties and its applicability to many real-world scenarios.

Several reasons make the Gaussian distribution suitable for modeling additive noise:

Central Limit Theorem: The Central Limit Theorem states that the sum of a large number of independent random variables, regardless of their individual distributions, tends to follow a Gaussian distribution. In practice, additive noise often arises from a combination of multiple independent sources, and the Central Limit Theorem justifies the use of the Gaussian distribution to represent their collective effect.

Ubiquity in Nature: Many natural phenomena and physical processes exhibit behavior that can be approximated by the Gaussian distribution. For instance, thermal noise in electronic circuits, atmospheric noise in wireless communication, and background noise in audio signals are often modeled as Gaussian noise due to their inherent statistical properties.

Maximum Likelihood Estimation: When the goal is to estimate the unknown parameters of a noisy signal, the Gaussian distribution allows for convenient and efficient parameter estimation using maximum likelihood estimation (MLE) techniques.

Analytical Simplicity: The Gaussian distribution has desirable mathematical properties, such as closed-form expressions for probability density function (PDF), cumulative distribution function (CDF), and moments. This analytical simplicity facilitates mathematical analysis and system design.

While the Gaussian distribution is a commonly used model for additive noise, it is worth noting that there are scenarios where other distributions might be more appropriate. For instance, certain types of impulsive noise or non-Gaussian interference might require alternative models like the Laplace distribution, Cauchy distribution, or various heavy-tailed distributions. However, in many practical situations, the Gaussian distribution remains a good choice for modeling additive noise at the receiver end.

**Q6:Hilbert Tranfrom of Cos2t**

[Hilbert Transform - an overview | ScienceDirect Topics](https://www.sciencedirect.com/topics/mathematics/hilbert-transform)

**Q7: Power signal or energy signal?**

To determine whether the signal x(t) = 2t^(-1/4) falls under the category of a power signal or an energy signal, we need to examine its energy and power properties.

An energy signal is a signal that has finite energy, meaning its total energy over a given time period is finite. Mathematically, the energy of a signal x(t) is given by:

E = ∫ |x(t)|^2 dt

A power signal, on the other hand, is a signal that has infinite energy but finite power. The power of a signal x(t) is defined as the average power per unit time and is given by:

P = lim T→∞ (1/T) ∫ |x(t)|^2 dt

Let's analyze x(t) = 2t^(-1/4) based on these definitions:

Energy Analysis:

To compute the energy of x(t), we integrate |x(t)|^2 over the entire time axis:

E = ∫ |2t^(-1/4)|^2 dt = ∫ 4t^(-1/2) dt

Integrating 4t^(-1/2) yields 8t^(1/2), which diverges as t approaches infinity. Therefore, the energy of x(t) is infinite, indicating that x(t) is not an energy signal.

Power Analysis:

To compute the power of x(t), we need to calculate the average power per unit time. However, since x(t) does not have a periodic nature, we cannot directly apply the power formula.

In this case, we can consider the limit as T approaches infinity for the power expression mentioned earlier:

P = lim T→∞ (1/T) ∫ |2t^(-1/4)|^2 dt

Simplifying the expression inside the integral gives:

P = lim T→∞ (1/T) ∫ 4t^(-1/2) dt = lim T→∞ (1/T) [8t^(1/2)] evaluated from 0 to T

Taking the limit as T approaches infinity, we have:

P = lim T→∞ (1/T) [8T^(1/2)] = lim T→∞ 8/T^(1/2) = 0

The power of x(t) approaches zero as the time period T tends to infinity. Therefore, x(t) is a power signal.

In summary, the signal x(t) = 2t^(-1/4) is a power signal as it has infinite energy but finite power.

**Q8:Is periodic and deterministic continuous signal?**

No, the signal sin(2πt) / (2πt) is not a periodic signal.

To determine if a signal is periodic, we need to check if there exists a positive value T such that the signal repeats itself exactly every T units of time.

In the case of sin(2πt) / (2πt), the denominator (2πt) in the sinc function causes the signal to approach zero as t approaches zero. As t approaches zero, the sinc function exhibits oscillations and approaches its main lobe centered around t = 0. However, the sinc function never reaches zero for all values of t.

Therefore, the sinc function does not satisfy the condition of repeating itself exactly every T units of time, and hence, sin(2πt) / (2πt) is not a periodic signal.

Yes, the signal sin(2πt) / (2πt) is a deterministic continuous signal.

A deterministic signal is a signal that can be precisely described by a mathematical function or equation. In this case, the signal sin(2πt) / (2πt) is defined by a specific mathematical function, namely the sinc function. The sinc function is a well-defined mathematical expression that relates the value of the signal to the variable t.

Furthermore, the signal is continuous, meaning it is defined and continuous for all real values of t. There are no abrupt changes or discontinuities in the signal's behavior.

Therefore, sin(2πt) / (2πt) is a deterministic continuous signal.

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