

Energy/Power Signal

$x(n) = (0.5)^n u(n)$. State whether it is an energy or power signal. Justify.

Ans:- First we will calculate the energy of signal of signal $x(n)$. It is given by

$$E = \sum_{n=-\infty}^{\infty} |x(n)|^2 \dots \textcircled{1}$$

The given signal is,

$$x(n) = (0.5)^n u(n) \dots \textcircled{2}$$

Since, it is multiplied by unit step; this signal is present from $n=0$ to $n=\infty$

Thus Eq (1) becomes,

$$E = \sum_{n=0}^{\infty} [(0.5)^n]^2 = \sum_{n=0}^{\infty} \left(\frac{1}{2}\right)^{2n}$$

$$E = \sum_{n=0}^{\infty} \left(\frac{1}{4}\right)^n$$

We have the standard Geometric series formula,

$$\sum_{n=0}^{\infty} A^n = 1 + A + A^2 + \dots A^n = \frac{1}{1-A}$$

for $|A| < 1$

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$$\therefore E = \frac{1}{1 - \left(\frac{1}{4}\right)} = \frac{4}{3}$$

$$\boxed{E = \frac{4}{3}} \rightarrow \text{Finite}$$

If $0 < E < \infty$ then the signal is energy signal. Since the calculated value of energy is finite; the given signal is energy signal.

Since the energy is finite; the given signal is an Energy signal.

If the energy of signal is finite then its power is zero.

Thus the power of given signal is zero.

$$\therefore \boxed{P = 0}$$