Maths Assignment

Abhignya Gogula
EE23BTECH11023

Problem Statement

A G.P consists of an even number of terms. If the sum of all terms is 5 times the sum of terms occupying odd places, then find its common ratio.

Solution

Parameter	Description	condition
n	Number of terms in the G.P	-
m	natural number	n=2m
$x(0)$	first term in the G.P	-
r	common ratio in the G.P	-
$x(n)$	$n+1$ th term in the G.P	$x(n) = x(0)r^n$
$y(n)$	sum of G.P series	$y(n) = x(0)\left(\frac{r^{n+1}-1}{r-1}\right)u(n)$
$x_o(n)$	$n+1$ term of G.P of odd places	$x_o(n) = x(0)r^{2n}$
$y_o(n)$	sum of terms in odd places	$w(n) = x(0)\left(\frac{r^{n+1}-1}{r^2-1}\right)u(n)$

TABLE I
Input Parameters

Solving the Question in time domain:

$$x(n) = x(0)r^n \tag{1}$$

$$y(n) = x(0)\left(\frac{r^{n+1}-1}{r-1}\right)u(n) \tag{2}$$

The sum of terms in odd places:

$$x_o(n) = x(0)r^{2n} \tag{3}$$

$$y_o(n) = x(0)\left(\frac{r^{n+1}-1}{r^2-1}\right)u(n) \tag{4}$$

Then from (2) and (4)

$$x(0)\left(\frac{r^{n+1}-1}{r-1}\right)u(n) = 5\left(x(0)\left(\frac{r^{n+1}-1}{r^2-1}\right)u(n)\right) \tag{5}$$

$$\frac{r^2-1}{r-1} = 5 \tag{6}$$

$$\text{as } r \neq 1, \quad \text{hence } r = 4 \tag{7}$$

$$\tag{8}$$

X,Y,Xo,Yo are frequency counterparts of the above GP

$$X(z) = \frac{x(0)}{1-rz^{-1}} \quad |z| > |r| \tag{9}$$

$$X_o(z) = \frac{x(0)}{1-r^2z^{-1}} \tag{10}$$

$$Y(z) = \frac{x(0)}{(1-rz^{-1})(1-z^{-1})} \tag{11}$$

$$Y_o(z) = \frac{x(0)}{\left(1-rz^{\frac{-1}{2}}\right)(1-z^{-1})} \tag{12}$$