2.ZEROS AND POLES FROM TRANSFER FUNCTION

AIM:

To obtain zeros and poles from a given transfer function using MATLAB.

APPARATUS:

Software: MATLAB

THEORY:

The transfer function provides a basis for determining important system response characteristics without solving the complete differential equation. As defined, the transfer function is a rational function in the complex variable $s = \sigma + j\omega$, that is

$$H(s) = \frac{b_m s_m + b_{m-1} s_{m-1} + \cdots\cdots\cdots\cdots\cdots + b_0}{a_n s_n + a_{n-1} s_{n-1} + \cdots\cdots\cdots\cdots\cdots\cdots + a_0}$$

It is often convenient to factor the polynomials in the numerator and the denominator, and to write the transfer function in terms of those factors:

$$H(s) = \frac{N(s)}{D(s)} = K\frac{(s-z_1)(s-z_2)\cdots\cdots\cdots\cdots(s-z_{m-1})(s-z_m)}{(s-p_1)(s-p_2)\cdots\cdots\cdots\cdots(s-p_{m-1})(s-p_m)}$$

where, the numerator and denominator polynomials, N(s) and D(s), have real coefficients defined by the system's differential equation and $K = \frac{b_m}{a_n}$.

As written in the above equation,

the $z_i's$ are the roots of the equation $N(s) = 0$ and are defined to be the system zeros

the $p_i's$ are the roots of the equation $D(s) = 0$ and are defined to be the system poles.

MATLAB PROGRAM:

num = input('enter the numerator of the transfer function')

den = input('enter the denominator of the transfer function')

[z,p,k] = tf2zp(num,den)

EXAMPLE:

Obtain the poles and zeros of the transfer function given below:

$$\frac{C(s)}{R(s)} = \frac{s^2 + 4s + 3}{s^3 + 3s^2 + 7s + 5}$$

PROCEDURE:

- Type the program in the MATLAB editor that is in M-file.
- Save and run the program.
- Give the required inputs in the command window of MATLAB in matrix format.
- tf2zp converts the transfer function filter parameters to pole-zero-gain form.
- [z,p,k] = tf2zp(b,a) finds the matrix of zeros z, the vector of poles p, and the associated vector of gains k from the transfer function parameters b and a:
- The numerator polynomials are represented as columns of the matrix b.
- The denominator polynomial is represented in the vector a.
- Note down the output of the program that is zeros, poles and gain obtained in MATLAB.
- The zeros, poles and gain are also obtained theoretically.

THEORITICAL CALCULATIONS:

Enter the numerator of the transfer function

num =

Enter the denominator of the transfer function

den =

z =

p =

RESULT: