

CONTROL SYSTEMS

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What is transfer Function

The **transfer function** of a control system is defined as the ratio of the Laplace transform of the output variable to Laplace transform of the input variable assuming all initial conditions to be zero.

$$\implies G(s) = C(s)/R(s)$$

where

$G(s) \longrightarrow$ *Transfer function*

$C(s) \longrightarrow$ *Output of a control system*

$R(s) \longrightarrow$ *Input of a control system*

Question

Transfer function of a system is

$$G(s) = \frac{s^4 + 25s^3 + 20s^2 + 15s + 42}{s^5 + 13s^4 + 9s^3 + 37s^2 + 35s + 50}$$

Find

- the ratio of factors;
- the ratio of polynomials .

a. The ratio of factors:

$$G(s) = \frac{(s + 24.2)(s + 1.35)(s^2 - 0.5462s + 1.286)}{(s + 12.5)(s^2 + 1.463s + 1.493)(s^2 - 0.964s + 2.679)}$$

b. The ratio of polynomials:

$$G(s) = \frac{s^4 + 25s^3 + 20s^2 + 15s + 42}{s^5 + 13s^4 + 9s^3 + 37s^2 + 35s + 50}$$

Code for Zeroes:

```
import numpy as np
p = np.poly1d([1, 25, 20, 15, 42])
print(p)
rootsp = p.r
print(" of Polynomials is :", rootsp)
```

Code for Poles:

```
import numpy as np
p = np.poly1d([1, 13, 9, 37, 35, 50])
print(p)
rootsp = p.r
print(" of Polynomials is :", rootsp)
```

```
      4      3      2
1 x + 25 x + 20 x + 15 x + 42

Roots of Polynomials is : [-24.19607608+0.j          -1.35013808+0.j
      0.27310708+1.10048744j    0.27310708-1.10048744j]

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(program exited with code: 0)

Press any key to continue . . .
```

Figure: Zeroes of a transfer function

```
      5      4      3      2
1 x + 13 x + 9 x + 37 x + 35 x + 50

Roots of Polynomials is : [-12.50095019+0.j          0.48201861+1.56410215j
      0.48201861-1.56410215j  -0.73154352+0.97875441j
      -0.73154352-0.97875441j]

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(program exited with code: 0)

Press any key to continue . . .
```

Figure: Poles of a transfer function