SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE – 641035

23MCT203 - Theory of Control Engineering

Transfer Function

The transfer function of a system is defined as the ratio of Laplace transform of output to the **Laplace transform of input where all the initial** conditions are zero.

$$Transferfunction = \frac{Laplace\ transform\ of\ output\ variable}{Laplace\ transform\ of\ input\ variable}$$

$$T(S) = \frac{C(S)}{R(S)} = G(S)$$

Where,

1. T(S) = Transfer function of the system.
2. C(S) = output.
3. R(S) = Reference output.
4. G(S) = Gain.

Steps to obtain transfer function -

Step-1 Write the differential equation.

Step-2 Find out Laplace transform of the equation assuming 'zero' as an initial condition.

Step-3 Take the ratio of output to input.

Step-4 Write down the equation of G(S) as follows -

$$G(S) = \frac{C(S)}{R(S)}$$

$$= \frac{b_m S^m + b_{m-1} s^{m-1} + \ldots\ldots\ldots b_1 S + b_0}{a_n S^n + a_{n-1} S^{n-1} + \ldots\ldots\ldots a_1 S + a_0} \qquad \text{-----Eq.1}$$

Here, a and b are constant, and S is a complex variable

Characteristic equation of a transfer function -

Here, the characteristic equation of a linear system can be obtained by equating the denominator to the polynomial of a transfer function is zero. Thus the characteristic equation of the transfer function of Eq.1 will be:

$a_n s^n + a_{(n-1)} s^{(n-1)} + \ldots\ldots\ldots + a_1 s + a_0 = 0$