First-Order Response:

$$\frac{dy}{dt} + a_0 y = b_1 \frac{dr}{dt} + b_0 r \quad \Rightarrow \quad Y(s) = \frac{b_1 s + b_0}{s + a_0} R(s) + \frac{y(0^-) - b_1 r(0^-)}{s + a_0}$$

Second-Order Response:

$$\frac{d^2 y}{dt^2} + a_1 \frac{dy}{dt} + a_0 y = b_1 \frac{dr}{dt} + b_0 r \quad \Rightarrow$$

$$Y(s) = \frac{b_1 s + b_0}{s^2 + a_1 s + a_0} R(s) + \frac{s y(0^-) + y'(0^-) + a_1 y(0^-) - b_1 r(0^-)}{s^2 + a_1 s + a_0}$$

Kharitonov's Theorem:

Consider the polynomial:

$$a_p(s) = a_0 + a_1 s + \ldots + a_n s^n \quad \text{where } 0 < l_i \le a_i \le h_i, \forall i = [0, n]$$

The Kharitonov polynomials are:

$$a_{e_1}(s) = h_0 + l_1 s + l_2 s^2 + h_3 s^3 + h_4 s^4 + l_5 s^5 + l_6 s^6 + \ldots$$
$$a_{e_2}(s) = h_0 + h_1 s + l_2 s^2 + l_3 s^3 + h_4 s^4 + h_5 s^5 + l_6 s^6 + \ldots$$
$$a_{e_3}(s) = l_0 + h_1 s + h_2 s^2 + l_3 s^3 + l_4 s^4 + h_5 s^5 + h_6 s^6 + \ldots$$
$$a_{e_4}(s) = l_0 + l_1 s + h_2 s^2 + h_3 s^3 + l_4 s^4 + l_5 s^5 + h_6 s^6 + \ldots$$