

# Control Systems Presentation

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## Question

- A second-order real system has the following properties:
- a) the damping ratio  $\zeta = 0.5$  and undamped natural frequency  $\omega_n = 10 \text{ rad/s}$
  - b) the steady state value of the output, to a unit step input, is 1.02.

The transfer function of the system is

(A)  $\frac{1.02}{s^2+5s+100}$  (B)  $\frac{102}{s^2+10s+100}$   
(C)  $\frac{100}{s^2+10s+100}$  (D)  $\frac{102}{s^2+5s+100}$

## Solution

Characteristic equation of second order system is as follows

$$s^2 + 2\zeta\omega_n s + \omega_n^2 = 0$$

Given  $\zeta = 0.5$  and  $\omega_n = 10\text{rad/s}$

Therefore the equation becomes  $s^2 + 10s + 100 = 0$

Denominator of the Transfer Function is characteristic equation.

From this we can eliminate A and D options

We know that output of the system in s domain is

$$C(s) = T(s)R(s)$$

and  $R(s) = \frac{1}{s}$  as it is unit step input.

Steady state output is given by  $C(\infty) = \lim_{s \rightarrow 0} sC(s)$

Steady state output is 1.02 for only option B

Therefore, transfer function of the system is

$$\frac{102}{s^2 + 10s + 100}$$