ENG4550: Introduction to Control Systems

Section 3.2 Pre-lab Questions

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Lab #: 3

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Nguyen
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ENG4550 Pre-Lab 3.2

1. Type 0 because there is a step input, and the error is non-zero & non-infinite.

2. $k_p = \frac{-1 + 2\zeta w_n \tau}{K} = \frac{-1 + 2(0.690)(86.7)(0.0254)}{(1.53)}$

$= 1.332685229 \ \frac{V}{rad/s}$

$K_i = \frac{w_n^2 \tau}{K} = \frac{(86.7)^2(0.0254)}{1.53} = 124.7902$

3. $P_1(jw) = \frac{P(jw)}{jw} = \frac{K}{jw(\tau(jw)+1)} = \frac{K}{-\tau w^2 + jw}$

$|P_1(jw)| = \frac{K}{\sqrt{\tau^2 w^4 + w^2}}$

4. DC Gain $= \frac{1.53}{\sqrt{(0.0254)^2 + 1}}$

$= 1.529506691 \approx 1.53$

5. $1 = \frac{K}{\sqrt{\tau^2 w_g^4 + w_g^2}}$

$1 = \frac{K^2}{\tau^2 w_g^4 + w_g^2}$

$\tau^2 w_g^4 + w_g^2 - K^2 = 0$ $\quad w_g^2 = \frac{-1 \pm \sqrt{1 + 4\tau^2 K^2}}{2\tau^2}$

$w_g = 1.528$ rad/s $\quad = \frac{-1 \pm 1.003}{1.2903 \times 10^{-3}}$ ignore →

$w_g^2 = 2.337$ rad/s $\quad w_g = 1.528$