20192

MKT3122 Otomatik Kontrol /Automatic Control

1. Soru/question

Soy/Adı:

Sur/name: Numara/No:

İleri yol transfer fonksiyonu $\frac{K(s+1.5)}{s(s-1)(s+10)}$ olan bir birim geri beslemeli kontrol sisteminin kök yer eğrisi -2.7 ± 3.71i noktasından geçmektedir. Bu noktada kontrol katsayısı nedir? Bu noktanın sönüm oranı nedir? (1+KG(s) = 0 eşitliğinden faydalanıp verilen kök değerleri için K yı çekebilirsiniz.)

A unity feedback control system with a forward loop dynamics of $\frac{K(s+1.5)}{s(s-1)(s+10)}$, is present. Root locus of the system is passing through -2.7 ± 3.71i. Find the corresponding gain of the control system for this point. Find the damping ratio for this point.

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Auxiliary Equations:

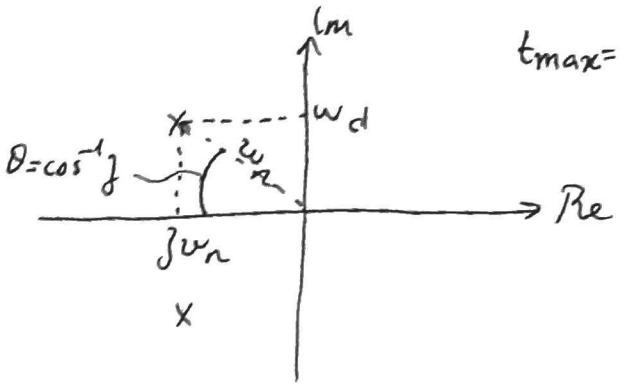
$$e_{ss} = \lim_{s \to 0} s\,E(s)$$

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

$$\omega_d = \omega_n\sqrt{1-\zeta^2}$$

maximum overshoot $= e^{-\pi\zeta/\sqrt{1-\zeta^2}}$

$$t_{max} = \frac{\pi}{\omega_d}$$



$$t_r = \frac{0.8 + 2.5\zeta}{\omega_n}$$

$$t_s \cong \frac{3.2}{\zeta\omega_n} \quad 0 < \zeta < 0.69$$

$$t_s \cong \frac{4.5\zeta}{\omega_n} \quad \zeta > 0.69$$

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$$K_v = \lim_{s \to 0} s\,G(s) \qquad e_{ss} = \frac{1}{K_v}$$

$$K_a = \lim_{s \to 0} s^2 G(s) \qquad e_{ss} = \frac{1}{K_a}$$

$$G(s) = \frac{K_{s1}}{s+s_1} + \frac{K_{s2}}{s+s_2} + \cdots \frac{K_{sn}}{s+s_n} = \frac{Q(s)}{P(s)}$$

$$K_{s1} = \left[(s+s_1)\,\frac{Q(s)}{P(s)}\right]\Bigg|_{s=-s_1}$$

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s^0

$$\theta_i = \frac{(2i+1)}{|n-m|} \times 180^\circ \quad n \neq m$$

$$\sigma_1 = \frac{\sum \text{real parts of poles of } G(s)H(s) - \sum \text{real parts of zeros of } G(s)H(s)}{n-m}$$

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Second order system

$$M(s) = \frac{Y}{R}(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

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$\theta = \omega T$

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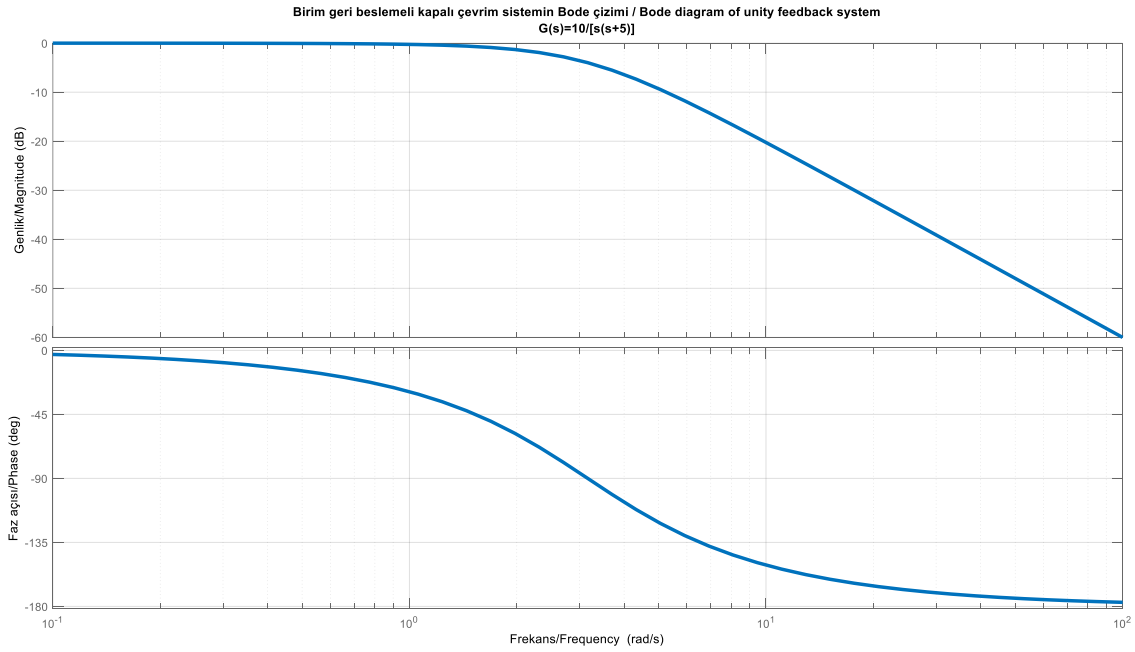
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a. Aşağıda kapalı çevrim bode diagramı verilen sistemin kontrolcü türünü verilen formüle göre söyleyiniz (grafik başlığında). [What is the control type of below system in graphics. [title]
b. ω=1 ve 10 rad/sn için **genlik ve faz açılarını şekil üzerinden bulunuz**. [Find magnitude and phase angles for ω=1 ve 10 rad/sn from graphics]
c. Bu sistemin **giriş çıkış genlikleri arasında fark olmadan çalışabilecekleri çalışma frekansı aralığı (yani sistemin bant genişliği) nedir**? [What is the bandwidht?]
d. Bu **bant genişliği için faz açısı nasıl değişmektedir ve çalışma performansını** sizce nasıl etkiler? [what is the change in phase angle for the bandwidht and how does it affect the working performance?]



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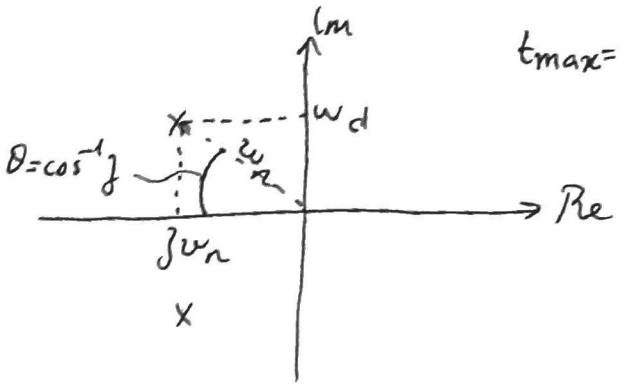
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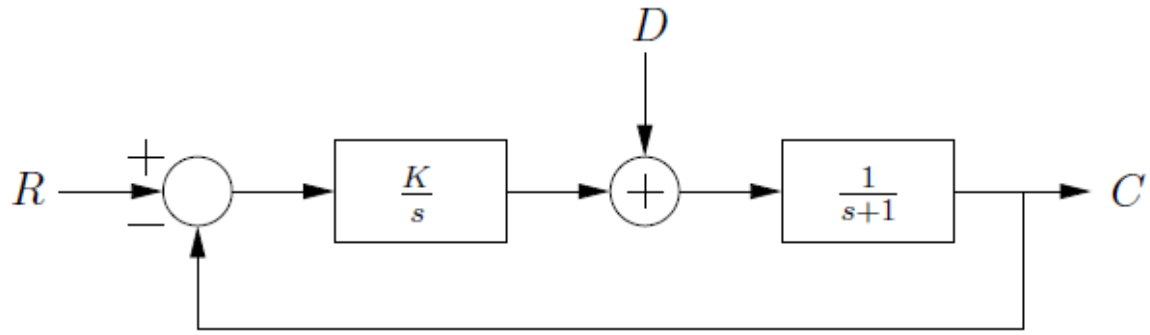
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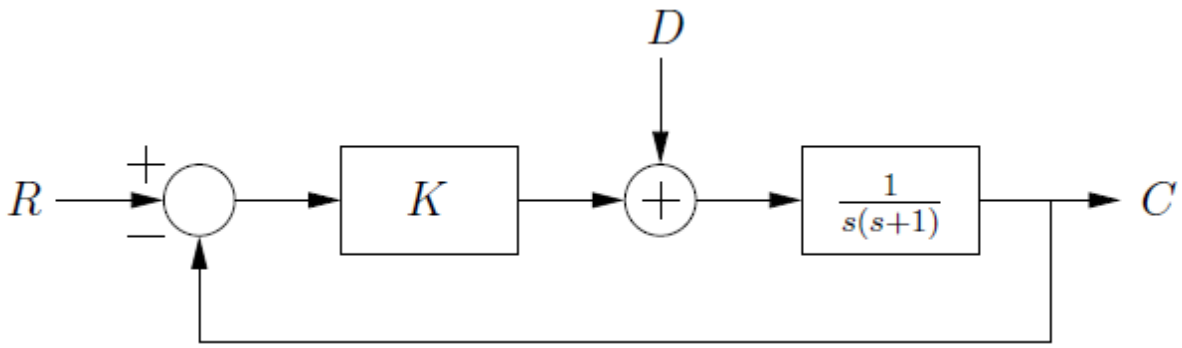
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İki sistemin referans ve bozucu etki girişleri için çıkışları aralarındaki transfer fonksiyonlarını yazınız, fark varmı tartışınız.
İki kontrol sisteminin davranış olarak farkı nedir? Yerleşme zamanı mı, kararlı hal hatası, vb. hesaplayarak farkı gösteriniz.

Find the transfer function between input (R or D) and output (C) of two systems below. Discuss the difference.
What are the behavioral differences between systems? Settling time, steady state error, etc? Calculate and show.





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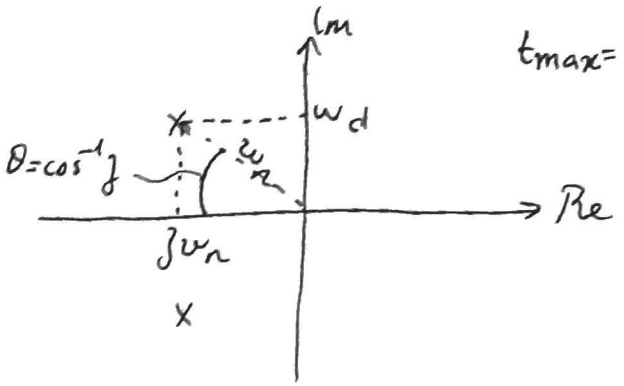
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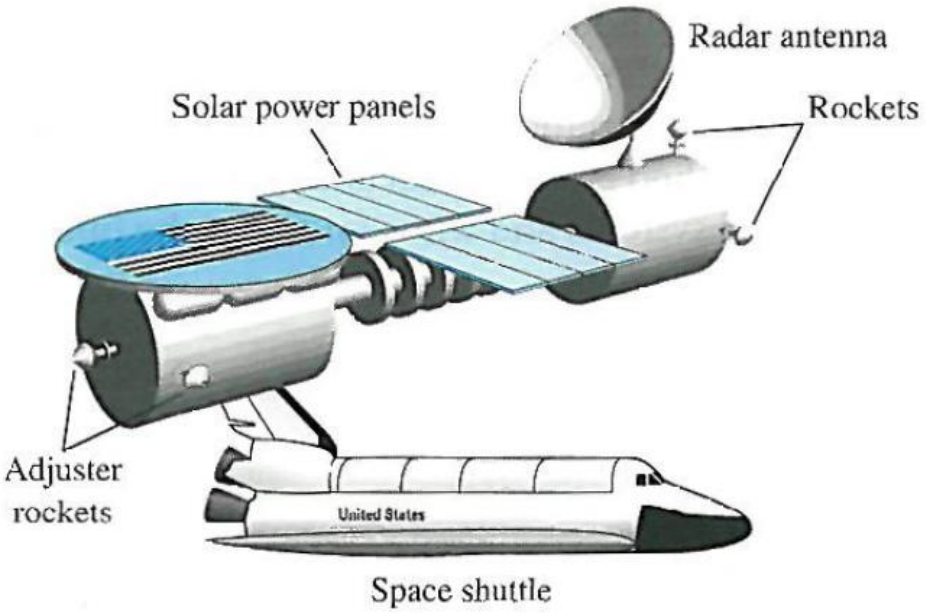
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4. Soru/question

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Aşağıdaki uydunun güneş panellerinin birim geri beslemeli kontrol sistemi ileri yol transfer fonksiyonu aşağıdaki gibidir. (unity feedback control system forward loop transfer function is given)

$$G_c(s)G(s) = \frac{20K}{s(s^2 + 20s + 100)}$$

Sistemi kararsız kılan K değerini bulunuz. (what is the boundary control parameter for instability)



Space shuttle

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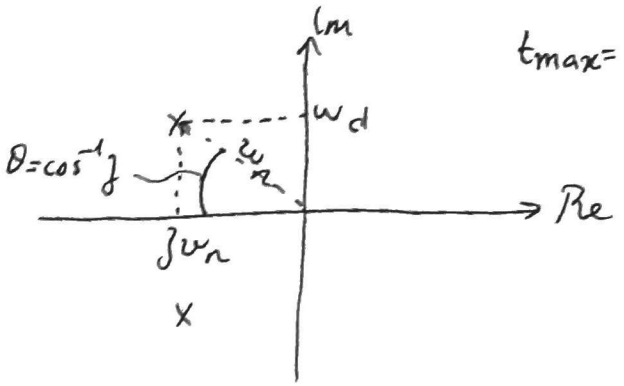
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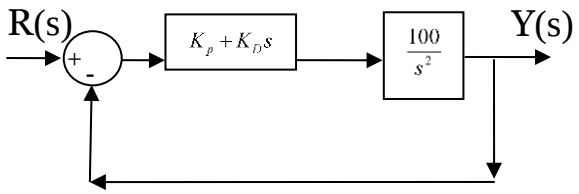
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Aşağıda blok diagramında verilen system için, K_P ve K_D düzleminde, (A control system is given below. In the plane of K_P and K_D)

a. Kararlılık bölgesini gösteriniz (show the region of stability)
b. ζ=1 olan bölge, çizgi veya noktayı gösteriniz.(show the region of damping ratio, 1)
c. ω_n=50 rad/sec olan bölge, çizgi veya noktayı gösteriniz (show the region of undamped natural freq. of 50 rad/sec)
d. Bu şartların hepsi aynı anda sağlanabilir mi? (Is it possible to maintain a, b and c all together)



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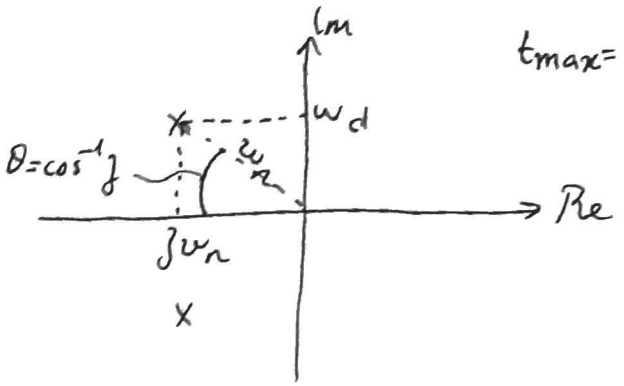
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