Reglerteknik Ö5

Köp övningshäfte på kårbokhandeln

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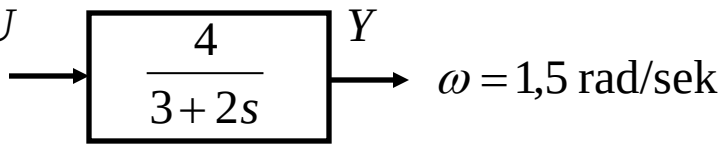
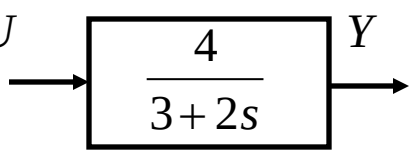
9.2 Amplitud och Fas- värden

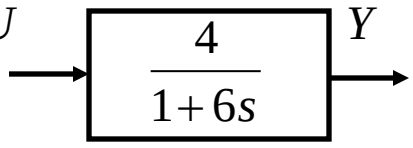
$$A(\omega) = ? \quad \varphi(\omega) = ?$$

a) 

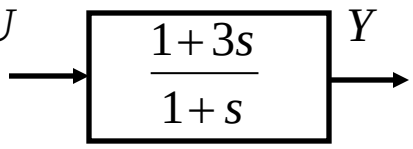
$\omega = 1{,}5$ rad/sek

b) 

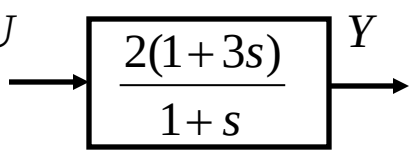
$\omega = 6$ rad/sek

c) 

$\omega = 1$ rad/sek

d) 

$\omega = 0{,}5$ rad/sek

e) 

$\omega = 2$ rad/sek

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9.2 b lösn. Amplitud och Fas

$$A(\omega) = ? \quad \varphi(\omega) = ?$$

b) U → $\dfrac{4}{3+2s}$ → Y $\quad \omega = 6$ rad/sek

$$A(\omega) = \frac{4}{\sqrt{9+4\omega^2}} \quad \varphi(\omega) = 0 - \arctan\frac{2\omega}{3}$$

$$A(6) = \frac{4}{\sqrt{9+4\cdot 6^2}} \approx 0{,}33 \quad \varphi(6) = -\arctan\frac{2\cdot 6}{3} \approx -76°$$

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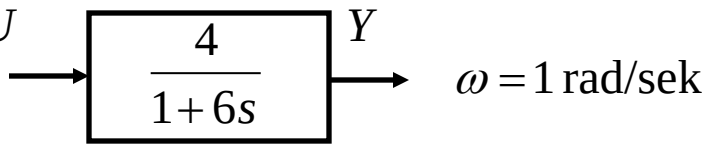
9.2 c lösn. Amplitud och Fas

$$A(\omega) = ? \quad \varphi(\omega) = ?$$

c) 

$\omega = 1$ rad/sek

$$A(\omega) = \frac{4}{\sqrt{9+6\omega^2}} \quad \varphi(\omega) = 0 - \arctan 6\omega$$

$$A(1) = \frac{4}{\sqrt{9+36\cdot 1^2}} \approx 0{,}66 \quad \varphi(1) = -\arctan 6\cdot 1 \approx -81^\circ$$

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9.2 d lösn. Amplitud och Fas

$$A(\omega) = ? \quad \varphi(\omega) = ?$$

d) U → $\dfrac{1+3s}{1+s}$ → Y $\quad \omega = 0{,}5$ rad/sek

$$A(\omega) = \frac{\sqrt{1+9\omega^2}}{\sqrt{1+\omega^2}} \qquad \varphi(\omega) = \arctan 3\omega - \arctan \omega$$

$$A(0{,}5) = \frac{\sqrt{1+9\cdot 0{,}5^2}}{\sqrt{1+0{,}5^2}} \approx 1{,}6$$

$$\varphi(0{,}5) = \arctan 3\cdot 0{,}5 - \arctan 0{,}5 \approx 56{,}3 - 26{,}6 \approx 30°$$

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9.3 sinusformad instorhet

$u(t) = 3 \cdot \sin(2 \cdot t)$ $\quad u \rightarrow \boxed{\dfrac{1+2s}{1+3s+1s^2}} \rightarrow y \quad$ $y(t) = ?$

amplitud $\quad$ 2 rad/sek

$$\frac{1+2s}{1+3s+s^2} \qquad j\omega = s \qquad \frac{1+2j\omega}{1+3j\omega+(j\omega)^2} = \frac{1+2j\omega}{1-\omega^2+3j\omega}$$

$$A(\omega) = \frac{\sqrt{1+4\omega^2}}{\sqrt{(1-\omega^2)^2+9\omega^2}} \qquad A(2) = \frac{\sqrt{1+4\cdot 2^2}}{\sqrt{(1-2^2)^2+9\cdot 2^2}} \approx 0{,}61$$

$$\Rightarrow \quad y(t) = 0{,}61 \cdot 3 \cdot \sin(2t+\varphi) \qquad 0{,}61 \cdot 3 = 1{,}84$$

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9.3 Matlab sinus instorhet

$u(t) = 3 \cdot \sin(2 \cdot t)$ $\xrightarrow{u}$ $\boxed{\frac{1+2s}{1+3s+1s^2}}$ $\xrightarrow{y}$ $y(t) = ?$ 2 rad/sek

```
abs(freqresp(tf([2,1],[1,3,1]),2))
>> ans = 0.61
```

$0{,}61 \cdot 3 = 1{,}84$

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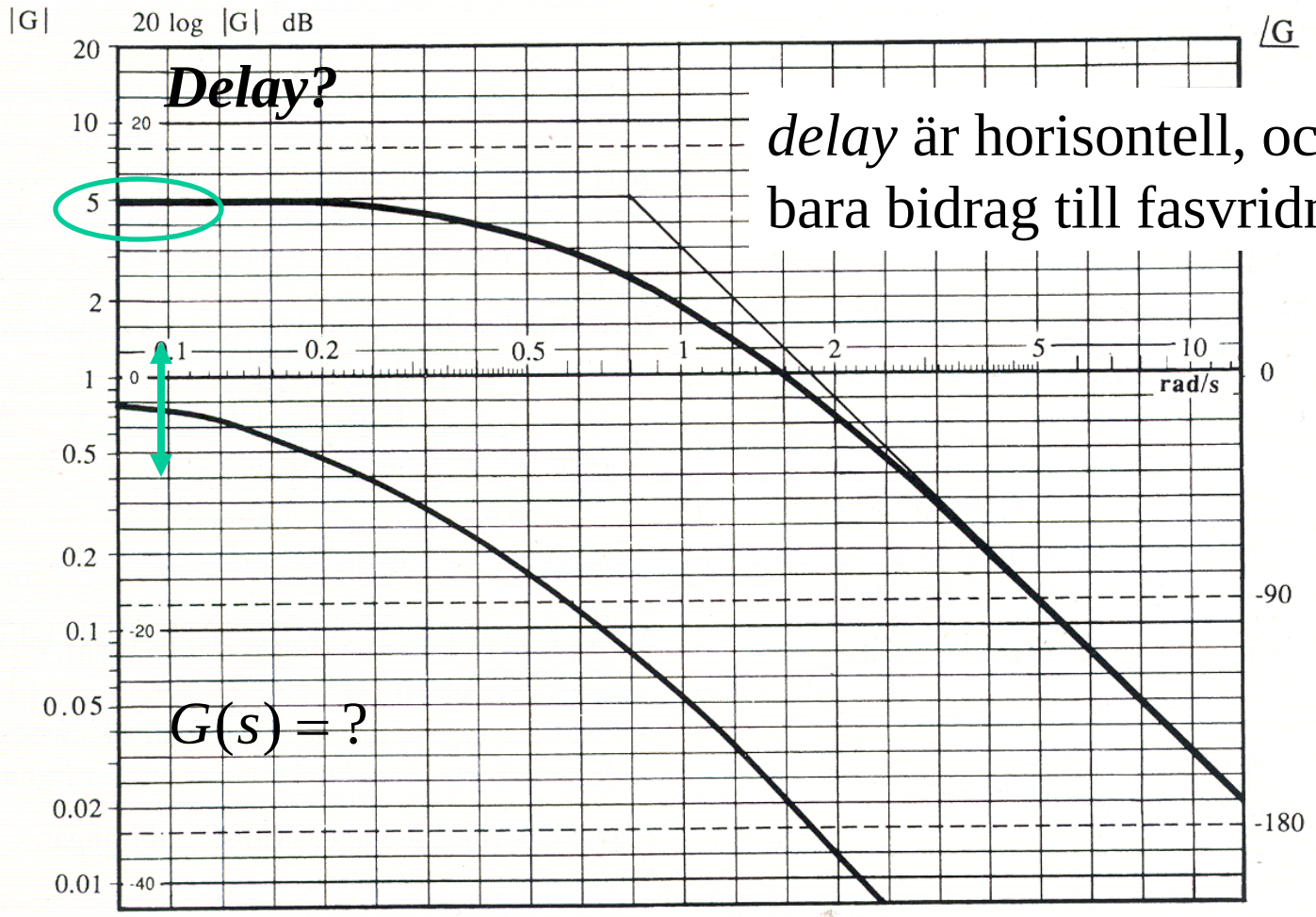
9.11 $G(s)$ med delay ur Bode



delay är horisontell, och ger bara bidrag till fasvridningen

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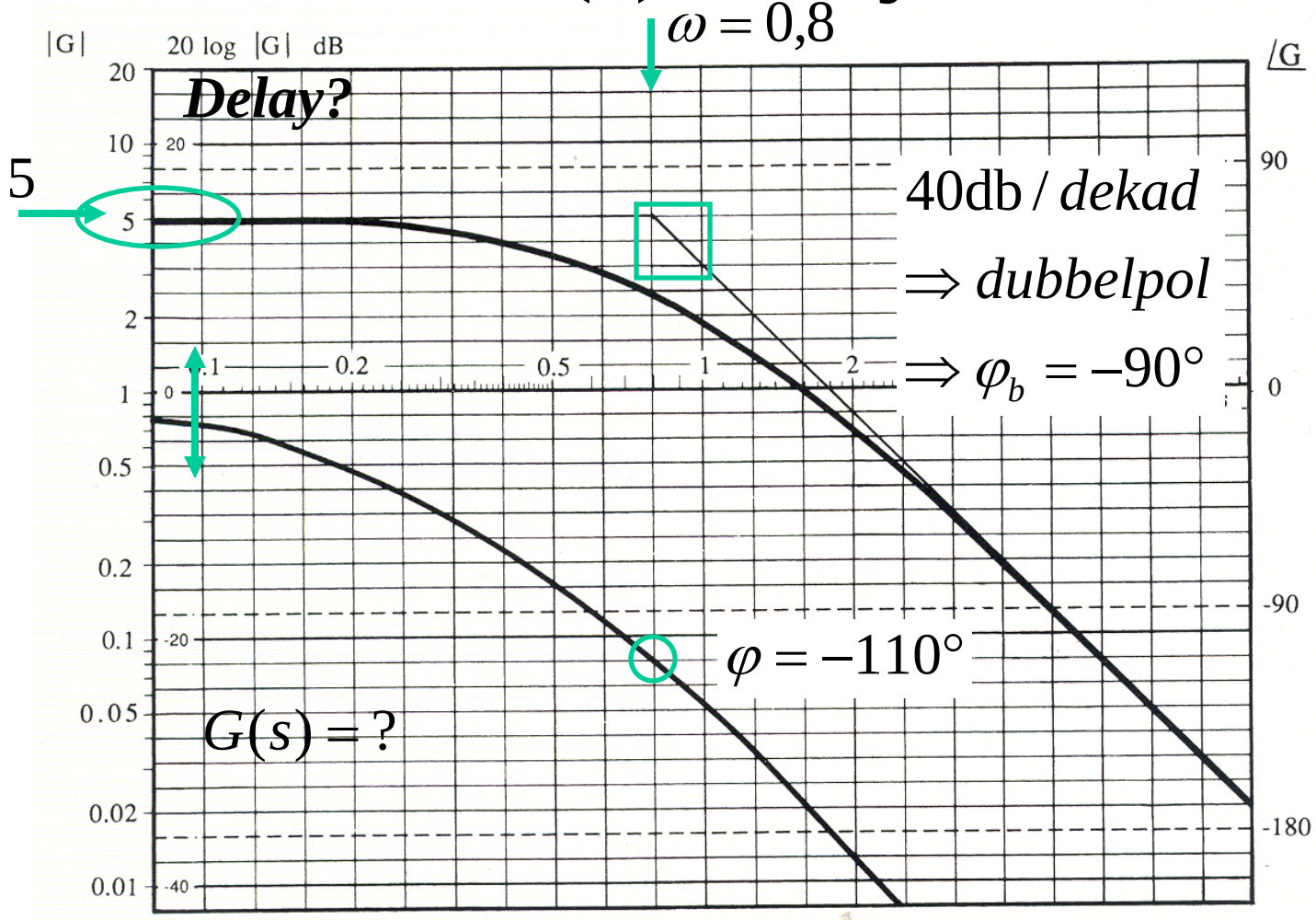
9.11 lösn. $G(s)$ delay ur Bode



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9.11 lösn. $G(s)$ delay ur Bode

$$G(s) = 5 \cdot e^{-Ls} \cdot \frac{1}{(1+\frac{1}{0{,}8}s)^2} = 5 \cdot e^{-Ls} \cdot \frac{1}{(1+1{,}25s)^2}$$

Ur diagrammet, vid $\omega = 0{,}8$ är $\varphi = -110°$
varav dubbelpolen bidrar med $-90°$.

$$\varphi(\omega) = -L\omega - \boxed{2 \cdot \arctan(1{,}25 \cdot \omega)}$$

$$-110\frac{\pi}{180} = -L \cdot 0{,}8 - 90\frac{\pi}{180} \quad \Rightarrow L = \frac{20 \cdot \pi}{0{,}8 \cdot 180} \approx 0{,}44$$

$[°] \rightarrow [\text{rad}]$

9.11 lösn. $G(s)$ delay ur Bode

$$G(s) = \frac{5 \cdot e^{-0,44s}}{(1+1,25s)^2}$$

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