Lecture 3

4 og 5) $Y(s) = T(s)R(s) + F(s)W(s)$. Find $T(s)$, $F(s)$ for P and PI controller

$$T(s) = \frac{Y(s)}{R(s)} = \frac{\text{Direct term}}{1 + \text{open loop}} = \frac{D(s)\cdot\left(\frac{1}{10s+1}\right)\cdot\left(\frac{1}{10s+1}\right)}{1 + D(s)\cdot\left(\frac{1}{10s+1}\right)\cdot\left(\frac{1}{10s+1}\right)\cdot\left(\frac{1}{0.1s+1}\right)}$$

Forkort -> $\frac{D(s)\cdot 0.1^2\cdot(s+10)}{(s+0.1)^2(s+10)+D(s)\cdot 0.1}$

$$F(s) = \frac{Y(s)}{W(s)} = \frac{\text{Direct term}}{1 + \text{open loop}} = \frac{\frac{1}{10s+1}}{1 + \left(\frac{1}{10s+1}\right)\left(\frac{1}{10s+1}\right)\left(\frac{1}{0.1s+1}\right)D(s)} = \frac{0.1\cdot(s+0.1)(s+10)}{(s+0.1)^2(s+10)+0.1\cdot D(s)}$$

From $W(s)$ on diagram

steps

$$T(s) = \frac{D(s)(0.1s+1)}{(10s+1)^2(0.1s+1)+D(s)} = \frac{0.1^2\cdot D(s)(0.1s+1)}{(s+0.1)^2(0.1s+1)+D(s)\cdot 0.1^2} = \frac{0.1^2\cdot D(s)(s+10)}{(s+0.1)^2(s+10)+D(s)\cdot 0.1}$$

P-control: $D(s) = K_p = 7.08$

$$T(s) = \frac{0.1^2\cdot 7.08\cdot(0.1s+1)}{(s+0.1)^2(0.1s+1)+7.08\cdot 0.1^2}; \lim_{s\to 0} T(s) = \frac{0.1^2\cdot 7.08}{0.1^2+7.08\cdot 0.1^2} = 0.9$$

$$F(s) = \frac{0.1(s+0.1)(s+10)}{(s+0.1)^2(s+10)+0.1\cdot 7.08}; \lim_{s\to 0} F(s) = \frac{0.1^2\cdot 10}{0.1^2\cdot 10+0.1\cdot 7.08} = 0.12$$

PI-control $D(s) = K\left(1+\frac{1}{T_i\cdot s}\right) = 1.4\,\frac{s+0.1}{s}$

$$T(s) = \frac{0.1^2\cdot 1.4\cdot\frac{s+0.1}{s}\cdot(s+10)}{(s+0.1)^2(s+10)+1.4\cdot\frac{s+0.1}{s}\cdot 0.1}; \lim_{s\to 0} T(s) = \frac{0.1^2\cdot 1.4\cdot 10}{1.4\cdot 0.1} = 1$$

$$F(s) = \frac{0.1\cdot(s+0.1)(s+10)}{(s+0.1)^2(s+10)+0.1\cdot 1.4\cdot\frac{s+0.1}{s}} = \frac{s\cdot 0.1\cdot(s+0.1)(s+10)}{s\cdot(s+0.1)^2(s+10)+0.1\cdot 1.4\cdot(s+0.1)}; \lim_{s\to 0} F(s) = \frac{0}{0.1^2\cdot 1.4} = 0$$