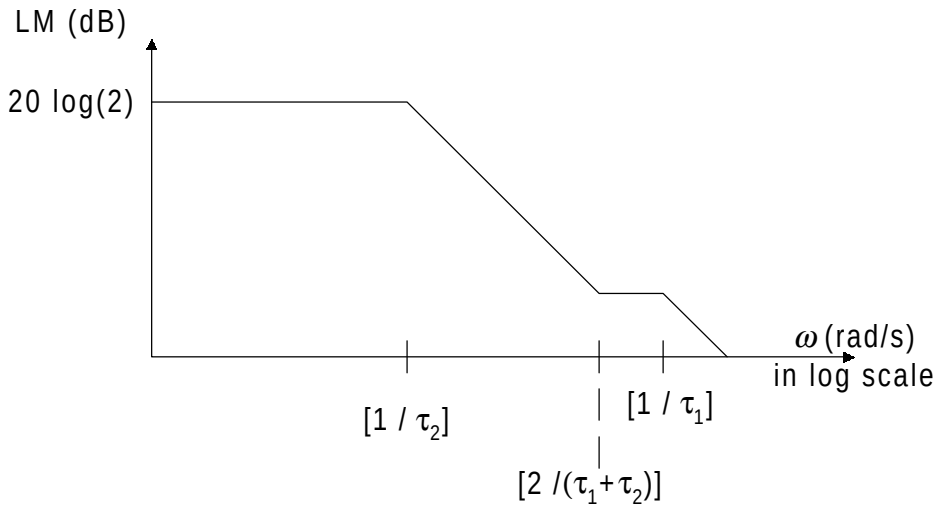
Solution to Exam 3
April 30, 2002

1. $$G(s) = \frac{1}{\tau_1 \cdot s + 1} + \frac{1}{\tau_2 \cdot s + 1} = \frac{\left(\tau_2 \cdot s + 2 + \tau_1 \cdot s\right)}{\left(\tau_1 \cdot s + 1\right) \cdot \left(\tau_2 \cdot s + 1\right)}$$

$$G(i \cdot \omega) = \frac{\left(i \cdot \tau_2 \cdot \omega + 2 + i \cdot \tau_1 \cdot \omega\right)}{\left(i \cdot \tau_1 \cdot \omega + 1\right) \cdot \left(i \cdot \tau_2 \cdot \omega + 1\right)}$$

$$MR = \left|G(i \cdot \omega)\right| = \sqrt{\frac{4 + \left(\tau_1 + \tau_2\right)^2 \cdot \omega^2}{\left(1 + \tau_1^{\,2} \cdot \omega^2\right) \cdot \left(1 + \tau_2^{\,2} \cdot \omega^2\right)}}$$



2. $\omega_{pc} := 10$ $\quad Pu := \frac{2\cdot\pi}{\omega_{pc}}$ $\quad Pu = 0.628$ $\quad Ku := 10^{\frac{40}{20}}$ $\quad Ku = 100$

$Kc := \frac{Ku}{1.7}$ $\quad \tau_I := \frac{Pu}{2}$ $\quad \tau_D := \frac{Pu}{8}$

$Kc = 58.824$ $\quad \tau_I = 0.314$ $\quad \tau_D = 0.079$

3. Case 1: G2

Case 2: G5

Case 3: G1

Case 4: G3

4. a) $x := 1.7\cdot 0.5$ $\quad GM := \frac{1}{x}$ $\quad GM = 1.176$

b) want kc such that $kc\cdot\sqrt{1.4^2 + 1.4^2} = 1$

$kc := \frac{1}{\sqrt{2\cdot 1.4^2}}$ $\quad kc = 0.505$

5. $MR := \frac{5}{10}$

$LM := 20\cdot\log(MR)$

$LM = -6.021$ (decibels)

$P := 20$

$\omega := \frac{2\cdot\pi}{20}$

$\omega = 0.314$

$t_{shift} := -15$

$\phi := \omega\cdot t_{shift}\cdot\frac{180}{\pi}$

$\phi = -270$ (degrees)