(1) $G(s) = \frac{14,145}{(s^2 + 0,8425 + 2,829)} \therefore \frac{K\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$

$= \frac{5.(2,829)}{s^2 + 0,8425 + 2,829}$

Valor do sobressinal $\Rightarrow Mp = e^{\frac{-\zeta\pi}{\sqrt{1-\zeta^2}}}$

Tempo de subida $\Rightarrow tr = \frac{\pi}{2\omega n}$

Tempo de acomodação $\Rightarrow ts = \frac{4}{\sigma} \therefore 4T$

Instante de pico do sistema $\Rightarrow tp = \frac{\pi}{\omega d}$

$\omega n = \sqrt{2,829} \approx 1,682$

$dn = \frac{3,14}{2.1,682} = \frac{3,14}{3,364} \approx 0,9334$

$0,842 = 2.\zeta.1,682$

$\zeta = \frac{0,842}{3,364} \approx 0,2503$

$Mp = e^{\frac{-5\pi}{\sqrt{1-5^2}}} = e^{\frac{-0,2503.3,14}{\sqrt{1-0,2503^2}}}$

$= e^{\frac{-0,785942}{\sqrt{1-0,0626}}}$

$= e^{\frac{-0,7859}{0,9682}}$

$= e^{-0,8117} \approx 0,4444$

$T_{s\ 2\%} = 4.\frac{1}{\zeta\omega n} = 4.\frac{1}{0,2503.1,682} = \frac{4}{0,421} = 9,501$

$T_p = \frac{\pi}{\omega d} = \frac{3,14}{1,682.0,9682} \approx 1,9281$

(2) a) $G(s) = \frac{16}{s^2 + 3s + 16}$

- $2\zeta\omega_n = 3 \rightarrow \omega_n = \sqrt{16} = 4$
  $2\zeta = \frac{3}{4}$
  $\zeta = \frac{3}{8} = 0375$
- $e = e^{\frac{-2\pi\zeta}{\sqrt{1-\zeta^2}}} = e^{\frac{-2,355}{\sqrt{0,92702}}}$
  $e \approx 0,0788$

- $T_s\ 2\% = \frac{4}{\zeta \cdot \omega_n} = \frac{1}{0,375} = 2,666$
- $T_p = \frac{\pi}{\omega_n \cdot \sqrt{1-\zeta^2}} = \frac{3,14}{4 \cdot 0,92702} \approx 0,8468$
- $T_n \approx \frac{\pi}{2\omega_n} \rightarrow t_r \approx \frac{3,14}{8} \approx 0,3925$

b) $G(s) = \frac{0,04}{s^2 + 0,02s + 0,04}$

- $2\zeta\omega_n = 0,02 \rightarrow \omega_n = \sqrt{0,04} = 0,2$
  $\zeta = \frac{0,01}{0,2} = 0,05$
- $e = e^{\frac{-\pi\zeta}{\sqrt{1-\zeta^2}}} = e^{\frac{-0,314}{0,9987}} = e^{-0,3147408} = 0,7302$

- $T_s\ 2\% = \frac{4}{\zeta \cdot \omega_n} = \frac{4}{0,05 \cdot 0,2} = 400$
- $T_p = \frac{\pi}{\omega_n \cdot \sqrt{1-\zeta^2}} = \frac{3,14}{0,2 \cdot 0,9987} \approx 15,7204$
- $T_n = \frac{\pi}{2\omega_n} = \frac{3,14}{0,4} = 7,85$

(3) $\frac{Y(s)}{R(s)} = \frac{\frac{K}{s(s+2)}}{1 + \frac{K}{s(s+2)}} = \frac{K}{s^2+2s+K}$

- $e^{\frac{-\xi\pi}{\sqrt{1-\xi^2}}} = 0,2$

$\xi = 0,46$

$T_{s\ 5\%} = \frac{3}{\xi\omega_n} = 3\,seg$

- $2\xi\omega_n = 2 \Rightarrow \omega_n = \frac{1}{\xi} = \omega_n = 2,2$

$K = \omega_n^2 = 4,8$

$\Rightarrow$ Ganho estático unitário independente de K