

Jaeger 3rd edition

16.1

$$(a) \quad A_v(s) = \frac{50s^2}{(s+2)(s+30)} = \underbrace{[50]}_{\text{Amid}} \left[\frac{s}{s+2} \frac{s}{s+30} \right]_{F_L(s)}$$

(b) The dominant pole corresponds with 30 rad/s

$$(c) \quad A_v(s) \approx 50 \frac{s}{s+30}$$

$$(d) \quad \text{Cutoff freq } f_L \approx \frac{30}{2\pi} \text{ Hz} = 4.8 \text{ Hz (approx)}$$

(e) Exact cutoff f_L is ...

$$\frac{1}{\sqrt{2}} = \left| \frac{j\omega_L}{j\omega_L + 2} \frac{j\omega_L}{j\omega_L + 30} \right| \quad \text{solve for } \omega_L$$

$$\frac{1}{2} = \frac{\omega_L^2}{\omega_L^2 + 4} \cdot \frac{\omega_L^2}{\omega_L^2 + 900} \quad (\text{2nd order})$$

$$0 = \omega_L^4 - 904\omega_L^2 - 3600$$

$$\omega_L^2 = 908.0 \quad \text{OR} \quad -3.965$$

$$\omega_L = 30.13 \text{ rad/s} \quad \text{OR} \quad f_L = 4.796 \text{ Hz (exact)}$$