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TT-43-11

3a.

$K_1 = -3\,dB \qquad f_1 = 6000\,Hz$

$K_2 = -15\,dB \qquad f_2 = 12000\,Hz$

Jika $H(s) = \dfrac{1}{s+1}$ (LPF) $\to H(s) = \dfrac{1}{\frac{\Omega_u}{s}+1}$ (HPF)
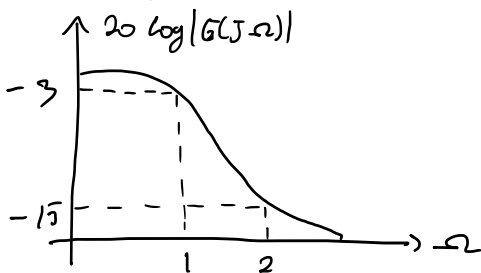
$\Omega_1 = 2\pi \cdot 6000 = 12000\,\pi$

$\Omega_2 = 2\pi \cdot 12000 = 24000\,\pi$

a. Butterworth karena filter analog bekerja pada HPF
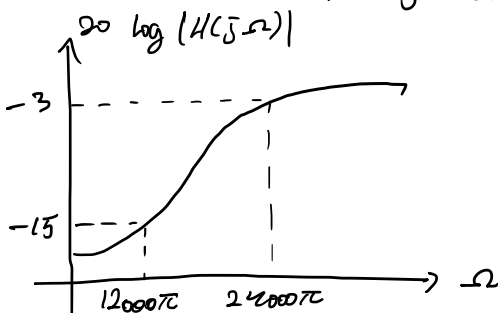
b. $\Omega_r' = 12000\,\pi \qquad \Omega_f = \dfrac{\Omega_u}{\Omega_r'} = \dfrac{24000\,\pi}{12000\,\pi} = 2$

$\Omega_u = 24000\,\pi$

c.

$$n = \left\lceil \dfrac{\log_{10}\left[\dfrac{10^{\frac{-K_1}{10}}-1}{10^{\frac{-K_2}{10}}-1}\right]}{2\log_{10}\left(\dfrac{\Omega_1}{\Omega_2}\right)} \right\rceil = \left\lceil \dfrac{\log_{10}\left(\dfrac{10^{0.3}-1}{10^{1.5}-1}\right)}{2\log_{10}\left(\dfrac{12000\,\pi}{24000\,\pi}\right)} \right\rceil = \lceil 2.47 \rceil = 3$$

d. $\quad M_3(s) = \dfrac{1}{s^3 + 2s^2 + 2s + 1}$

e. $\quad \Omega_c = \dfrac{\Omega_1}{\left(10^{-\frac{k_1}{\omega}} - 1\right)^{\frac{1}{2n}}} = \dfrac{12000\,\pi}{\left(10^{0,3} - 1\right)^{\frac{1}{6}}} = 37720,06$

Transformaz $\quad LP \rightarrow HP, \quad s \rightarrow \dfrac{\Omega_c}{s}$

$M(s) = M_n(s)\Bigg|_{s \rightarrow \frac{37720,06}{s}}$

$M(s) = \dfrac{1}{\left(\dfrac{37720,06}{s}\right)^3 + 2\left(\dfrac{37720,96}{s}\right)^2 + 2\left(\dfrac{37720,96}{s}\right) + 1}$

f.