Ap 14.1–14.5 Hw 7 Peter A. Dranishnikov

A14.1 series RC lowpass filter requires a cutoff frequency of 8 kHz. Use $R = 10\,k\Omega$ and compute the value of C required

$$2\pi \cdot f_c = \frac{1}{RC} \qquad 2\pi \cdot 8000 = \frac{1}{10000C} \qquad C = 1.989 \times 10^{-9}\ F$$

A14.2 series RL lopass filter req. cutoff freq. of 2kHz Using $R = 5\,k\Omega$, compute

a) L

b) $|H(j\omega)|$ at 50 kHz

c) $\theta(j\omega)$ at 50 kHz

a) $2\pi f_c = \frac{R}{L}$

$2\pi 2000 = \frac{5000}{L}$

$L = 0.398\ H$

b)
$$|H(j\omega)| = \frac{R/L}{\sqrt{\omega^2 + (R/L)^2}} = \frac{\frac{5000}{0.398}}{\sqrt{(2\pi 50000)^2 + \left(\frac{5000}{0.398}\right)^2}} = 0.040\ V$$

c) $$\theta(j\omega) = -\tan^{-1}\left(\frac{50000 \cdot 2\pi \cdot 0.398}{5000}\right)$$

$$= -87.71^\circ$$

A14.3 Series RL hipass $R = 5k\Omega$, $L = 3.5 \times 10^{-3}$ H, what is ω_c?

$$\omega_c = \frac{R}{L} = 1.43 \times 10^6 \text{ rad/s}$$

A14.4 Series RC Hipass $C = 1 \times 10^{-6}$ F

Cutoff freq. ω_c for

a) 100Ω

b) 5kΩ

c) 30kΩ

a) $\frac{1}{RC} = \frac{1}{100 \cdot 10^{-6}} = 10000$ rad/s

b) $\frac{1}{5000 \cdot 10^{-6}} = 200$ rad/s

c) $\frac{1}{30000 \cdot 10^{-6}} = 33.\bar{3}$ rad/s

A14.5 Compute the transfer function of a series RC lopass filter w/ load resistor R_L in parallel w/ cap.

(unloaded) $H(s) = \frac{R/L}{s + R/L}$

loaded

$$H(s) = \frac{\frac{R_L/sC}{R_L + 1/sC}}{R + \frac{R_L/sC}{R_L + 1/sC}} = \frac{\frac{1}{RC}}{s + K\frac{1}{RC}}, \quad K = \frac{R_L}{R + R_L}$$