ECE2101L
Electrical Circuit Analysis II

Assignment 1

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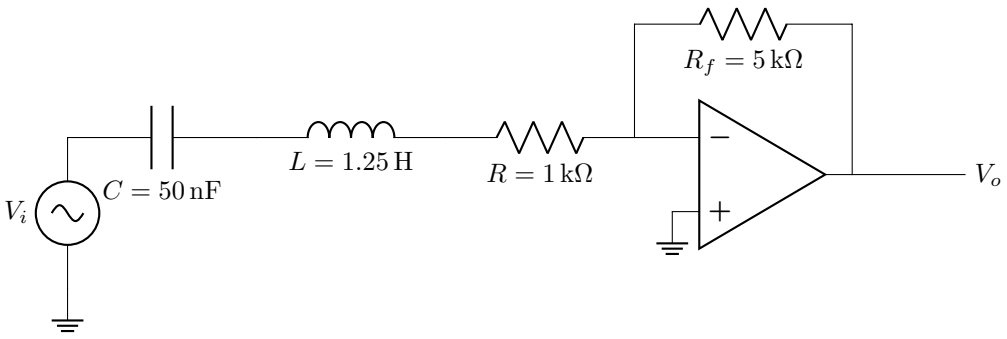


$$H(j\omega) = \frac{V_o}{V_i} = -\frac{Z_f}{Z_i} = \frac{-5000}{1000 + 1.25j\omega - \frac{1}{50\times10^{-6}\omega}j}$$

$$H(j\omega) = \frac{-5000}{1000 + (1.25\omega - \frac{20000}{\omega})j} \times \frac{1000 - (1.25\omega - \frac{20000}{\omega})j}{1000 - (1.25\omega - \frac{20000}{\omega})j}$$

$$H(j\omega) = \frac{-5000}{1000^2 + (1.25\omega - \frac{20000}{\omega})^2}\left(1000 - (1.25\omega - \frac{20000}{\omega})j\right)$$

$$H(j\omega) = \frac{-5000}{1000^2 + (1.25\omega - \frac{20000}{\omega})^2}\sqrt{1000^2 + (1.25\omega - \frac{20000}{\omega})^2}\underline{/tan^{-1}(\frac{20}{\omega} - 0.00125\omega)}$$

$$H(j\omega) = \frac{-5000}{\sqrt{1000^2 + (1.25\omega - \frac{20000}{\omega})^2}}\underline{/tan^{-1}(\frac{20}{\omega} - 0.00125\omega)}$$

At resonance frequency (ω_o), X = 0:

$$1.25\omega_o - \frac{20000}{\omega_o} = 0$$

$$1.25\omega_o = \frac{20000}{\omega_o}$$

$$\omega_o = \sqrt{\frac{80000}{5}} = 200\sqrt{\frac{2}{5}} \approx 126.49\frac{rad}{s}$$

Maximum Gain at ω_o:

$$|H(j\omega_o)| = \left|\frac{-5000}{\sqrt{1000^2 + (1.25\omega_o - \frac{20000}{\omega_o})^2}}\right| = 5$$

For ω_{3dB} bandwidth:

$$\frac{5000}{\sqrt{1000^2 + (1.25\omega_{3dB} - \frac{20000}{\omega_{3dB}})^2}} = \frac{1}{\sqrt{2}}$$

$$1000^2 + (1.25\omega_{3dB} - \frac{20000}{\omega_{3dB}})^2 = 2(5000)^2$$

$$1.25\omega_{3dB} - \frac{20000}{\omega_{3dB}} = \sqrt{2(5000)^2 - 1000^2}$$

$$1.25\omega_{3dB}^2 - \sqrt{2(5000)^2 - 1000^2}\omega_{3dB} - 20000 = 0$$

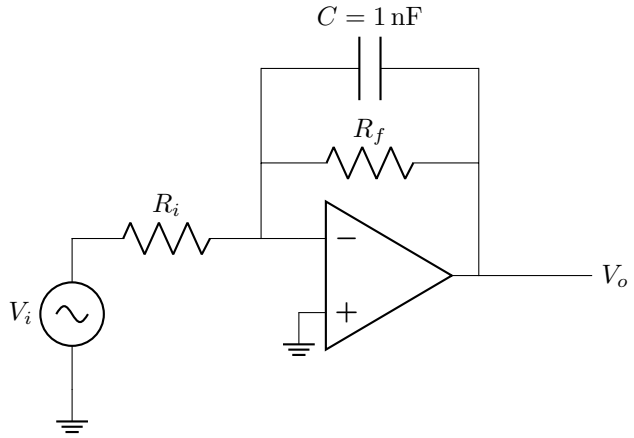
$$1.25\omega_{3dB}^2 - 7000\omega_{3dB} - 20000 = 0$$

$$\omega_{3dB,H} = 5603$$

$$\omega_{3dB,L} = -2.8557$$

$$\omega_{3dB} = 5603 - 0 = 5603$$

2



$$H(j\omega) = \frac{V_o}{V_i} = -\frac{Z_f}{Z_i} = \frac{\frac{-1}{\frac{1}{R_f}+j\omega C}}{R_i} = -\frac{R_f}{R_i}\left(\frac{1}{1+j\omega R_f C}\right)$$

$$H(j\omega) = -\frac{R_f}{R_i}\left(\frac{1}{1+j\omega R_f C}\right)\left(\frac{1-j\omega R_f C}{1-j\omega R_f C}\right)$$