Homework Assignment No. 2 - Solutions

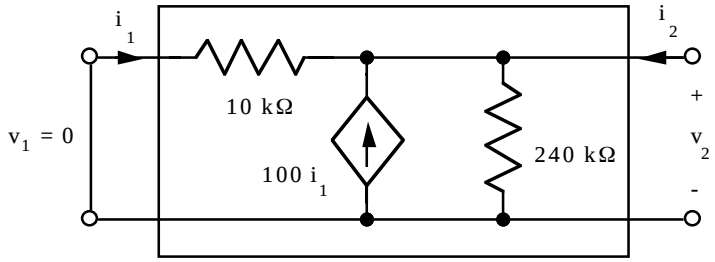
Problem 10.20 (11.16)

$$g_{11} = \left.\frac{\mathbf{i_1}}{\mathbf{v_1}}\right|_{\mathbf{i_2}=0} : \mathbf{v_1} = 10^4\,\mathbf{i_1} + 101\,\mathbf{i_1}(240\text{k}\Omega) \rightarrow g_{11} = 4.124 \text{ x } 10^{-8}\,\text{S} = 4.12 \text{ x } 10^{-8}\,\text{S}$$

$$g_{12} = \left.\frac{\mathbf{i_1}}{\mathbf{i_2}}\right|_{\mathbf{v_1}=0} : \mathbf{i_1} = -\frac{240\text{k}\Omega}{240\text{k}\Omega + 10\text{k}\Omega}(\mathbf{i_2} + 100\mathbf{i_1}) \rightarrow g_{12} = -9.90 \text{ x } 10^{-3}$$

$$g_{21} = \left.\frac{\mathbf{v_2}}{\mathbf{v_1}}\right|_{\mathbf{i_2}=0} : \mathbf{v_2} = 101\mathbf{i_1}(240\text{k}\Omega) \;\mid\; \mathbf{i_1} = g_{11}\mathbf{v_1} \rightarrow g_{21} = 1.00$$

$$g_{22} = \left.\frac{\mathbf{v_2}}{\mathbf{i_2}}\right|_{\mathbf{v_1}=0} : \mathbf{i_2} = \frac{\mathbf{v_2}}{240\text{k}\Omega} + \frac{\mathbf{v_2}}{10\text{k}\Omega} + 100\,\frac{\mathbf{v_2}}{10\text{k}\Omega} \rightarrow g_{22} = 99.0\ \Omega$$



Problem 10.48 (11.34)

$$V_O = V_S\,\frac{R_{IN}}{R_{IN} + R_S}\,A\,\frac{R_{IN}}{R_{IN} + R_{OUT}}\,A\,\frac{R_L}{R_L + R_{OUT}}$$

$$A_V = \frac{5000}{5000 + 1000}(-1000)\frac{5000}{5000 + 250}(-1000)\frac{100}{100 + 250} = +2.27 \text{ x } 10^5$$

$$A_I = \frac{I_O}{I_S} = \frac{2.27\text{x}10^5\,V_S}{100}\,\frac{1}{\frac{V_S}{6000}} = +1.36 \text{ x } 10^7$$

$$A_P = \frac{2.27\text{x}10^5\,V_S\left(+1.36 \text{ x } 10^7\,I_S\right)}{V_S I_S} = +3.09 \text{ x } 10^{12}$$

Problem 10.57 (11.37)

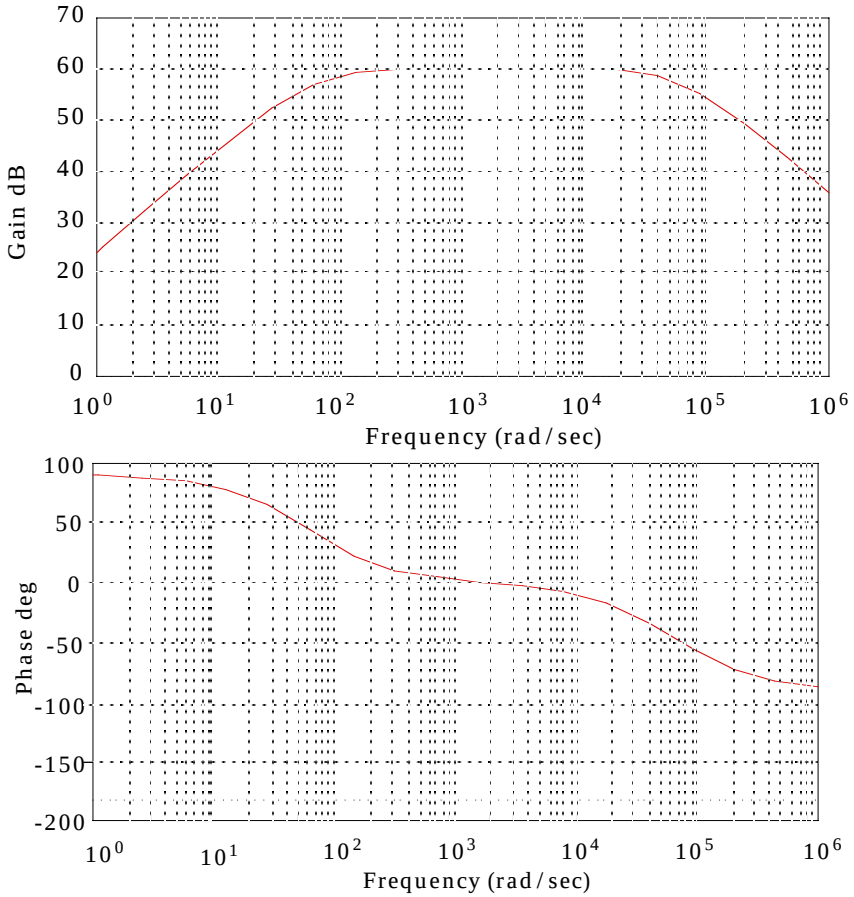
$$A_V = \frac{2\pi \text{ x } 10^7\,s}{(s + 20\pi)\left(s + 2\pi \text{ x } 10^4\right)} = \frac{1000s}{(s + 20\pi)\left(1 + \frac{s}{2\pi \text{ x } 10^4}\right)} \;\mid\; A_{mid} = +1000 = 60\ \text{dB}$$

$$f_L = \frac{20\pi}{2\pi} = 10\ \text{Hz} \;\mid\; f_H = \frac{2\pi \text{ x } 10^4}{2\pi} = 10\ \text{kHz} \;\mid\; BW = 10\text{kHz} - 10\text{Hz} = 9.99\ \text{kHz}$$

Bandpass Amplifier

Problem 10.63 (11.43)

Using MATLAB: n=[2e7*pi 0]; d=[1 (20*pi+2e4*pi) 40e4*pi^2]; bode(n,d)



Problem 10.75 (11.55)

$$(a)\ A_{mid} = +10^{\frac{20}{20}} = +10 \quad | \quad A_V = \frac{10}{1 + \frac{s}{2\pi \times \left(5 \times 10^6\right)}} = \frac{10}{1 + \frac{s}{10^7 \pi}} = \frac{10^8 \pi}{s + 10^7 \pi}$$

$$(b)\ A_{mid} = -10^{\frac{20}{20}} = -10 \quad | \quad A_V = -\frac{10^8 \pi}{s + 10^7 \pi}$$