

$$1) a) XY = 2$$

$$F(s) = \frac{K}{Ts+1} \Rightarrow F(i\omega) = \frac{K}{T(i\omega)+1} \Rightarrow \boxed{F(s) = \frac{4}{5s+1}}$$

$$P = [2; -2i], \omega = 0,2$$

$$2 - 2i = \frac{K}{T \cdot 0,2i + 1} \quad | \cdot T \cdot 0,2i + 1$$

$$(2 - 2i)(T \cdot 0,2i + 1) = K$$

$$2T \cdot 0,4i + 2 - T \cdot 0,4i^2 - 2i = K$$

$$0,4Ti + 2 + 0,4T - 2i = K$$

Re:

$$2 + 0,4T = K$$

$$2 + 0,4 \cdot 5 = K$$

$$\underline{\underline{4 = K}}$$

Im:

$$0,4Tx - 2x = 0$$

$$0,4Tx = 2x \quad | : 0,4$$

$$\underline{\underline{T = 5}}$$

$$b) u(t) = 3\sin(2t)$$

$$u(s) = \frac{6}{s^2 + 4}$$

$$F(s) = \frac{4}{5s+1} \cdot \frac{6}{s^2+4} = \frac{24}{5s^3 + 20s + s^2 + 4} = \frac{24}{5s^3 + s^2 + 20s + 4}$$

$$F(i\omega) = \frac{4}{5i\omega + 1} \cdot \frac{6}{i^2\omega^2 + 4} = \frac{24}{5i^3\omega^3 + i^2\omega^2 + 20i\omega + 4} = \frac{24}{-5i\omega^3 - \omega^2 + 20i\omega + 4} =$$

$$= \frac{24}{(i\omega)(-5\omega^2 + 20) + (4 - \omega^2)} = \frac{24((i\omega)(-5\omega^2 + 20) + (4 - \omega^2))}{(i\omega)(-5\omega^2 + 20) - (4 - \omega^2)} = \frac{24((i\omega)(-5\omega^2 + 20) + (4 - \omega^2))}{-i(-5\omega^2 + 20) - (4 - \omega^2)}$$

Re:

$$\frac{24(4 - \omega^2)}{(-5\omega^2 + 20)^2 + (4 - \omega^2)^2} \stackrel{\omega=0,2}{=} 0,233$$

Im:

$$\frac{24(i\omega)(-5\omega^2 + 20)}{(-5\omega^2 + 20)^2 + (4 - \omega^2)^2} \stackrel{\omega=0,2}{=} 0,233i$$

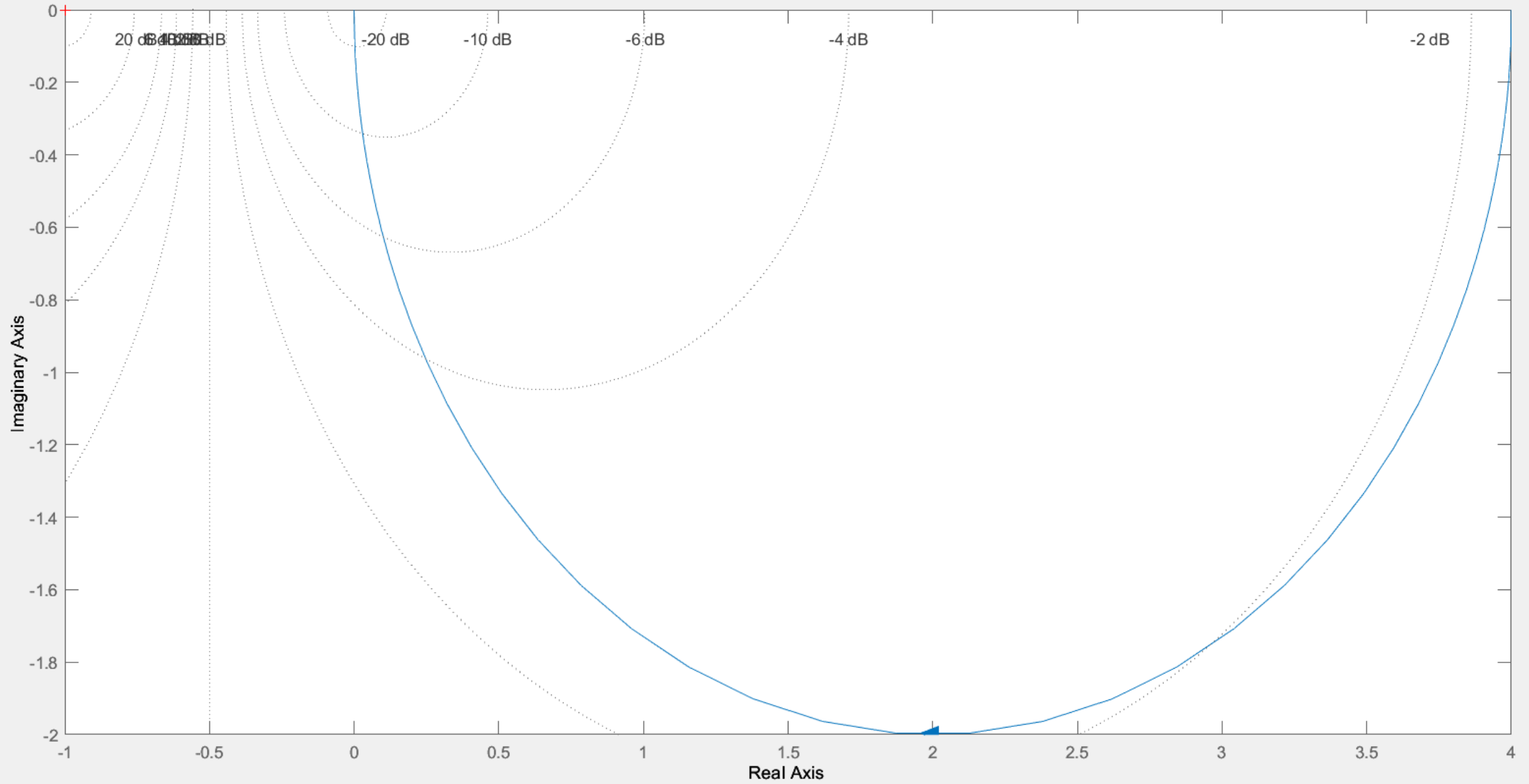
Amplitude

$$A = \sqrt{Re^2 + Im^2} = \sqrt{0,233^2 + 0,233^2} = 0,329$$

Fáze φ

$$\varphi = \operatorname{atg} \frac{Im}{Re} = \operatorname{atg} \frac{0,233}{0,233} = 0,785 \text{ rad}$$

Nyquist Diagram



$$2) \quad M = \frac{\pi v^2 \cdot v \cdot \rho}{3} = \frac{\pi \cdot 0,03^2 \cdot 0,1 \cdot 1,24}{3} = 116 \cdot 10^{-6} \text{ kg}$$

$$L = 0,2 \cdot 2 = 0,4 \text{ mH}$$

$$\frac{X(s)}{U(s)} = \frac{0,63}{s[(11s+b)(Ls+R)+0,63^2]} = \frac{0,63}{s[(116s+1,6)(0,4s+4)+0,63^2]}$$

$$= \frac{0,63}{s(4,64s^2 + 4,64s \cdot 10^{-3} + 0,4s \cdot 10^{-3} + 4) + 0,63^2} = \frac{0,63}{s(4,64s^2 + 4,64s \cdot 10^{-3} + 0,4s \cdot 10^{-3} + 4) + 0,63^2}$$

$$= \frac{0,63}{4,64s^3 \cdot 10^{-8} + 4,6464s^2 \cdot 10^{-4} + 0,4033s + 0,000464s^3 + 0,000464s^2 + 0,4033s}$$

$$= \frac{0,63}{s[(0,000464s^3 + 0,000464s^2 + 0,4033s + 0,000464s^3 + 0,000464s^2 + 0,4033s) + 0,63^2]} = \frac{0,63}{s(0,000928s^3 + 0,000928s^2 + 0,8066s + 0,4033)}$$

$$= \frac{0,63}{0,000928s^3 + 0,000928s^2 + 0,4033s}$$

Maximální výchylka jsou 7 mm.

