ELEC-E8116 Model-based control systems /exercises 12

Problem 1. Consider a SISO system in a two-degrees-of-freedom control configuration. Let the loop transfer function be $L(j\omega) = G(j\omega)F_y(j\omega)$, where the symbols are standard used in the course.

a. Define the *sensitivity* and *complementary sensitivity functions* and determine where in the complex plane it holds

$$|S(j\omega)| < 1, \quad |S(j\omega| = 1, \quad |T(j\omega)| < 1 \text{ and } |T(j\omega)| = 1$$

b. Let the Nyquist diagram of the loop transfer function approach from below the point where $|S(j\omega_n| = 1$ and assume that it also holds then $|T(j\omega_n| = 1$. Assuming that there are no right hald poles of the open loop transfer function, what is the phase margin of the closed-loop system? Hint. In the complex plane (xy) let $L(j\omega) = x(\omega) + jy(\omega)$.

Problem 2. You are given the nominal plant

$$G(s) = \frac{10}{s^2 + 4}$$

with an input feedback uncertainty $\|\Delta_{fi}(s)\|_\infty \le 0.5$, and the controller $F_y(s) = \frac{4(s+2)}{s+8}$ (see Fig.) What can be said about robust stability of the closed-loop system?