**Academic Year 2025-2026**

**Exam 1 – Part II - Maximum duration: 3 hours**

**Problem 1 [1 point]** [Estimated maximum completion time: 30 minutes]

Write down everything you know about Nyquist's stability criterion. Apply it to the closed-loop stability analysis of the system given by the following open-loop transfer function:

**Problem 2 [2 points]** [Estimated maximum completion time: 60 minutes]

Consider a system represented by the transfer function:

1. Design a control scheme that allows a step disturbance at the plant input to be rejected without steady-state error and with dynamics dictated by real poles that are as fast as possible (it is important to first reason what the position of these poles should be) and that manages to follow a step reference without steady-state error with dynamics dictated by the same dominant poles as in the case of disturbance rejection. **[0.75 points]**
2. Design a phase-lead network that guarantees a phase margin of 70 degrees and a steady-state error in the step reference of 1%. This exercise can be done analytically or by using the semi-logarithmic paper on the following page. Indicate the gain crossover frequency and the approximate rise time that will be obtained in closed loop. Draw the root locus of the system compensated with the lead network and indicate whether the closed-loop system can have two dominant complex conjugate poles that justify the use of the relationship between the gain crossover frequency and the rise time. **[0.75 points]**
3. Solve the previous section using a phase lag network and justifying all sections. **[0.5 points]**

**Problem 3 [2 points]** [Estimated maximum completion time: 30 minutes]

Consider the system defined by the following block diagram, which defines the corresponding states that will be used to solve the exercise:

Imagen que contiene reloj, objeto

El contenido generado por IA puede ser incorrecto.

1. Obtain the internal description corresponding to the states defined in the previous block diagram. Is the description obtained in canonical control form? And in canonical observation form? **[0.5 points]**
2. Determine whether the system is controllable and calculate a linear state vector feedback control scheme that allows regulation to a constant reference with dynamics twice as fast as those dictated by the open-loop poles. Indicate what the closed-loop transfer function will be. **[0.75 points]**
3. Design a state estimator (observer) and draw the complete block diagram that includes the state estimator and the linear state feedback controller, taking into account that the output y is measurable. **[0.75 points]**

Imagen que contiene biombo, edificio, jaula

Descripción generada automáticamente