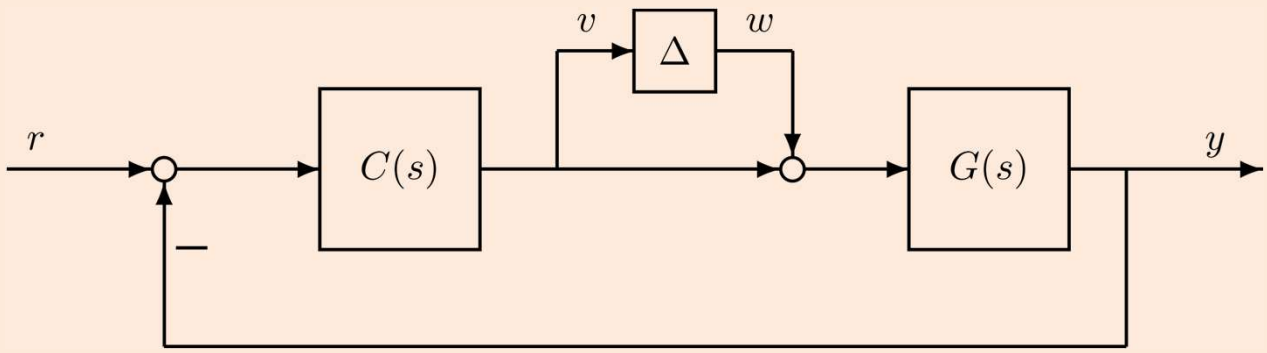
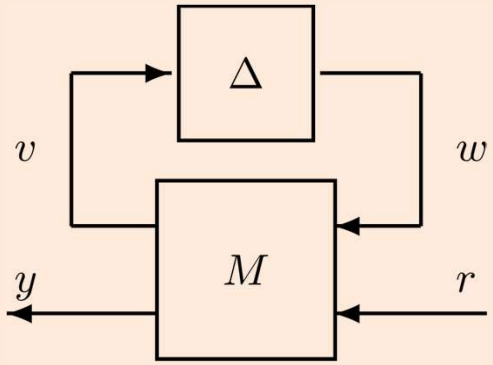
Self-Study Problems

1) Express the SISO feedback diagram below as an LFT $F_U(M, \Delta)$.





2) Consider the following state-space system:

$$\dot{x}(t) = A\,x(t) + B\,u(t)$$
$$y(t) = C\,x(t) + D\,u(t)$$

Show that the transfer function $G(s) = C(sI - A)^{-1}B + D$ can be expressed as an LFT $F_U(M, \frac{1}{s}I)$ where:

$$\mathrm{M} = \begin{bmatrix} A & B \\ C & D \end{bmatrix}$$

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3) A stable, SISO, LTI system Δ satisfies the IQC defined by $J = \mathrm{diag}(1,-1)$, and $\Psi = \mathrm{diag}(W,1)$ where $W(s) = \frac{2s+0.1}{s+1}$. What is the uncertainty bound at $\omega = 0$? What is the uncertainty bound as $\omega \to \infty$?

4) True or False? A SISO system Δ satisfies the IQC defined by $J = \mathrm{diag}(1,-1)$, and $\Psi = \mathrm{I}$. The system $-\Delta$ satisfies the IQC defined by $J = \mathrm{diag}(-1,1)$, and $\Psi = \mathrm{I}$.

5) True or False? A system Δ satisfies the IQCs defined by (J_1, Ψ_1) and (J_2, Ψ_2). For any non-negative λ_1, λ_2, Δ satisfies the IQC with:

$$J = \begin{bmatrix} \lambda_1 J_1 & 0 \\ 0 & \lambda_2 J_2 \end{bmatrix} \text{ and } \Psi = \begin{bmatrix} \Psi_1 \\ \Psi_2 \end{bmatrix}$$