## Discussion 10: Closed-Loop Systems and Marginal Stability

## **1. System Function Practice**

a) Consider the block diagram below, which represents a general feedback system. What is the system function, H(s) = Y(s)/X(s)?



b) Consider the block diagram below. What is the system function, H(s) = Y(s)/X(s)?



c) Consider the block diagram from part b). Imagine there is some noise or disturbance, d(t), at one of the nodes. This is usually modeled as disturbance signal added to the node. Select any node on which to add noise, and find the transfer function,  $H_d(s) = Y(s)/D(s)$ .

## 2. Bode Diagrams and Marginal Stability

A few Bode diagram rules:



- a) Sketch (log-log)  $H(j\omega)$ , if  $H(s) = \frac{200\pi}{s+20\pi}$ . What kind of filter is this function?
- b) If H(s) represents the <u>open-loop gain</u> of a system, write down the <u>closed-loop system function</u> for a system with feedback, as shown below.
- c) Find the gain margin and phase margin for the closed-loop system.