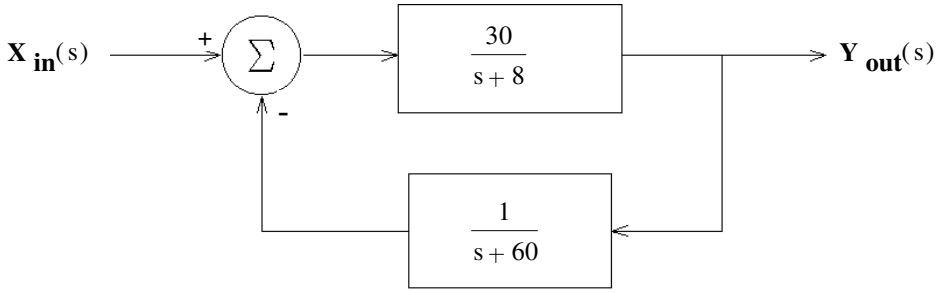
ECE 3510 homework # 4

b

Properly simplify all your expressions for $\mathbf{H}(s)$. By this I mean that he numerator and denominator should both be simple polynomials or factored polynomials. There should be no $1/s^n$ terms in either the numerator or denominator. Also, there should be no coefficient on the highest-order term in the denominator

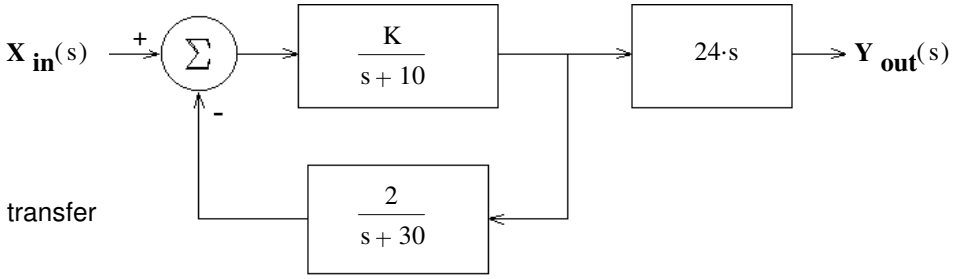
1. For the feedback system shown below, find the transfer function of the whole system, with feedback.

$$\mathbf{H}(s) = \frac{\mathbf{Y}_{\mathbf{out}}(s)}{\mathbf{X}_{\mathbf{in}}(s)}$$



2. a) For the feedback system shown below, find the transfer function of the whole system, with feedback.

$$\mathbf{H}(s) = \frac{\mathbf{Y}_{\mathbf{out}}(s)}{\mathbf{X}_{\mathbf{in}}(s)} = ?$$



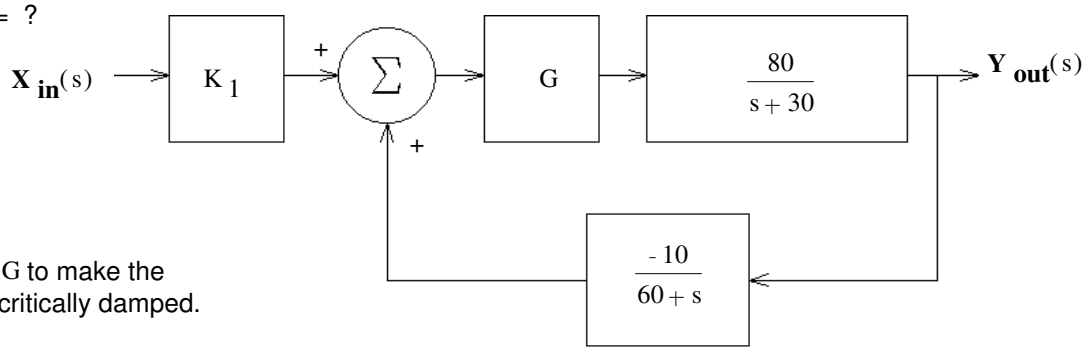
b) Find the value of K to make the transfer function critically damped.

c) If K is **more** than this value, will the system be underdamped or overdamped?

d) List any zeroes of the transfer function.

3. a) For the feedback system shown below, find the transfer function of the whole system, with feedback.

$$\mathbf{H}(s) = \frac{\mathbf{Y}_{\mathbf{out}}(s)}{\mathbf{X}_{\mathbf{in}}(s)} = ?$$



b) Find the value of G to make the transfer function critically damped.

c) If G is **less** than this value, will the system be underdamped or overdamped?

d) List any zeroes of the transfer function.

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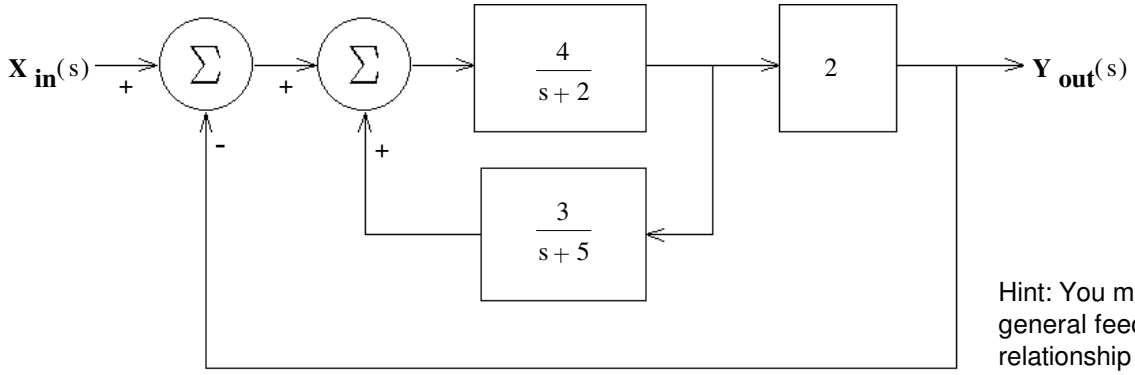
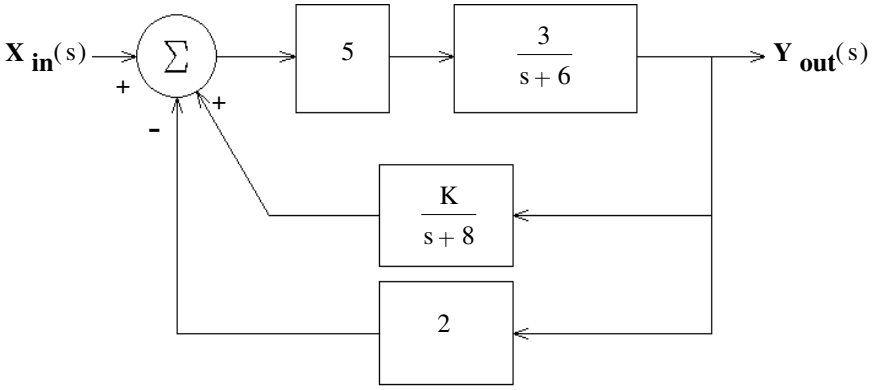
4. For the feedback system shown below, find the transfer function of the whole system, with feedback.

Find $\mathbf{H}(s) = \dfrac{\mathbf{Y_{out}}(s)}{\mathbf{X_{in}}(s)}$



Hint: You may use the general feedback relationship twice, it's just a loop inside a loop.

5. Redraw the feedback system below so that it is just one simple loop.



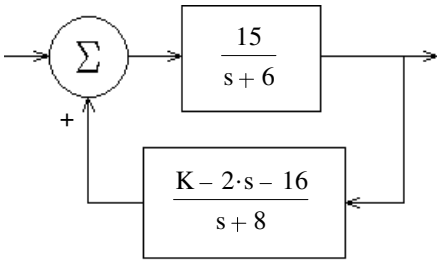
Answers

1. a) $\dfrac{30 \cdot s + 1800}{s^2 + 68 \cdot s + 510}$ 2. a) $\dfrac{K \cdot 24 \cdot s \cdot (s + 30)}{s^2 + 40 \cdot s + 300 + 2 \cdot K}$ b) 50 c) underdamped d) $0, -30$

3. a) $K_1 \cdot \dfrac{G \cdot 80 \cdot s + G \cdot 4800}{s^2 + 90 \cdot s + 800 \cdot G + 1800}$ b) 0.28125 c) overdamped d) -60

4. $\dfrac{8 \cdot s + 40}{s^2 + 15 \cdot s + 38}$

5.



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