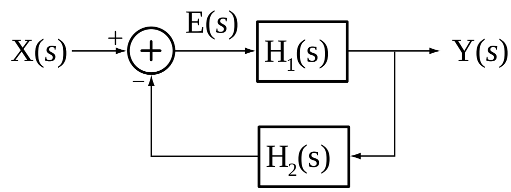
Solution of ECE 316 Test 6 S06

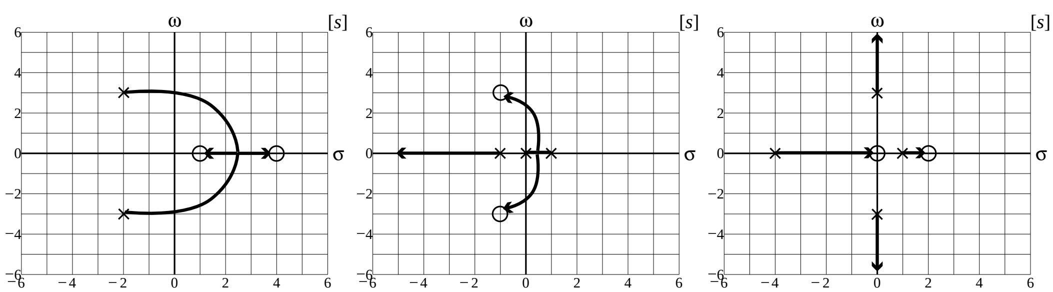
1. In the feedback system below $H_1(s) = \frac{s-3}{s-2}$ and $H_2(s) = K$. What range of real values of K makes this system stable?



$$H(s) = \frac{\frac{s-3}{s-2}}{1+K\frac{s-3}{s-2}} = \frac{s-3}{s-2+K(s-3)} = \frac{s-3}{s(K+1)-2-3K}$$

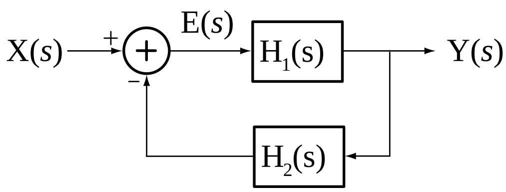
Poles at $s = \frac{2+3K}{K+1}$. For stability the real part of s must be negative. So we want $\frac{2+3K}{K+1} < 0$. For $K > -1$, that implies that $2+3K < 0$ and that $K < -2/3$. For $K < -1$, that implies that $2+3K > 0$ and that $K > -2/3$. But $K < -1$ and $K > -2/3$ are mutually exclusive. So the only range that works is $-1 < K < -2/3$.

2. Sketch a root locus for each set of zeros and poles of the loop transfer function of a feedback system below.



Solution of ECE 316 Test 6 S06

1. In the feedback system below $\mathrm{H}_1(s) = \dfrac{s-5}{s-3}$ and $\mathrm{H}_2(s) = K$. What range of real values of K makes this system stable?



$$\mathrm{H}(s) = \frac{\dfrac{s-5}{s-3}}{1 + K\dfrac{s-5}{s-3}} = \frac{s-5}{s-3+K(s-5)} = \frac{s-5}{s(K+1)-3-5K}$$

Poles at $s = \dfrac{3+5K}{K+1}$. For stability the real part of s must be negative. So we want $\dfrac{3+5K}{K+1} < 0$. For $K > -1$, that implies that $3+5K < 0$ and that $K < -3/5$. For $K < -1$, that implies that $3+5K > 0$ and that $K > -3/5$. But $K < -1$ and $K > -3/5$ are mutually exclusive. So the only range that works is $-1 < K < -3/5$.

2. Sketch a root locus for each set of zeros and poles of the loop transfer function of a feedback system below.