1. Find the breakaway points for k>0 and k<0 and obtain the break in points of them.

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

....

2. Plot the root locus diagram for positive values of K for the solutions of the equation

$$s^4+3s^3+12s^2+(k-16)s+k=0$$

Find the imaginary roots of equation

....

3. Qualitative analysis of the root locus, Plot the

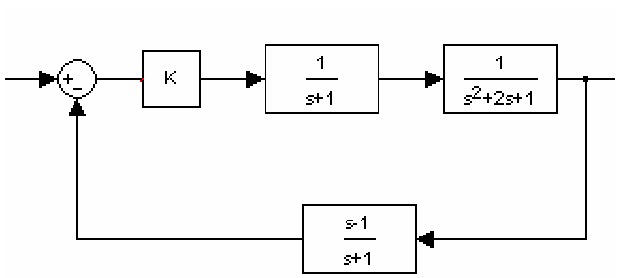
a. root locus diagram for $G(s)=\dfrac{K}{s(s+1)}, H(s)=1$

b. root locus with additional zero: $G(s)=\dfrac{K(s+1.5)}{s(s+1)}, H(s)=1$

c. root locus with additional pole: $G(s)=\dfrac{K}{s(s+1)(s+2)}, H(s)=1$

....

4. A feedback control system is shown bellow. Draw the root locus for the system and determine the smallest value of gain K for which a closed-loop pole has a positive real part.



....

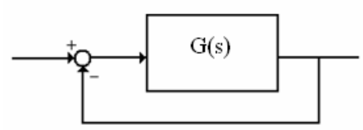
5. Design of PD controller for $G(s)=\dfrac{1}{s(s+2)}$ *to have :*

steady state error for ramp input =0.125

percent overshoot =16.3

....

6. For a system that shown in Figure, $G(s)=\dfrac{K}{s(s+2)^2}$ *design lead controller with a zero in -1, to set rise time of system less than 1 second and percent overshoot less* *than 20%. So we want to place dominant poles of system in* $-1 \pm j\sqrt{3}$ *and then its* $\xi = 0.5$ *and* $\omega_n = 2$

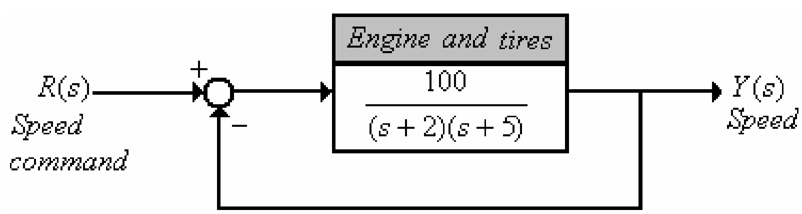


....

7. The engine, body, and tires of a racing vehicle affect the acceleration and speed attainable. The speed control of the car is represented by the model shown in Figure.

(a) Calculate the steady-state error of the car to a step command in speed.

(b) Calculate overshoot of the speed to a step command.



....

8. A unity negative feedback control system has the unstable plant $G(s) = \dfrac{1}{(s^2 - 1)(s+5)}$. *With a PD controller stable the system and set* $\xi = 0.5$ *and* $\omega_n = 2$ *for its dominant poles.*