EE 2227 - Control Systems

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Assignment - II

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1. Given the unity feedback system of Figure 1, use frequency response methods to determine the value of gain, K, to yield a step response with a 20% overshoot if

   (a) $G(s) = \frac{K}{s(s+6)(s+12)}$

   (b) $G(s) = \frac{K(s+4)}{s(s+8)(s+10)(s+12)}$

   (c) $G(s) = \frac{K(s+2)(s+7)}{s(s+4)(s+8)(s+10)(s+15)}$

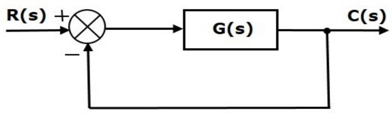

Figure 1

2. The unity feedback system shown in Figure 1 with

$$G(s) = \frac{K}{s(s+5)(s+8)}$$

   is operating with 20% overshoot. Using frequency response methods, design a compensator to yield a five-fold improvement in steady-state error without appreciably changing the transient response

3. Design a lag compensator so that the system of Figure 1 where

$$G(s) = \frac{K(s+4)}{(s+2)(s+6)(s+8)}$$

   operates with a $45°$ phase margin and a static error constant of 100

4. Self-guided vehicles, such as that shown in Figure 2(a), are used in factories to transport products from station to station. One method of construction is to embed a wire in the floor to provide guidance. Another method is to use an onboard computer and a laser scanning device. Bar-coded reflective devices at known locations allow the system to determine the vehicle's angular position. This system allows the vehicle to travel anywhere, including between buildings. Figure 2(b) shows a simplified block diagram of the vehicle's bearing control system. For 11% overshoot, K is set equal to 2. Design a lag compensator using frequency response techniques to improve the steady-state error by a factor of 30 over that of the uncompensated system.

Figure 2 (a)

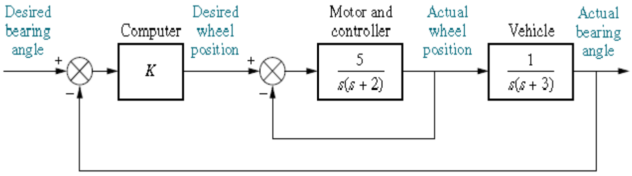

Figure 2 (b)

5. An aircraft roll control system is shown in Figure 3. The torque on the aileron generates a roll rate. The resulting roll angle is then controlled through a feedback system as shown. Design a lead compensator for a $60°$ phase margin and $K_v = 5$.

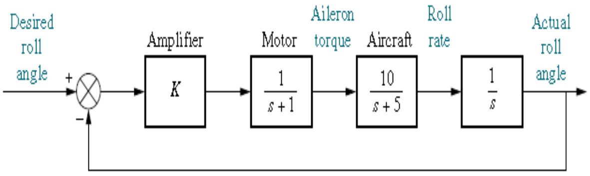

Figure 3