HW/ Due 18-5-2024

7.1. Given the characteristic equation $\lambda^3 + 3\lambda^2 + 3\lambda + 1 + k = 0$

find the range of values of k for which the system is stable.

7.2. Given the fourth-order characteristic equation $\lambda^4 + 6\lambda^3 + 11\lambda^2 + 6\lambda + k = 0$

for what values of k will the system be stable?

7.8. The single degree of freedom pitching motion of an airplane was shown to be represented by a second-order differential equation. If the equation is given as

$$\ddot{\theta} + 0.5\dot{\theta} + 2\theta = \delta_e$$

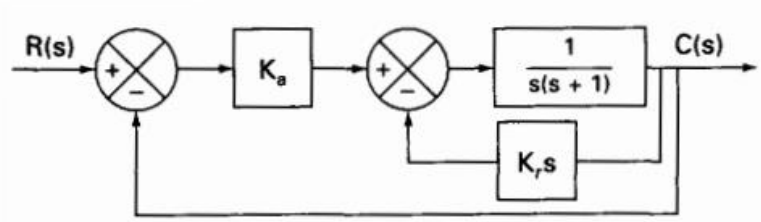
where the θ and δ_e are in radians, estimate the rise time, peak overshoot, and settling time for step input of the elevator angle of 0.10 rad.

7.11. Calculate the position, velocity, and acceleration error constants K_p, K_v, and K_a for the loop transfer function $G(s)H(s)$ that follows:

$$(a)\quad \frac{10}{s(s+1)(s+10)}$$

7.15. In the control system shown in Figure P7.15 rate feedback is to be used to increase the system damping. Estimate the gains k_a and k_r so that the system meets the following performance specifications:

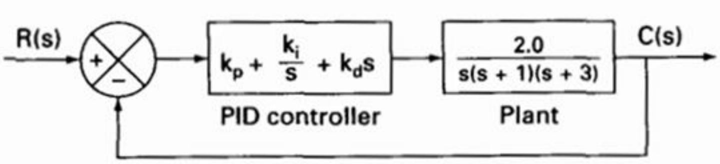
Damping ratio, $\zeta = 0.7$
Settling time, ≤ 3.0 s



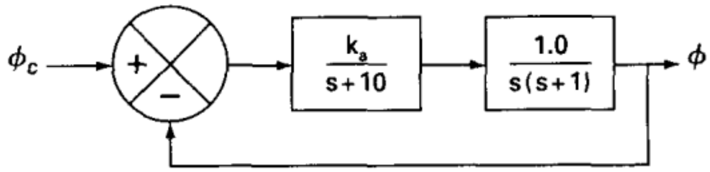
7.16(C). Given the control system shown in Figure P7.16 where the plant transfer function $G(s)$ is given by

$$G(s) = \frac{2.0}{s(s+1)(s+3)}$$

design a PID controller for this system.



8.1. A roll control system is shown in Figure P8.1. Sketch the root locus diagram for this system. (a) Determine the value of the gain, **(ka)** so that control system has a damping ratio of **ζ= 0.707**. (b) What is the steady-state error for a step and ramp input?



8.4. A simplified pitch control system is shown in Figure P8.4. Design a PID controller for this system and plot the response of the system to a 5' step change in the commanded pitch attitude.

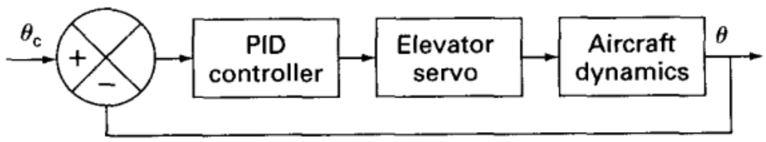


FIGURE P8.4

PID $k_p + \frac{k_i}{s} + k_d s$

Aircraft dynamic $\frac{-3}{s^2 + 3s + 4.0}$

Elevator servo $-\frac{10}{s + 10}$