Mech-465 Automatic Control

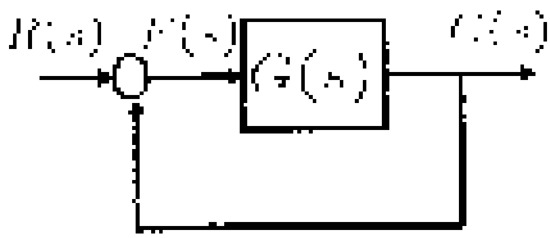
Lecture 5 Assignment

1. Sketch the unit step response of the following systems.

   (a) $\frac{3}{s+2.5}$

   (b) $\frac{1}{s^2+s+1}$

2. Consider the feedback system in the figure below:



   For a given first order plant, $G(s) = \frac{K}{Ts+1}$, what are the time-constant and DC gain of the closed-loop transfer function from $R(s)$ to $C(s)$?

3. Consider the system

$$G(s) = \frac{600}{(s+20)(s^2+8s+20)}$$

   (a) If the step input $5u(t)$ is applied to $G(s)$, what is the steady state output value?

   (b) Approximately how many seconds are required for the system to reach steady-state (2% settling time)?

   (c) Do you expect the transient response to be oscillatory? Justify your answer.

4. Consider a unity feedback system with a forward transfer function

$$\frac{K}{s(s+5)}$$

(a) Find the range of K for which the system is underdamped, critically damped and overdamped.

(b) Find the value of K that will result in the system having minimum settling time.

5. Consider a system

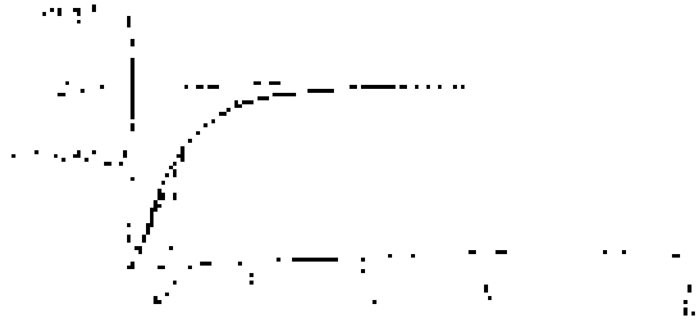
$$\frac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$$

Find the region of allowable s-plane pole locations such that the system 2% settling time is less than 2 seconds and an overshoot for a step response less than 16 percent.

1 (a) [illegible]

DC gain = [illegible] = 0.8

Time Constant = [illegible]



(b) [illegible]

DC gain = [illegible]

Undamped Natural frequency [illegible]

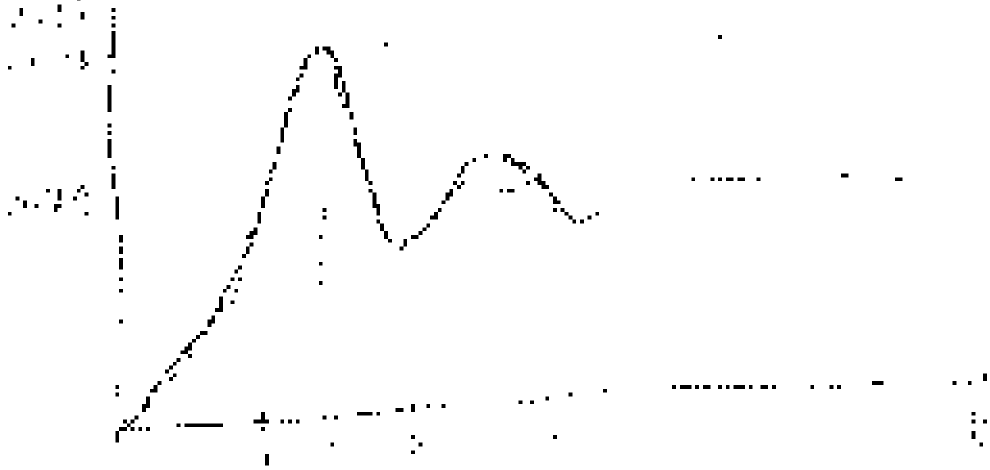
Damping ratio [illegible]

Time Constant = [illegible]

Damped natural frequency [illegible]

[illegible]

[illegible]



[illegible]

[illegible]

[illegible]

$G(s) = $ [illegible]

[illegible]

[illegible]

[illegible]

$G(s) = $ [illegible]

(a) [illegible]

[illegible]

[illegible] 7.5

(b) [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

(c) [illegible]

[illegible]

[illegible]

4 (a) [illegible] transfer function $T(s) =$ [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

(b) [illegible]

[illegible]

[illegible]

[illegible]

$\Longrightarrow$ [illegible] the system [illegible]

[illegible]