Portland State University

Electrical & Computer Engineering
ECE 311 Feedback & Control

-Homework #2-

Text Problems: **B-5-2, B-5-3, B-5-8, B-5-10**

Problem 1:

A unity negative feedback control system has the loop transfer function

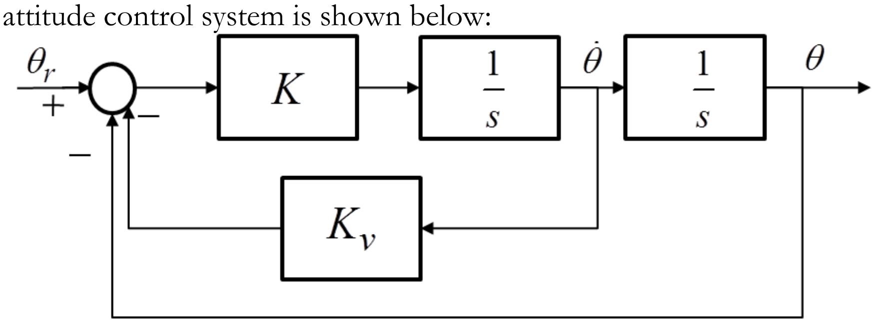
$$L(s) = G_c(s)G(s) = \frac{K}{s\left(s + \sqrt{2K}\right)}.$$

(a) Determine the percent overshoot and settling time (using a 2% settling criterion) due to a unit step input.

(b) For what range of K is the settling time less than 1 second?

Problem 2:

A satellite attitude control system is shown below:



(a) Write the system closed-loop transfer function

(b) The closed-loop system is to respond to a step input in minimum time with no overshoot, which requires $\xi = 1$. Find K_v as a function of K such that this specification is satisfied.

(c) The system from (b) is to reach steady state approximately 6 seconds (let $\tau = 1.5\,\text{sec}$) after a command to change the attitude angle. Find the value of K that satisfies this specification.

(d) Verify the results of (b) and (c) via MATLAB simulation.

(e) The rate signal is measured using a rate gyro. Suppose this rate gyro fails, such that no signal appears in the rate path (effectively $K_v = 0$). What is the nature of the system response in this scenario? (This failure occurred on a space lab mission of NASA).

(f) Simulate the system with $K_v = 0$ to verify your results in (e).

Fundamentals of Engineering Exam Problem 1 and 2:

The following problems refer to the function G(s).

$$G(s) = \frac{3s+9}{(s+2)(s+5)}$$

The partial fraction expansion of G(s) is most nearly:

(A) $\frac{5}{s+2} + \frac{2}{s+5}$

(B) $\frac{-1}{s+2} - \frac{2}{s+5}$

(C) $\frac{2}{s+2} + \frac{1}{s+5}$

(D) $\frac{1}{s+2} + \frac{2}{s+5}$

The inverse Laplace transform of G(s) is most nearly:

(A) $5e^{-2t}+2e^{-5t}$
(B) $-e^{-2t}-2e^{-5t}$
(C) $2e^{-2t}+1e^{-5t}$
(D) $e^{-2t}+2e^{-5t}$