Portland State University

Electrical & Computer Engineering

ECE 311 Feedback & Control

-Homework #5-

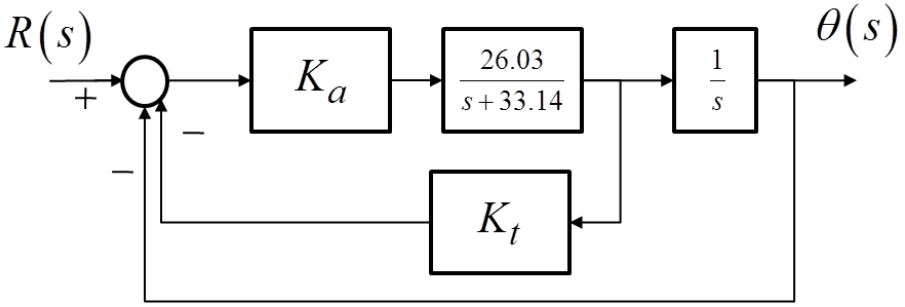
Text Problems: **B-6-7, B-6-11, B-6-16**

Problem 1:
Given open-loop transfer function:

$$G(s)H(s)=\frac{K(s+10)}{s(s+3)(s^2+4s+8)}$$

(a) Determine the value of gain *K* when the system oscillates
(b) Calculate the roots of the closed-loop system for the *K* determined in (a)
(c) Generate the root locus in MATLAB and verify the roots of the closed-loop system for the *K* determined in (a)

Problem 2:
Consider the motor control problem shown below. This problem is similar to HW#4, but now tachometer feedback has been included.



In order to meet a specification of 5% overshoot, the amplifier gain can be found to be $K_a = 22$ (feel free to verify for yourself). Assume that in addition to the overshoot specification, we also now need to meet a 2% settling time of $T_s \le 300\,ms$. Using the amplifier gain given above, find the range of the tachometer gain K_t to meet the specifications. Use the parameter root locus method.

Problem 3:
Sketch (by hand) the root locus having the open-loop transfer functions given below. In addition to the sketch, specifically solve for (if applicable) asymptote centers, breakaway points, and values of *s* at any crossings of the imaginary axis.

(a) $\dfrac{K(s+1)}{s^2}$

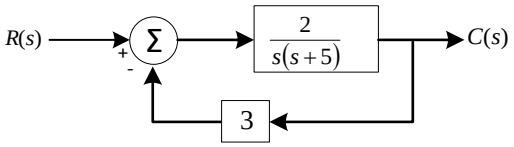
(b) $\dfrac{K}{s(s+2)^2}$

(c) $\dfrac{K}{s\left[(s+10)^2+1\right]}$

(d) Verify each root locus in (a) - (c) with MATLAB

Fundamentals of Engineering Exam Problem 1:

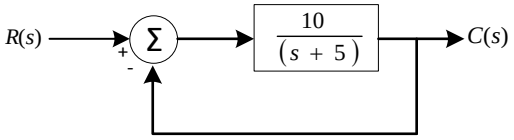
Consider the system shown below. The roots of the characteristic equation for the system are most nearly:



(A) 0, -5
(B) -2, -3, -5
(C) -5
(D) -2, -3

Fundamentals of Engineering Exam Problem 2:

The steady-state gain for the system shown below is most nearly:



(A) 1/5
(B) 1/2
(C) 2/3
(D) 2