Portland State University
Electrical & Computer Engineering
ECE 311 Feedback & Control

-Homework #7-

Text Problems: **B-8-6**

Problem 1:
A linearized model of the relationship between a wind turbine's blade pitch and speed is given by the following plant transfer function:

$$G(s) = \frac{7200}{5s+1}$$

Using the Matlab SISO tool, design a PI controller, D(s), to control the speed of the turbine blades.

$$D(s) = K_P + \frac{K_I}{s} = K_P\left(\frac{s+\tau_C}{s}\right)$$

where $\tau_C = K_I/K_P$.

Design Specifications:

- Zero steady-state error to a step input
- $M_p < 25\%$ to a step input
- $t_s < 4$ seconds to a step input ($\pm 2\%$ criterion)
- $t_r < 1$ second to a step input (0.1 to 0.9 criterion)
- $t_p < 3$ seconds to a step input

Deliverables:

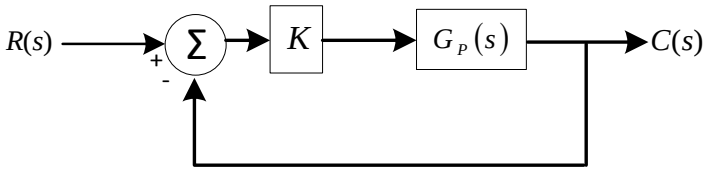
(a) State the values of K_P, τ_c. NOTE: Every student should have unique answers. There are many thousands of possible solutions

(b) On an *s*-plane, plot overlay of the root loci and zone of allowable poles along with your designed closed-loop poles (this is shown in the SISO tool)

(c) Show the step response

(d) Note compliance with specs.

Problem 2:
For a system with plant $G_p(s)$ and K = 1.64, determine the gain crossover frequency, phase margin, plant Type i and the appropriate error coefficient, K_i.



$$G_P(s) = \frac{s+8}{(s+1)(s+2)(s+6)}$$

Fundamentals of Engineering Exam Problem 1 (Afternoon – 4 minutes) (Angus, et al):

A control system has a phase angle of -150º at the frequency where its open-loop gain is 0 dB. The phase margin is most nearly:

(A) 180º
(B) 30º
(C) 20º
(D) 10º

Fundamentals of Engineering Exam Problem 2 (Afternoon – 4 minutes) (Angus, et al):

A control system has a phase angle of -180º when its open-loop gain is -20 dB. The gain margin is most nearly:

(A) 40 dB
(B) 30 dB
(C) 20 dB
(D) 10 dB