EE426 Exam II

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Contents

Assignment

EE 426/526-AW
Examination II
Fall 2020

Student Name: ____________________

Due back by: 11:59 p.m. on Friday, December 4th, 2020

BlazerID: ____________________

Instructions: This is a Take-home examination. Open books, open notes, and open reference. You may also use MATLAB and/or software that came with the textbook, where it makes sense to do so. **Please note the final due date and time.** The completed work will be submitted to CANVAS, on or before the date and time specified above.

NO LATE WORK WILL BE ACCEPTED.

Your exam must be done as an individual effort. Your submitted work will be carefully examined for suspicious-looking similarities. Do your own work.

If you need clarifications on the questions you may contact me by e-mail at dnelson@uab.edu

Show how you obtained your design and attach any relevant computer-based, or descriptions of work carried out, that support your answers. If you attach additional paper, make sure all your work is scanned in the correct order. Make sure to include these examination question sheets in your submitted work, as the cover pages, and write your name and BlazerID in the spaces provided above.

There are 3 questions on this examination. The points for each question are shown, for a total possible score of 100 points.

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Questions:

1. The system shown below, has a feedforward transfer function

$$G(s) = \frac{1.06}{s(s+1)(s+2)}$$

And the closed-loop transfer function is found to be

$$\frac{C(s)}{R(s)} = \frac{1.06}{s(s+1)(s+2)+1.06}$$

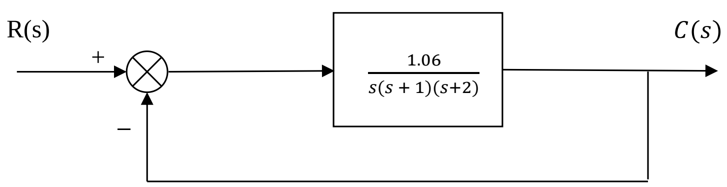
$$= \frac{1.06}{(s+0.3307-j0.5864)(s+0.3307+j0.5864)(s+2.3386)}$$

The dominant closed-loop poles are

$$s = -0.3307 \ \pm j0.5864,$$

the damping ratio of the dominant closed-loop poles is $\zeta = 0.5$, the undamped natural frequency of the dominant closed-loop poles is 0.67 rad/sec, and the static velocity error constant, K_v is 0.53.

For the system previously described, it is desired to improve the system such that there is an increase in the static velocity error constant K_v to about 5, without significantly changing the location of the dominant closed-loop poles, by inserting a cascaded lag compensator.



Using a root-locus approach for your design procedure, compare the specifications of the uncompensated (primarily to confirm the initial tests results that were given) and the compensated systems (use a tabular presentation such as that in shown Tables 9.2 and 9.3; include all the items (the rows, as much as is feasible) in these tables). Choose at least two separate compensator designs for comparison, and **choose the one that best satisfies the design specifications.**

Estimate the validity of a second-order approximation for each column of your table.
[40 points]

2. As part of your design procedure, attach computer plots of the time response of the control system that clearly shows the transient and settling time (use enough of a time scale to show this properly), for a unit step and a unit ramp inputs to the uncompensated system and the compensated systems. All the plots must be on the same graph so that they can be easily compared. Show appropriate (computer-generated) labeling of the respective axes.

   Show also, the root locus plot and Bode plots, before and after compensation. [40 points]

3. Document your work as a design project. List the constraints to which your solution must comply. List the goals that apply to judge how good your solution is (as well as to decide between alternatives). Show your calculations in a way that is legible and that can be easily traced. If you use computer generated calculations, you must at least say what formula will be used, and then provide your answer. Traceable results will be important here. At the end, show your completed system design in block diagram form, with the appropriate components and signals, with their labels. [20 points]

Note 1: BE SURE TO PUT YOUR NAME AND BLAZER ID in the header of any code you generate, and a formatted printout should be included as part of your submitted work.

Note 2: You may use the interactive development SISO Design Tool in MATLAB called SISOTOOL. See the textbook for some basic details, Help in MATLAB, and various online tutorials.

Note 3: Be sure to add comments for any assumptions that you make, and things such as data items to be evaluated. The appropriateness of the assumptions will be evaluated as well as your results.

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