Unit 10 - Week 6: 2-Degree of freedom control design for robustness

Week-6 Assessment

The due date for submitting this assignment has passed. **Due on 2018-09-12, 23:59 IST.**
As per our records you have not submitted this assignment.

Week-6 Assessment

1) Consider a plant whose transfer function is given by *1 point*

$P(s) = \frac{129K_p}{s(s/p+1)(s/264+1)}$. Although the nominal gain of the plant K_p is 10.75, it could drift to any value between 4.3 and 43. The nominal value of p is 43. We wish to employ a 2 DOF control system such that, for the nominal plant, the dominant closed-loop poles lie at $s = -86 \pm j215$. We also desire that when the gain of the plant varies between the aforesaid values, the closed-loop poles vary at most by 4.3. Find out the location of the controller zeros that will have to be added in order to achieve the desired objective if the transfer function of the designed controller C(s) and pre–filter F(s) are of the following form

$C(s) = \frac{K_c(s+z_c)(s+\bar{z}_c)}{(s+p_c)^2}$, $F(s) = \frac{z_c\bar{z}_c}{(s+z_c)(s+\bar{z}_c)}$, where p_c is a far-off pole located l distant away from the origin.

- $z_c = 87.9 \pm j215.2$
- $z_c = 91 \pm j205.2$
- $z_c = 101.1 \pm j305.2$
- $z_c = 87.9 \pm j150$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$z_c = 87.9 \pm j215.2$

2) For Q1, calculate the distance (l) of the two far-off poles from the origin if it is desired that all the closed loop poles have to be stable. *1 point*

- $l = 49000$
- $l = 1000$
- $l = 2000$
- $l = 4900$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$l = 49000$

3) For Q1, identify the correct pre-filter's transfer function **1 point**

- $F(s) = \frac{54040}{s^2+175.8s+54040}$
- $F(s) = \frac{50388}{s^2+182s+50388}$
- $F(s) = \frac{10335}{s^2+202s+10335}$
- $F(s) = \frac{30226}{s^2+175.7s+30226}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$F(s) = \frac{54040}{s^2+175.8s+54040}$

4) For Q1 what was the reason to add two poles in the controller transfer function far away from the origin? **1 point**

- To make the controller transfer function causal
- In order to make sure that the root locus passes through the desired location
- To make sure that the root locus branch emanating from them do not affect the desired closed loop performance.
- To ensure robust performance

No, the answer is incorrect.
Score: 0

Accepted Answers:
To make the controller transfer function causal

5) Consider the plant given in Q1. Assume that the gain of the plant is fixed at 10.75. Although the nominal position of the dominant open loop pole is p = 43 it varies between 4.3 to 107.5. A unity feedback control system with a controller C(s) along with a pre-filter F(s) is designed to achieve the following specifications: **1 point**

(i) The dominant poles of the closed loop system should be situated at $-86 \pm j215$
(ii) The variation in the dominant closed loop pole due to variations of the plant pole should be less than 4.3.
(iii) All closed loop poles have to be stable.

The transfer function of the designed controller and pre-filter are $C(s) = \frac{K_c(s+z_c)(s+\bar{z}_c)}{(s+p_c)^2}$ and $F(s) = \frac{z_c\bar{z}_c}{(s+z_c)(s+\bar{z}_c)}$. Identify the value of z_c among the following:

- $z_c = 95.1 \pm j216.03$
- $z_c = 85 \pm j104.23$
- $z_c = 15.2 \pm j25.87$
- $z_c = 65.2 \pm j102.8$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$z_c = 95.1 \pm j216.03$

6) Identify the values of p_c & K_c for the controller C(s) designed in Q5. *1 point*

- $p_c = 1100$ & $K_c = 1045.52$
- $p_c = 1200$ & $K_c = 1045.56$
- $p_c = 2600$ & $K_c = 387.25$
- $p_c = 1600$ & $K_c = 8035.61$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$p_c = 2600$ & $K_c = 387.25$

7) For the plant given in Q1, although the nominal value of the plant gain K_p is 10.75 it varies between 4.3 to 43. Similarly, the dominant pole whose nominal location i = 43 varies between 4.3 to 107.5. A unity feedback control system with a controller C(s) along with a pre-filter F(s) is designed to achieve the following specifications: *1 po*

(i) The dominant poles of the closed loop system should be situated at $-86 \pm j215$
(ii) The variation in the dominant closed loop pole due to variations of the plant gain and pole should be less than 4.3.
(iii) All closed loop poles are stable.

The transfer function of the designed controller and pre-filter are $C(s) = \frac{K_c(s+z_c)(s+\bar{z}_c)}{s(s+p_c)^2}$ and $F(s) = \frac{z_c\bar{z}_c}{(s+z_c)(s+\bar{z}_c)}$. Identify the value of z_c among the following:

- $z_c = 97.8 \pm j316.02$
- $z_c = 87.8 \pm j215.2$
- $z_c = 19.2 \pm j359.87$
- $z_c = 95.2 \pm j480.9$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$z_c = 87.8 \pm j215.2$

8) Identify the value of p_c for the controller C(s) designed in Q7. *1 point*

- $p_c = 3600$
- $p_c = 10000$
- $p_c = 53000$
- $p_c = 8000$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$p_c = 53000$

9) Identify the value of K_c for the controller C(s) designed in Q7. *1 point*

- $K_c = 3.3X10^6$
- $K_c = 5.6X10^4$
- $K_c = 4.231X10^4$
- $K_c = 9.521X10^3$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$K_c = 3.3X10^6$

10)What will be the shape of the region within which the closed-loop pole would wander when both the gain and pole of a plant varies? *1 po*

- Triangular
- Circle
- A trapezoid
- It would wander along a straight line

No, the answer is incorrect.
Score: 0

Accepted Answers:
A trapezoid

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