EE5351: CONTROL SYSTEMS DESIGN

COMPUTER ASSIGNMENT 01

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Q1) Using MATLAB, find the values of zeros and poles of the system given in following transfer functions. Also, show the locations of zeros and poles in s-plane.

I. $G(s) = \frac{3(s+7)}{s^2+2s+2}$

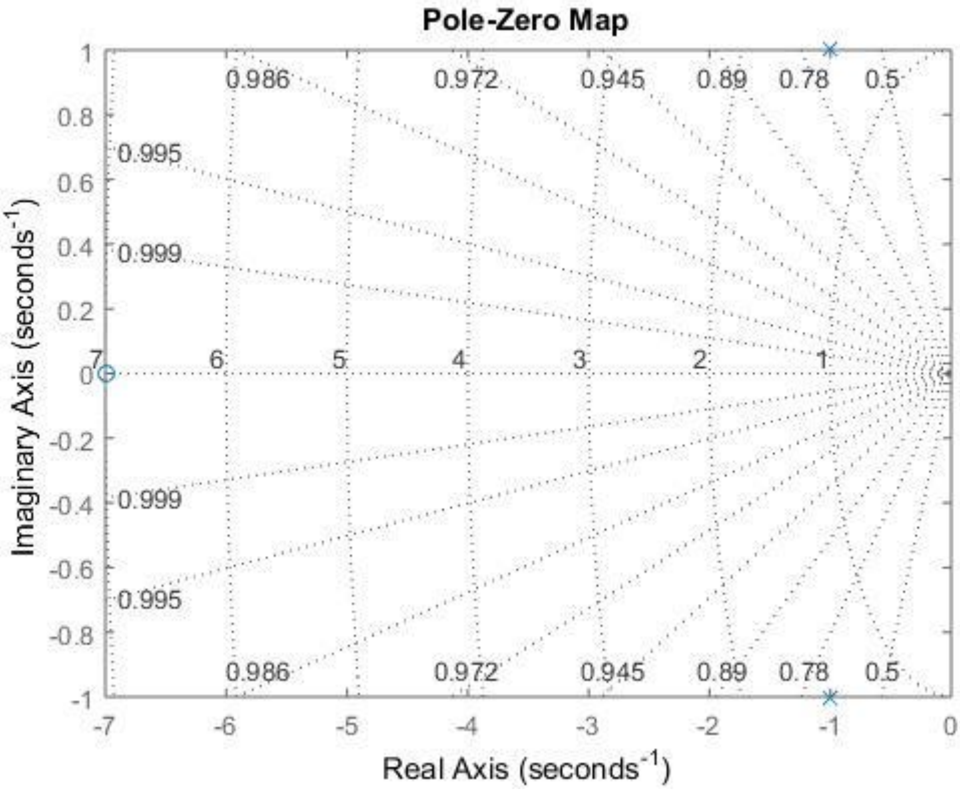


FIGURE 1: POLE- ZERO MAP OF THE G(S)

II. $G(s) = \frac{5(s+2)}{(s+1)(s^2+s-6)}$

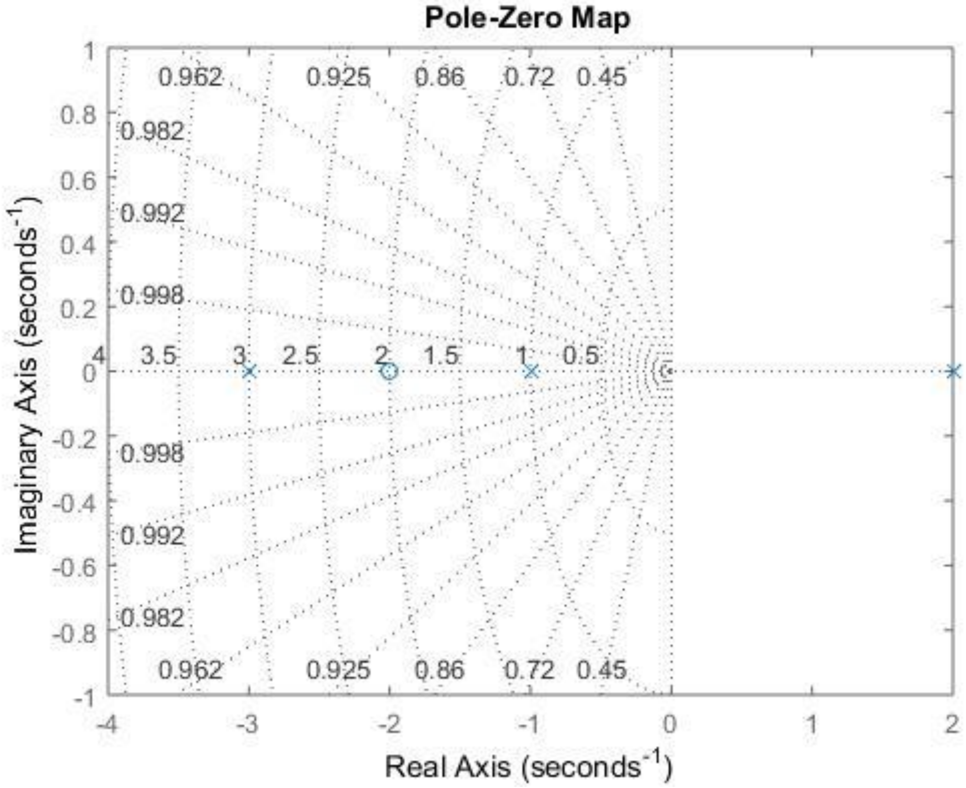


FIGURE 2: POLE- ZERO MAP OF THE G(S)

III. $G(s) = \frac{2(s+3)(s+5)^2}{(s+2)(s^2+4)^2}$

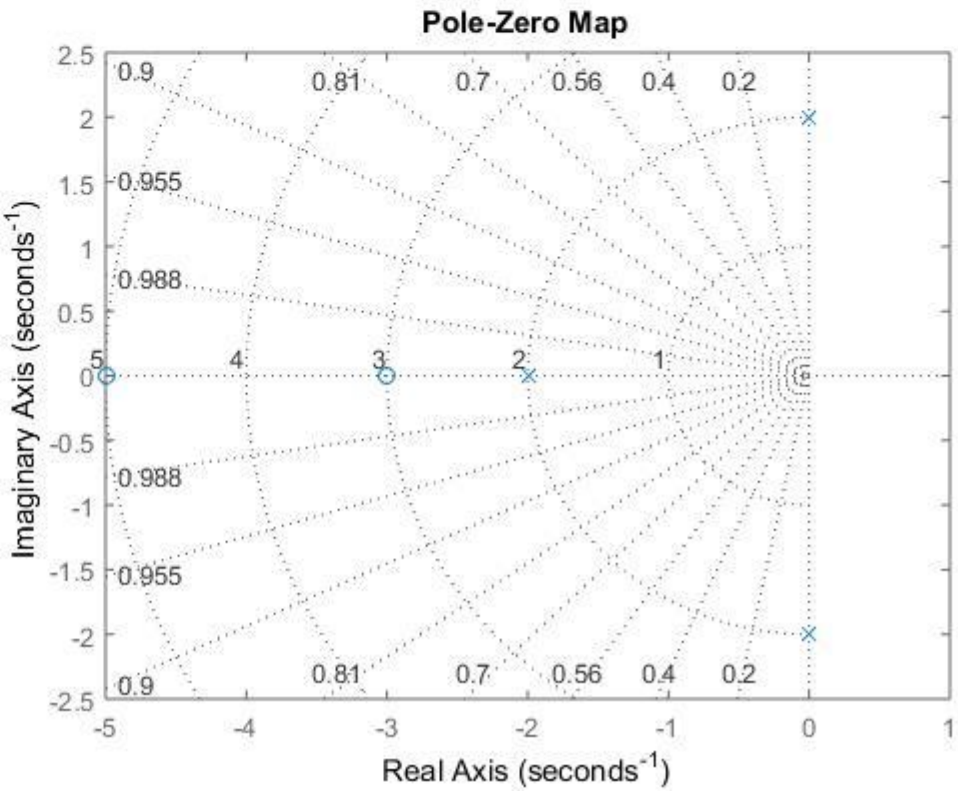


FIGURE 3: POLE- ZERO MAP OF THE G(S)

Q2) Given the zeros, poles, and gain K of Y(S)/R(S), using MATLAB obtain the function Y(S)/R(S) for the each of the following case.

I. There is no zero. Poles are at-1+2j and -1-2j. K=10

n = 0 0 10

d = 1 2 5

Transfer function:

$$G(s) = \frac{Y(S)}{R(S)} = \frac{\text{num}}{\text{den}} = \frac{10}{s^2+2s+5}$$

II. A zero is at O. Poles are at -1 +2j and -1-2j. K=10.

n = 0 10 0

d = 1 2 5

Transfer function:

$$G(s) = \frac{Y(S)}{R(S)} = \frac{\text{num}}{\text{den}} = \frac{10s}{s^2+2s+5}$$

III. A zero is at -1. Poles are at -2, -4 and -8. K=12.

n = 0 0 12 12

d = 1 14 56 64

Transfer function:

$$G(s) = \frac{Y(S)}{R(S)} = \frac{\text{num}}{\text{den}} = \frac{12s+12}{s^3+14s^2+56s+64}$$

Q3) Using MATLAB obtain the partial-fraction expansion of the following transfer functions. Clearly write down the partial fractions on your report.

I. $G(s) = \frac{2s^3+5s^2+3s+6}{s^3+6s^2+11s+6}$

$$r = \begin{bmatrix} -6.0000 \\ -4.0000 \\ 3.0000 \end{bmatrix}$$

$$p = \begin{bmatrix} -3.0000 \\ -2.0000 \\ -1.0000 \end{bmatrix}$$

$$k = [2]$$

Partial-fraction expansion

$$G(s) = 2 - \frac{6}{s+3} - \frac{4}{s+2} + \frac{3}{s+1}$$

II. $G(s) = \frac{2(s+2)}{(s+1)(s^2+4)^2}$

$$r = \begin{bmatrix} -0.2000 - 0.6000i \\ -0.2000 + 6000i \\ 0.4000 + 0.0000i \end{bmatrix}$$

$$p = \begin{bmatrix} 0.0000 + 2.0000i \\ 0.0000 - 2.0000i \\ -1.0000 + 0.0000i \end{bmatrix}$$

$$k = [\ \ ]$$

Partial-fraction expansion

$$G(s) = \frac{2.4 - 0.4s}{s^2+4} + \frac{0.4}{s+1}$$

III. $G(s) = \frac{5(s+2)}{(s+1)(s)^2(s+3)}$

$$r = \begin{bmatrix} 0.2778 \\ 2.5000 \\ -2.7778 \\ 3.3333 \end{bmatrix}$$

$$\mathrm{p} = \begin{bmatrix} -3.0000 \\ -1.0000 \\ 0.0000 \\ 0.0000 \end{bmatrix}$$

$$k = [\quad]$$

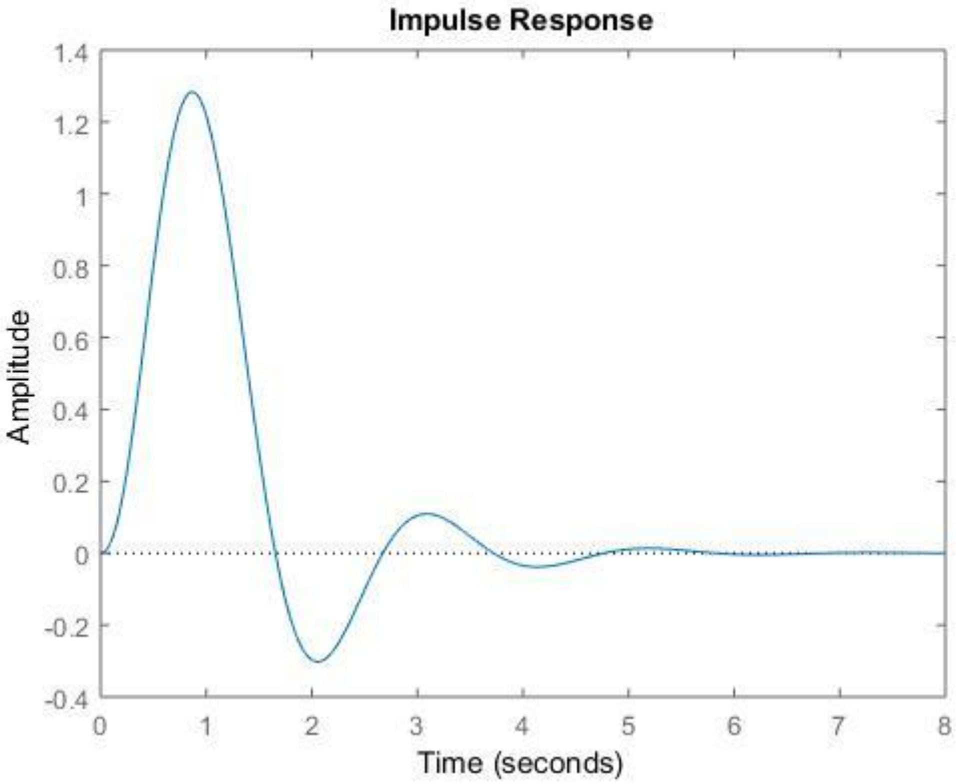
Partial-fraction expansion

$$G(s) = \frac{0.2778}{s+3} + \frac{2.5}{s+1} - \frac{2.7778}{s} + \frac{3.333}{s^2}$$

Q4) The transfer function of a system is given by

$$G(s) = \frac{5(s+20)}{(s^2+2s+10)s^2+6s+10)}$$

(i) In order to obtain the impulse response of the system, write the MA TLAB .m file. State the reason for writing each line in .m file. Obtain the plot of the impulse response.



<u>FIGURE 4: IMPULSER RESPONSE OF THE G(S)</u>

(ii) In order to obtain the unit-step response of the system, write the MATLAB m file. Obtain the plot of the unit-step response. Find the value of the unit-step response at t=1.5 s

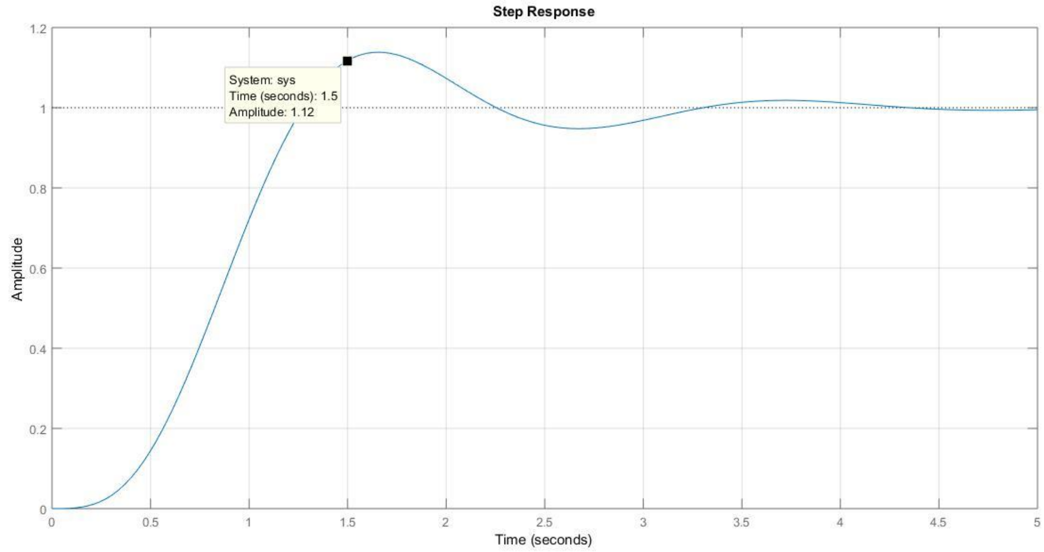


FIGURE 5: UNIT-STEP RESPONSE OF THE G(S)

The value of the unit-step response at t=1.5 s = 1.12

(iii) In order to obtain the unit-ramp response of the system, write the MATLAB m file. Obtain the plot of the unit-ramp response. Show the unit-ramp input in the same plot.

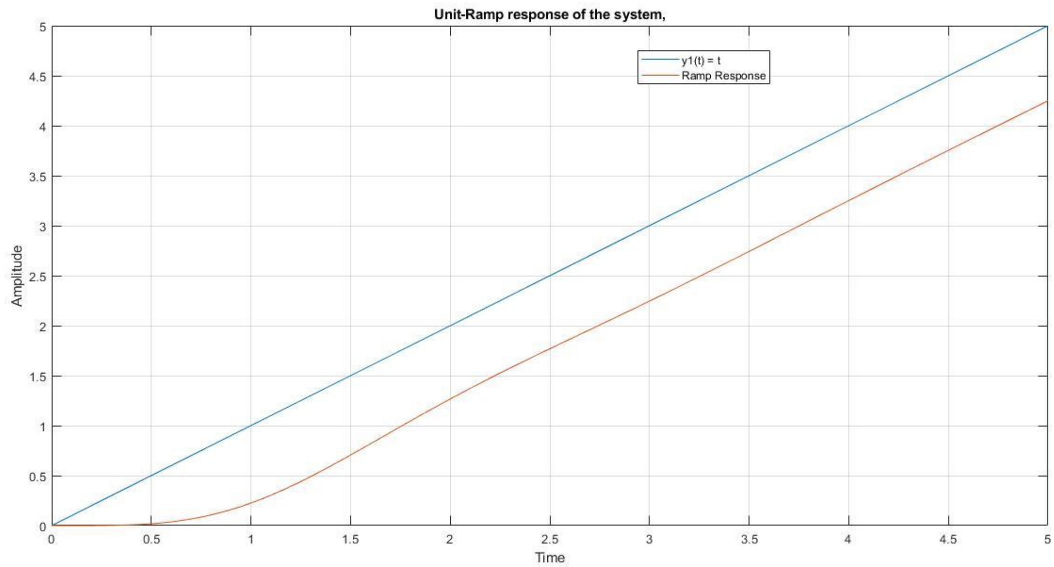


FIGURE 6: UNIT-RAMP RESPONSE OF THE G(S)