Homework Set # 4 – Due Dec 8, 2009 in class

1) Consider the following state-space representation:

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} -3 & 1 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 1 \\ 2 \end{bmatrix} u(t),$$

$$y(t) = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}.$$

a) Obtain the system transfer function by using two different methods.

b) Determine the stability of the system.

2) The unit step response of a system with zero initial conditions is given by

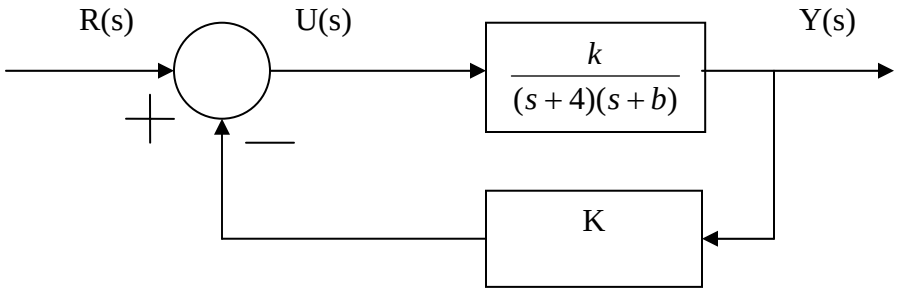
$$y(t) = 5 - 2e^{-3t} - 3e^{-6t}.$$

Computer the system poles and zeros, if any.

3) The unit step response of the system described by the following block diagram is shown below it.

(a) Determine the values of the gains *k*, K, and the other pole of the plant, *b*.

(b) Obtain the peak, rise, and settling time for 2% criterion.



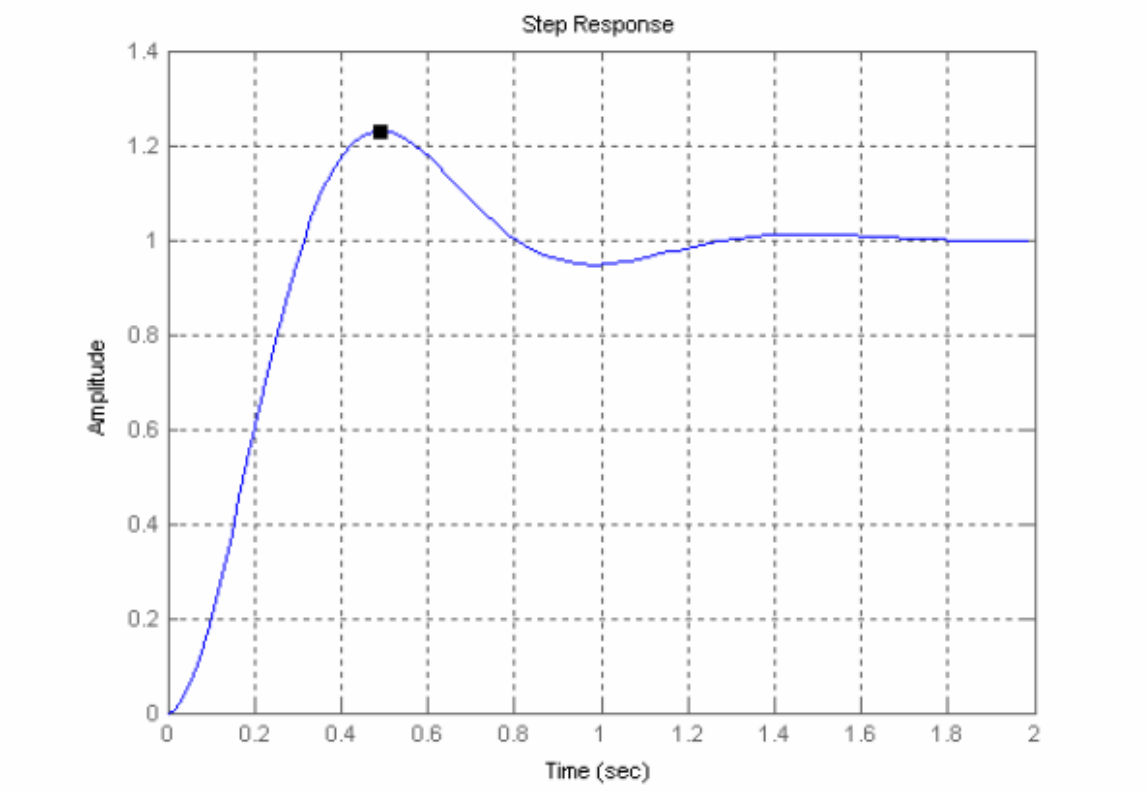


Fig. 1 Figure for Problem 3

4) Find the damping ratio and natural frequency for each of the transfer functions below.

a) $G(s) = \dfrac{20}{(s^2 + 2s + 20)}$

b) $G(s) = \dfrac{20}{(s^2 + 4s + 20)}$

c) $G(s) = \dfrac{20}{(s^2 + 6s + 79)}$

d) $G(s) = \dfrac{20}{(s^2 + 6s + 17)}$

e) $G(s) = \dfrac{20}{(s^2 + 3.6s + 20)}$

f) $G(s) = \dfrac{20}{(s^2 + 7.4s + 20)}$

g) $G(s) = \dfrac{20}{(s^2 + 9s + 79)}$

h) $G(s) = \dfrac{20}{(s^2 + 2s + 17)}$

Problems 5-11 from your textbook

E5.2, E55, E5.9, E5.17, P5.2, P5.10, AP5.7