Controls - 2

Sections (A) and (B) of this question are independent of one another.

(A) [40 - 10 points each] The transfer function of a systems is given as follows:

$$G = \frac{-2s + 4}{s^2 + 0.5s + 4}$$

i) Figure 1 depicts the *Bode* plots of several systems. Circle the *Bode* plot that corresponds to this system? Your selection must be backed up by appropriate calculations.

ii) Figure 2 depicts the *Polar* plots of several systems. Circle the *Polar* plot that corresponds to this system? Your selection must be backed up by appropriate calculations.

iii) The solid lines in Figure 3 describe the steady state response of various systems to sinusoidal inputs, which are shown as dashed lines. Circle the steady state response that corresponds to this system? Your selection must be backed up by appropriate calculations.

iv) Which of the responses depicted in Figure 4 best corresponds to a unit step input for $G = \frac{1}{s^2+0.2s+1}$. Your selection must be backed up by appropriate calculations.

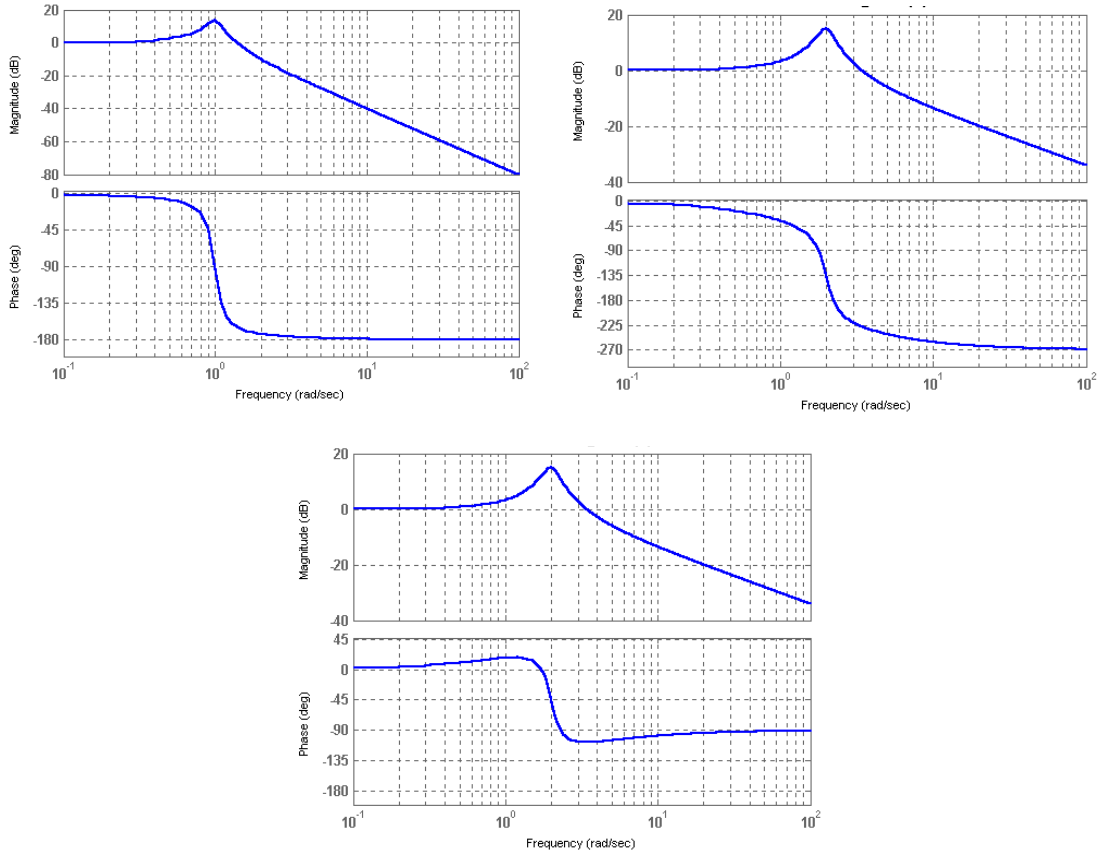

Figure 1: Bode Plots

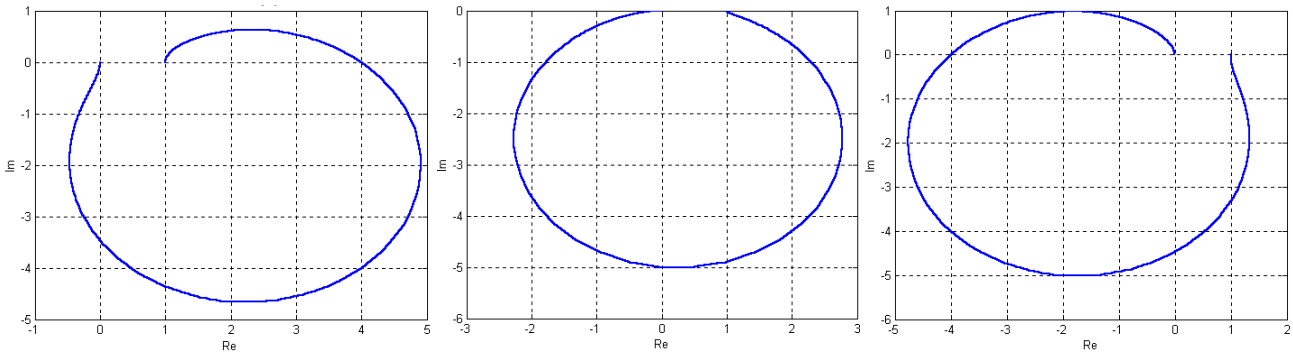

Figure 2: Polar Plots

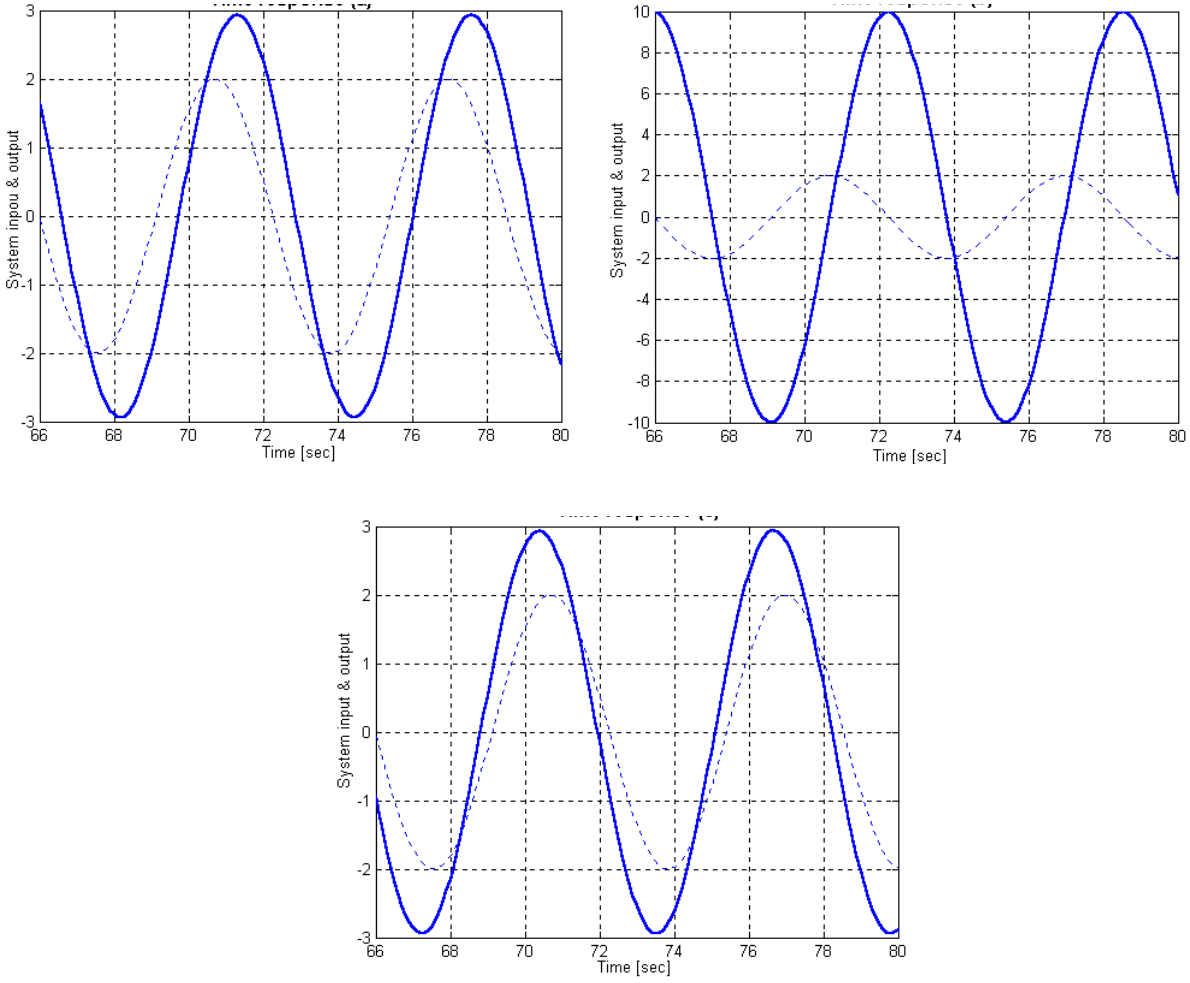

Figure 3: Steady state responses to a sine wave

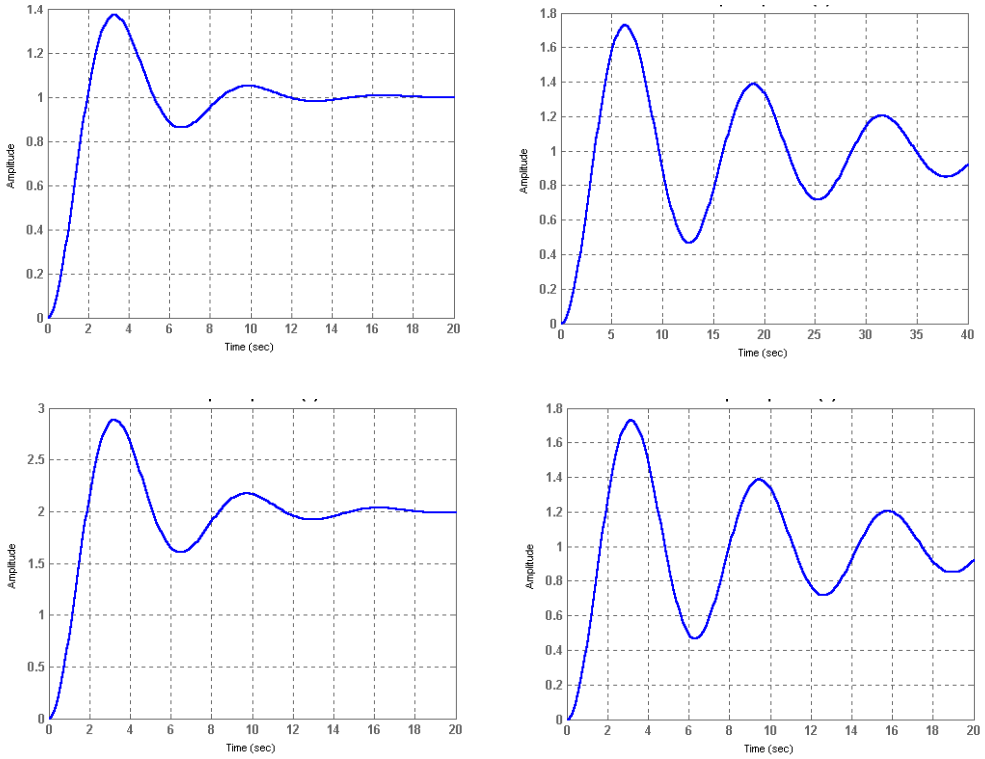

Figure 4: Step responses

(B) [60 points] The Bode plot of a stable system G(s) is given in Figure 5. The system is controlled in closed loop as shown in Figure 6.

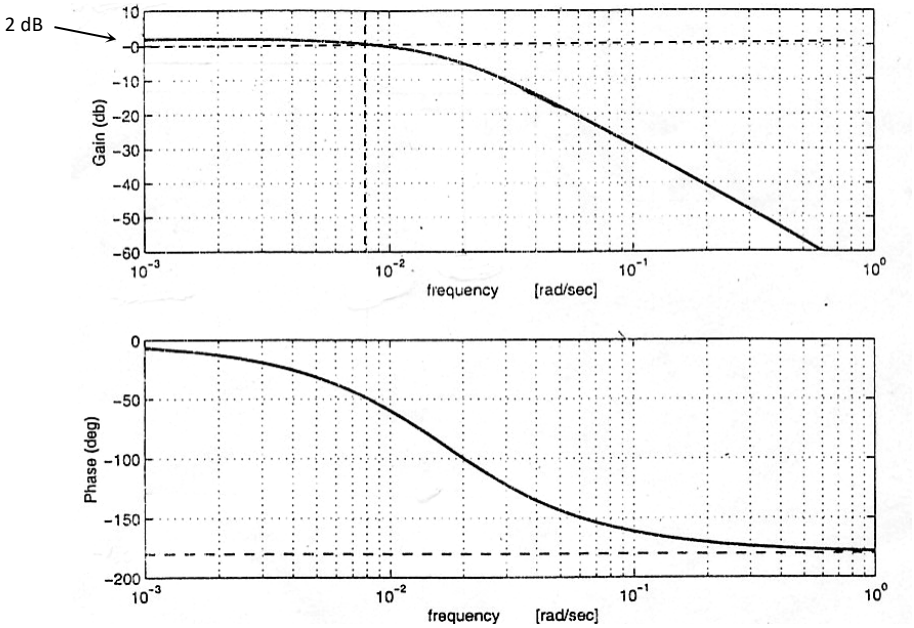

Figure 5: Bode plot of a stable system G(s)

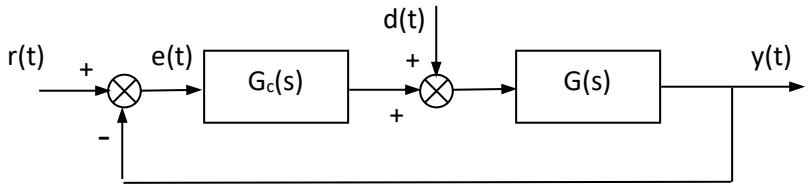

Figure 6: Closed loop system

[15 points each] Assume that the controller $G_c(s)$ is proportional: $G_c(s) = K$.

1. Find the gain and phase margins of the system G(s). Show clearly your result graphically.
2. In Figure 7, the pole-zero configurations of two systems are given. Which one of the pole-zero configurations corresponds to the given system G(s)? Explain!
3. Sketch the Root Locus for the pole-zero configuration you have selected.
4. For K=2, calculate the closed-loop steady-state response y_{ss} when the following $r(t)$and $d(t)$are applied simultaneously: $r(t) = 0.5 \cdot 1(t-4),\ d(t) = \sin(0.06t)$

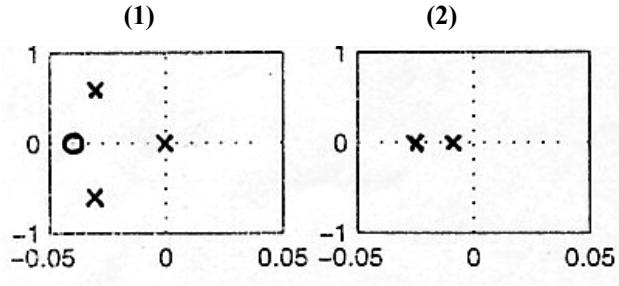

Figure 7: Pole-zero configurations of two systems