1 Tutorial problems

1. Given

$$G(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2},$$

   where $0 < \zeta < 1$, find expressions for the peak magnitude response, the frequency at which it occurs, and the 3dB bandwidth of G.

   Briefly describe what happens to each of these three quantities as $\zeta \to 0$ and as $\zeta \to 1$.

2*. Draw the Bode diagrams (magnitude and phase) for the following transfer functions:

   (a)
   $$G(s) = s + 2$$

   (b)
   $$G(s) = \frac{1}{s+5}$$

   (c)
   $$G(s) = \frac{s+2}{s+5}$$

   (d)
   $$G(s) = \frac{s+2}{(s+5)^2}$$

   (e)
   $$G(s) = \frac{s+2}{s(s+5)^2}$$

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

   Check your sketch using MATLAB.

3*. Open-loop frequency response data is obtained for a system and an approximate Bode diagram is plotted as shown in Figure 1.

   (a) Identify a transfer function model of the system.
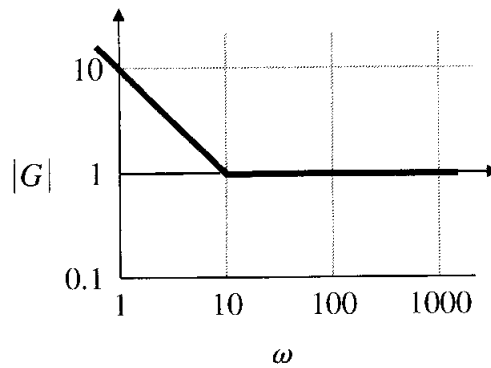
   (b) Sketch the step response of the system.

Figure 1: Question 2 (Bode).

2 Additional solved problems

1. A-7-1 and A-7-5 (pages 521, 525-526): "Modern Control Engineering" by Katsuhiko Ogata; 5th edition. (see additional sheet)