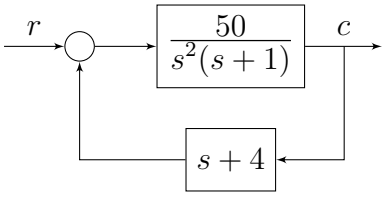
Problem 1. Frequency response of a control system. A unity feedback system has the open loop transfer function,

$$G(s)H(s) = \frac{3(s+1)}{(s+2)(s+3)}$$

(a) Derive the closed loop transfer function, $G_{cl}(s)$, relating the output c to the command input, r.
(b) Derive the magnitude and phase functions for $G_{cl}(s)$, by substituting $s = j\omega$.
(c) For the input, $r(t) = 5\cos(2t)$, determine the form of the steady-state output, $c(t)$, and relevant parameters.
(d) For the input $r(t) = 2\sin(5t - \pi/4) - 5\cos(8t)$, determine the form of the steady-state output, $c(t)$, and relevant parameters.

Problem 2. Sketching a Bode plot. Consider the control system shown below.



(a) Find the open loop transfer function, GH
(b) Express GH using basic factors and identify and list the key variables for each factor.
(c) Neatly sketch the Bode plot by hand and label key features (slopes, frequencies, etc.). Show both the basic factors and the composite curves in both the magnitude and phase plots.
(d) Verify your results using Matlab and provide these results as well.

Problem 3. Ogata B-8-19

Problem 4. Ogata B-8-22

Problem 5. Transfer function from measured Bode plots. Work one of Ogata B-8-27 or B-8-28