EE 4CL4 – Control System Design

Homework Assignment #8

1. Consider a feedback control loop where:

$$G_o(s)C(s) = \frac{9}{s(s+4)}.$$

   a. Verify Lemma 9.1 on page 242 of Goodwin et al. for this open-loop transfer function. Note that if the integral cannot be solved analytically, then you may calculate a numerical approximation using the MATLAB function `quadl()`. If you use this function, please include in your report the exact MATLAB command(s) that you used.

   b. Repeat but with $G_o(s)C(s) = \frac{17s+100}{s(s+4)}$. **(25 pts)**

2. The nominal model for a plant is given by:

$$G_o(s) = \frac{5(s-1)}{(s+1)(s-5)}.$$

   a. Use the pole placement method to synthesize a controller such that the closed-loop poles are at (−2; −2; −2).

   b. Verify Lemma 9.2 on page 244 of Goodwin et al. for this plant and controller placed in a unity-feedback loop. Again, if you use the MATLAB function `quadl()`, please include in your report the exact MATLAB command(s) that you used.

   c. Verify Lemma 9.5 on page 249 of Goodwin et al. for this plant and controller placed in a unity-feedback loop. Again, if you use the MATLAB function `quadl()`, please include in your report the exact MATLAB command(s) that you used. **(50 pts)**

3. A plant model is given by:

$$G(s) = \frac{e^{-s}}{s+1}.$$

Approximating the delay by $e^{-s} \approx \frac{s^2-6s+12}{s^2+6s+12}$, use Lemma 9.5 and the result from Example 9.1 (on pages 249 and 251, respectively, of Goodwin et al.), with $\epsilon = 0.1$ and $\omega_l = 3$ to derive a lower bound for the nominal sensitivity peak. **(25 pts)**

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