Recommended Assessment

Routh Hurwitz Stability

1. Given the feedback loop diagram in the lab, determine the closed-loop transfer function $\frac{Y(s)}{R(s)}$ in terms of k_p. Then substitute provided values for K and τ in, or use the values found in any of the modeling labs.

   Use the following definitions for Transfer Functions:

$$P(s) = \frac{K}{s(\tau s + 1)}$$

$$C(s) = \frac{1}{s + 10}$$

2. Create a Routh Table for the closed-loop transfer function:

s^3	
s^2	
s^1	
s^0	

3. From the previous two answers, calculate the range of k_p for which the system is marginally stable. Explain any reasoning used.

4. Is there a k_p for which the system is marginally stable? Explain any reasoning.

5. Show a screenshot of the behaviour of the Qube-Servo 3 when $k_p = 1$. Describe the behaviour observed and what happens when perturbed. What is the steady state error (approximately)?

6. Attach a screenshot of the response when $k_p = 5$. Compared to $k_p = 1$ describe any differences between the responses. What is the difference in steady state error?

7. Attach the response for the theoretical value of k_p where the system is marginally stable. What are the differences in responses between this value of k_p and $k_p = 5$? If the system is still stable, give an explanation why.

8. If the system was not marginally stable for the theoretical value of k_p, what value was it marginally stable for. Attach a screenshot of the marginally stable response. Describe the behaviour of the marginally stable system. Give a reason why the theoretical value for k_p was not marginally stable.