ChE381A: PROCESS DYNAMICS AND CONTROL

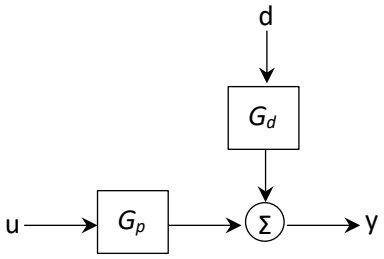
SIMULATION EXAMINATION

Instructions:

- *There is one problem that is to be solved using Matlab and Simulink.*
- *Be as systematic as possible in your work.*
- *You are encouraged to develop appropriate Matlab functions and script files and Simulink simulation files to do the work. These files are to be submitted along with your report file.*
- *Your Simulink file must be in a state where running it gives the results in your report.*
- *Your work and report must be genuine and original. In case two or more reports, Simulink files or Matlab files are similar, all such cases will get a straight zero. There shall be no distinction between the ones who copied and the ones who allowed their files to be copied. Both sets of students will get straight zeros, without any exceptions.*

QUESTION

Consider the process in Figure with $G_p = \frac{Ke^{-\theta s}}{\tau s+1}$ and $G_d = \frac{K_d e^{-\theta_d s}}{\tau_d s+1}$



A PID controller is to be designed with the integral time $\tau_I = \tau$ and the derivative time, τ_D, adjusted to maximize K_C, where K_c is chosen for a maximum closed loop log modulus (L_{CL}^{MAX}) of 2dB. It is given that K = 2, θ = 1 min and τ = 5 min, completely specifying G_p. Also, K_d = -2, θ_d = 2 min and τ_d = 8 min, which completely specifies G_d.

Systematically obtain K_C and τ_D. Plot the variation in K_C with τ_D to clearly show the maximum in K_C and the corresponding τ_D value. Also plot L_{CL} vs *log(ω)* to clearly show the L_{CL}^{MAX} peak.

Plot the servo and regulator unit step responses using the PID controller and compare with a PI controller with $\tau_I = \tau$ and K_c adjusted for L_{CL}^{MAX} = 2dB.

Prepare a short report on the exercise. Your report should clarify all the steps in tuning the PID or PI controllers.

Submit the following:

1. Your report as a pdf file. Negative marks for any other format (e.g. MS Word files).
2. Simulink .slx file.
3. Any Matlab function / script .m files used to solve the problem (e.g. anonymous function call for using *fsolve* or *fzero*).