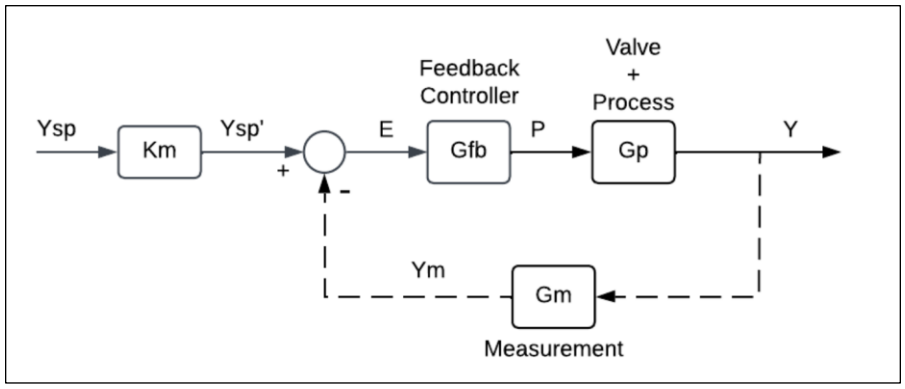
2024 CHE322 TERM PROJECT

PART-2

Based on the ASPEN Plus Dynamics simulations (refer to the manuals in Quercus), address the following questions in your report.

1. Use the *feedflowstep* task, assess the control performance of FC, LC12 and LC11 using the default controller tuning parameters with the correct controller action (KC =1; τI =20 min). (Hint – discuss controller's behavior to step change w.r.t gain, time delay, controller action etc.). Note - you may keep communication time as 0.01 hours for this case.
2. Develop a transfer function model of the process associated with FC. To do so, export the FC response data (either in numerical or percent values), as mentioned in manual, and use python to fit a transfer function to that data. Be sure to use a sufficiently small communication time in ASPEN Plus Dynamics to capture the process step response. (Hint – 0.0001 hours)
3. Develop a transfer function model of the process associated with LC12 using a similar procedure. A communication time of 0.01 hours is sufficient to capture the process step response in this case.
4. Develop a transfer function model of the process associated with LC11 using a similar procedure. A communication time of 0.01 hours is sufficient to capture the process step response in this case.
5. Consider FC controller overall system as the block diagram shown below:



Assuming Gm = Km =1, the overall transfer function for FC can be calculated as

$$\frac{y}{y_{sp}} = \frac{G_{FB} * G_p}{(1 + G_{FB} * G_P)}$$

$$where\ G_{FB} = k_c(1 + \frac{1}{\tau_I s} + \tau_D s)$$

$$G_P = \frac{Y}{P} = \frac{Feed\ flow\ rate}{Controller\ Output} = \frac{k}{\tau s + 1}$$

Note that kc, τI ,τD are controller's design parameters whereas k, τ are process parameters. In our case, τD = 0 as we considered PI controller. Substituting all the above, the overall transfer function for FC can be calculated as below:

$$\frac{y}{y_{sp}} = \frac{k_c k(1+\tau_I s)}{\tau_I s(\tau s+1)+k_c k(1+\tau_I s)}$$

Using this information, redesign the FC control parameters so that when a unit step change is made to the feed flow set point, the feed flowrate responds in a first order manner and reaches the new set point in 15 minutes. (Hint - read the "Some Ideas about the use of Derivative Action in PID Control" file)

6. Assess the performance of your redesigned FC in Aspen Dynamics using the two different tasks (*feedcompstep* and *feedflowstep)* activated separately.

Report Format:

- Each tutorial group is asked to prepare a single report answering the above questions. The title page must include the names of all group members, your tutorial section (Monday or Tuesday) and your group number.
- The second page must contain a summary of each student's contribution to the report and signatures attesting to their contribution being original work.
- You can choose to structure your report in a Q/A format or use separate headings and add content. In either case, it is expected that you will answer all the questions with sufficient discussion.
- The page limit for the main body of the report is **10 pages**.
- Essential figures should be well integrated into the body of the report. Additional (less essential) figures may be included in the appendix (not included in the page limit). Please ensure that the content of your main body should be self-sufficient on its own.
- Use MS Word or Latex to write the report and use Python to produce your figures.
- Your report will be assessed based on the rubric provided in Quercus.

Due Date: 18th March 2024, 11:59 PM

Deliverables: Submit **one PDF file** for the report and **one Python** (**.ipynb format only)** file including all required simulations and plotting. Submit electronically on Quercus. Please name both your files in this format: "**Group-XX_Project_Part-2"** where XX is your group number.