Corso di Dinamica e Controllo dei Processi Chimici – A.A. 2019-20

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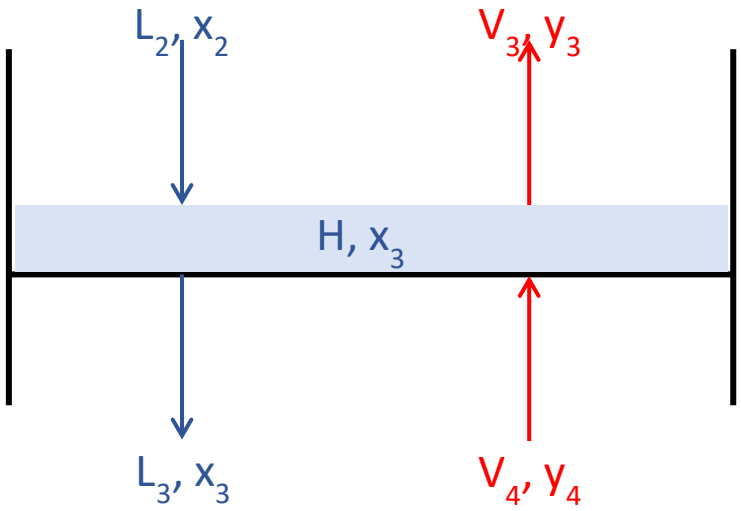
Homework #1

Da consegnare entro venerdì 03 Aprile 2020

Consider the tray #3 of a distillation column in which a non-ideal binary mixture needs to be separated.



The equilibrium mole fractions x_i e y_i of the more volatile component in the liquid and vapor streams leaving and entering tray 3 are represented in the figure above.

At the nominal operating conditions $\bar{x}_3 = 0.65$. Within the composition range $0.55 < x < 0.75$, the composition y in the vapor phase can be related to the equilibrium liquid composition x by the following expression:

$$y = f(x) = 0.01 + 1.44x - 0.58x^2 + 0.13x^3$$

We can assume that the McCabe–Thiele method approximations hold true, more in particular the internal liquid and vapor flows can be assumed not to change within the column section including tray 3. At the nominal operating conditions, $\bar{L} = 7.0\ mol/sec$ and $\bar{V} = 8.5\ mol/sec$.

Tray 3 and all trays in the same column section have the same liquid holdup, whose value is $\bar{H} = 400\ mol$ under nominal operating conditions. The vapor holdup on the trays is negligible.

Find the transfer function relating $x_3(t)$ to $x_2(t)$ and to $y_4(t)$ under operating conditions close to the nominal ones.

All parameters appearing in those transfer functions must be reported both in symbolic and numerical form (including their measurement units)

The solution must be reported within a maximum 4 pages PDF file.