CHE 362 **HW #11** **Due 6/22/23**

A mixture of 30 mol% toluene and 70% ethylbenzene is to be separated in a distillation column. The feed enters as a saturated liquid at a rate of 250 kmol/hr. The distillate is to exit at 99 mole% toluene and the residue at 1 mole% toluene.

#1 The column is to be designed for a reflux ratio of 1.2 times the minimum.

a) Model this column in Aspen. Use the number of stages from the McCabe-Thiele analysis from HW #10 in your Aspen model. Remember to add one stage to the total number of stages and feed stage location in your Aspen model. Submit a copy of the stream results and block results to confirm that your model works.

b) Use Aspen to determine the column diameter assuming 80% approach to flooding, 80% active area and 2 ft tray spacing. The trays are sieve trays. Submit a copy of the tray sizing results page.

#2 Use your Aspen results to size the condenser and reboiler for this column. Assume saturated steam is available at 150 psig and cooling water comes in at 30 °C and is returned at 45 °C. Report the following:

a) the heat duty of the condenser and reboiler in GJ/hr as calculated by Aspen

b) the heat transfer area of the condenser and reboiler in m^2

#3 Calculate the installed cost (C_{BM}) of the column shell, trays, condenser and reboiler. Assume an overall column efficiency of 75%. Calculate the annual operating cost for steam and cooling water. Use a steam cost of $14.83/GJ Assume that the column operates for 350 days/yr. Calculate the EAOC based on spreading the capital cost over 5 years. Show all of the details of your calculations.