DEPARTMENT OF CHEMICAL & BIOMOLECULAR ENGINEERING
NORTH CAROLINA STATE UNIVERSITY

CHE 596-028/605 **Spring 2020**
Homework Set 3 **Due on February 4, 2020**

Use ASPEN simulation to solve the following two problems. Email the instructor a compressed folder containing the *apwz* (or *apw* or *bkp*) files and *rep* files for both problems.

Problem 1 (60%) Gaseous ethanol at 180 °C & 1 atm is fed at the rate of 3.6 kmol/h to an *insulated* reactor that is packed with a dehydration catalyst which induces ethanol to undergo the following gaseous reaction, $2C_2H_5OH \rightarrow C_2H_5OC_2H_5 + H_2O$, to form diethylether & water vapor. The reaction attains equilibrium at 1 atm. The reactor effluent goes to a partial condenser operating at 1 atm. It is desired to recover 95 ± 0.5 % of diethylether in reactor effluent in the overhead products stream leaving the partial condenser. Use an ASPEN simulation to determine (a, 20%) the molar flowrates of the various components in the reactor effluent, (b, 20%) the operating temperature of the partial condenser, (c, 10%) the molar flowrates & compositions of the overhead & bottom streams leaving the partial condenser, and (f, 10%) the heat duty of the partial condenser. Assume the NRTL thermodynamic model. A *Design-Spec* approach is expected. Any other approach will get no more than 50% of the credits in part (b) even if it leads to the correct solution.

Problem 2 (40%) Compressed methane gas at 5 atm and 240 °C is fed at the rate of 20 kmol/h to a countercurrent heat exchanger where it is to be cooled to 90 °C by cooling water entering the heat exchanger at 25 °C and 5 atm. Determine (a, 24%) the required molar flow rate of the cooling water if the maximum permissible temperature of the water leaving the heat exchanger is 50 ± 0.01 °C, and (b, 16%) the required heat transfer area of the heat exchanger for a heat transfer coefficient of 730 kcal/(h.m^2.°C). A *Design-Spec* approach is expected. Any other approach will get no more than 50% of the credits in part (a) even if it leads to the correct solution.