Capstone Project - 390 points **Due: Lesson 40**

Deliverables: In this project, you will (1) complete three experiments to measure the boiling point of a mixture, (2) prepare an ideal solution Txy plot in Mathematica, (3) prepare a Txy plot with activity coefficients in Mathematica, (4) perform a curve fit of the experimental data, and (5) verify your Txy plot in CHEMCAD.

Go to the "cadet assignments" link on the course web page to find your assigned solutions, then proceed to the following assignments:

1. 10 points. Schedule and confirm group appointments with Mr. Mathew (Abhilash) by COB Friday 18 August. The instructor must be included in the calendar invite. Since you are assigned two experiments and each experiment takes ~30 minutes, your appointment will need to be at least one hour. One cadet in your group is required to attend. Since the experiments might exceed one hour, additional time may be necessary. Cadets can schedule longer blocks of time and stagger attendance to cover the overflow. Two hours are recommended to ensure you have enough time to complete the experiments.
2. 40 Points. Experiments must be completed, and results reported by 15 November. Get started early! Enter your boiling point results into the collaborative spreadsheet in Canvas. Submit experiment data log sheet to Canvas, to include ebulliometer pressure, temperature readings vs time, and initials and date from Mr. Matthew.
3. 50 Points. Prepare a Txy plot in Mathematica assuming *ideal solution* behavior. This part of the project is similar to work you already did in CH362. That work can be used as a basis for this work, but the new requirement is to complete the plot in Mathematica.
4. 50 Points. Prepare a Txy plot in Mathematica assuming *non-ideal solution* behavior with activity coefficients calculated from the Margules one-parameter equation ($A_{21}=A_{12}=A$). Use a value of A=0.64 for the Margules parameter.
5. 50 Points. Use the instructor-provided Excel Mathematica function to perform a regression analysis of experimental data with the Margules one-parameter equation to determine a revised value of the Margules parameter.
6. 50 Points. Produce a Txy plot in CHEMCAD to confirm your calculations with the revised Margules parameter from problem 5.
7. 50 Points. Writing assignment. Produce a two-page report of your results and calculations. The report must include three properly formatted plots for the three Txy plots. To save space, individual plots can be consolidated into a single figure. Discuss your experimental procedure, theoretical calculations, and difference between ideal and nonideal solutions using intermolecular forces to explain the differences.

IPR (90 points, due 15 November): Guidance: Problems 1-4 complete. A grade out of 90 points will be assessed using the extent of your group's progress on these four problems.

Final Deliverables (300 points total, 290 points for problems 2-7, due lesson 40):

- Lab results entered into collaborative spreadsheet.
- separate Mathematica files for problems 3 and 4.
- Excel file for problem 5.
- CHEMCAD file for problem 6.
- PDF file of written report, uploaded to Canvas.