A First Course on Kinetics and Reaction Engineering

Unit 15. Lesson Plan

Before Class

- Provide the redacted slides to the students and tell them to bring them to class
- The activity will involve calculations and least squares fitting that are most easily performed using a computer; either make arrangements so the students have access to whatever software they need/use for these activities or adapt the lesson plan so that they only set up the calculations but don't actually perform them

During Class

- Introduce today's topic and where it fits in the course (Slides 1 and 2)
- Review of Unit 15 (5 to 10 minutes)
  - Slides 3 and 4: go over the key concepts on the slides
- Ask whether the students have any questions from their pre-class preparation and answer them
  - Slide 5
- Learning Activity 15.1 (~20 minutes)
  - Slide 6: Read through the problem statement; if you used the activities provided for Unit 14, note that they solved this problem in the last class using a differential analysis. This example is a simple, straightforward application of the integral method of data analysis, it is important that they all can solve it. Circulate, observe, correct and answer questions as they work.
  - Slide 7: After ~15 minutes, go through the solution on this slide, emphasize that knowing how to do this is critical, and answering any question.
  - Slide 8: (Optional) Use this slide to compare the differential and integral methods. Make the point that finite differences is not very accurate and is highly sensitive to noise in the data. If a good polynomial fit is found, the polynomial method is comparable to the integral method, but in the polynomial method you have to fit twice, so why not just use the integral method.
- Learning Activity 15.2 (~20 minutes)
  - Slide 9: Read through the problem statement and point out that the reaction takes place in the gas phase and it involves a change in the total number of moles. Then send them to the chalk board in groups to set up the solution to the problem (to the point where they have an integrated model equation). Have half of them work on part (a) and half on part (b). Let the groups interact and ask each other questions; circulate, observe, correct and answer questions as they work.
  - Slide 10: Either use one of their solutions (if correct and legible to the whole class) or this slide and go through the solution. Emphasize the use of a mole table or definition of extent of reaction to relate $\dot{n}_{tot}$ and $\dot{n}_A$. Point out that the same kind of relationships are used if

the rate expression contains the concentrations or partial pressures of two different reagents, because one of them will need to be expressed in terms of the other.

- Slide 11: Use this slide to show how the integrated equation does not naturally have the form y = mx + b or y = mx. Then go through the remainder of the solution. Point out that Unit 16 will show how to do least squares when the model equation is not or cannot be linearized.
- Slide 12: Show the results and go through the assessment of whether the models are sufficiently accurate

- Slide 13: Put the material covered in this class into the overall context of the course.

After Class

- Provide the complete slides to the students.
- Provide the MATLAB code to the students if they use MATLAB.