A First Course on Kinetics and Reaction Engineering
Unit 31. Lesson Plan

Before Class

• Provide the redacted slides to the students
• Tell the students to print the worksheet for Activity 31.1 and bring it to class
• Tell the students to print the equations from Unit 17 or, preferably, the AFCoKaRE Exam Handout and bring it to class

During Class

• Introduce today's topic and where it fits in the course
  - Slides 1 and 2
• Review of Unit 31 (5 minutes)
  - Slides 3 and 4: go over points on the slides
    ‣ On slide 4 tell them that they will get to practice this approach in today's in-class activity
  - Slide 5: ask whether the students have any questions from their pre-class preparation and answer them
• Learning Activity 31.1 (~40 minutes)
  - Slide 6: Read through the problem statement.
    ‣ Point out that the reaction is written as an elementary reaction, but could also be written as
      $$A \rightarrow B$$
  - Slides 7 and 8: Read through the items. If you want them to work in pairs or teams, form the teams. Then tell them to make the sketch, give them a few minutes to do so, then show the diagram and answer any questions.
  - Slides 9 and 10: Read the first slide and tell them to start, give them some time to answer, circulate an answer individual questions as they work, when most are done or nearly so, show the results on the second slide and answer any questions.
  - Slides 11 and 12: Read the first slide, tell them to get out their equation sheet and find the general design equations for a PFR (make sure everyone can find the correct equations); discuss the need to assume negligible pressure drop; give them a few minutes to set up the equations, circulate answering questions as they do,, when most are done or nearly so, show the results on the second slide and answer any questions.
  - Slides 13 through 15: Show the first slide and tell the class to pretend it is an exam where they need to identify the exact equations to be solved numerically, to identify the kind of equations they are (non-linear or ODEs), to identify the different kinds of variables (independent and dependent for ODEs, unknowns for non-linear equations). Give them a few minutes to do so, then go over the results (second slide) and answer any questions. Then tell them to continue to pretend it is an exam and that they need to explain what they must provide in order to solve the equations numerically (it is on the

AFCoKaRE Exam Handout, if they are using that). Give them a few minutes to work, then show the third slide. Go through the equations variable by variable, noting whether it will be given, is a known constant or must be calculated in order to evaluate the equations.

▸ Point out that everything they need in order to evaluate the functions is given or known except the rate and discuss how to calculate it

▸ Then point out to them that they can't solve the PFR design equations at this point because the initial values are not known

- Slides 16 and 17: Read the first slide, tell them to start, give them some time to answer, circulate an answer individual questions as they work, when most are done or nearly so, show the results on the second slide and answer any questions.

- Slides 18 through 20: Show the first slide and tell the class to pretend it is an exam where they need to identify the exact equations to be solved numerically, to identify the kind of equations they are (non-linear or ODEs), to identify the different kinds of variables (independent and dependent for ODEs, unknowns for non-linear equations). Give them a few minutes to do so, then go over the results (second slide) and answer any questions. Then tell them to continue to pretend it is an exam and that they need to explain what they must provide in order to solve the equations numerically (it is on the AFCoKaRE Exam Handout, if they are using that). Give them a few minutes to work, then show the third slide. Go through the equations variable by variable, noting whether it will be given, is a known constant or must be calculated in order to evaluate the equations, point out that their code will be given flows and temperature of stream b, so it can solve the PFR design equations ... as per the bullets

- Slides 21 and 22: show the first slide and tell them now that they can solve all the equations, they need to explain how to answer the questions asked, give them a few minutes to do so and then show the second slide and go over the results, answering any questions.

▸ Optionally assign the numerical solution of the problem as homework.

• Summary
- Slide 23: Put the material covered in this class into the overall context of the course.

After Class

• Optionally assign as homework, a memo that explains why the outlet temperatures are nearly equal while the conversions are substantially different.

• Make the complete slides and the MATLAB code for Activity 31.1 available to the students