CBE 450 Syllabus

A. Course Details

CBE 450 Chemical Reactor Fundamentals

Meeting Place: Dougherty Engineering Building 511
Meeting Time: MWF 11:15AM - 12:05PM

Instructor: Dr. David Keffer, room 617 Dougherty Hall, dkeffer@utk.edu
Teaching Assistant: None

Required Text: "Elements of Chemical Reaction Engineering", Fourth Edition, H. Scott Fogler, Prentice Hall, Upper Saddle River, NJ, 2006.

Prerequisites: The course prerequisites are those listed in the Undergraduate Catalog. Currently the prerequisites are CBE 240, 301 and 340. Students without all of these prerequisites will be dropped from the course, unless they received permission for an exception from the instructor.

B. Course Learning Objectives:

These course learning objectives have been established collectively by the faculty of the UT department of Chemical and Biomolecular Engineering in accord with the ABET accreditation process. Any offering of the course, regardless of the instructor, should achieve at least the following objectives.

1. Formulate ideal reactor design equations for simple models of batch, continuous stirred flow (CSTR), and plug flow chemical reactors in terms of fractional conversion of limiting reactant, starting with the appropriate mole balances.
2. Size ideal homogeneous batch, CSTR, and plug flow reactors by analytical or numerical integration, when the reaction rate is given as a function of fractional conversion.
3. Evaluate multiple reactor configurations, e.g., combinations of reactors of various types in either series or parallel operation, when the reaction rate is given as a function of fractional conversion.
4. Determine reaction rate laws from experimental data by the differential and the integral methods, and determine the activation energy of the rate coefficients.
5. Use stoichiometric tables to express reactant concentration in terms of fractional conversion and the appropriate parameters of the system, for both liquid and gas phase systems.
6. Size batch, CSTR and plug flow reactors for isothermal homogeneous reaction systems, given the required production rate, rate law, and specified final conversion of the limiting reactant.

7. Calculate the production rate and fractional conversion of limiting reactant for isothermal, homogeneous batch, CSTR, or plug flow reactors of given size, when the rate law is known.

8. Size and develop catalyst requirements for a packed bed reactor, accounting for pressure drop, by numerical integration of the design equations.

9. Account for catalyst aging and deactivation in catalytic reactor design and operation.

10. Develop preliminary designs for non-isothermal batch, CSTR, and plug flow reactors by simultaneous integration of the material and energy balances.

11. Evaluate non-isothermal reactor designs for potential safety problems.

12. Select the proper contacting patterns to achieve maximum desired product yield in systems containing multiple chemical reactions occurring in series and in parallel.

13. Select the proper contacting patterns to achieve desired product selectivity in systems containing multiple chemical reactions occurring in series and in parallel.

14. Select the proper reactor type (e.g., batch, CSTR, plug flow) for a given application.

15. Assess potential explosion hazards by calculating vapor phase compositions of combustible mixtures, and comparing these values with the lower and upper explosion limits for the system.

16. Identify the chemical reactor design literature, know where to find useful and pertinent information concerning reactor design, operation, and safety, and quickly access related resources.

C. Grading Policy

C.1. Grade Breakdown

- Exams (2 mid-terms and 1 final exam @ 20% each): 60%
- Homeworks (10 assignments @ 2% each): 20%
- Computer Project and Report (1 project @ 20% each): 20%
- Total: 100%

C.2. Homework

- Homework assignments are made each Wednesday and due in one week unless a change is announced in class.
- Homework assignments are due at the beginning of class.
- Late homework assignments are not accepted.
- Students can work together to solve homework assignments. However, each student must turn in his/her own work in his/her own handwriting. For homework assignments where computer-generated code or graphs are required, each student must generate their own codes and graphs.
- Instances of plagiarism will be dealt with as stipulated by University guidelines. Please do not force me to have to deal with plagiarism. Remember, you are here to learn.

C.3. Exams

- There are 3 exams, as indicated on the schedule.

- Each exam counts 20% of the course grade.
- Do not miss exams. Make-up exams are given only in the event of a serious problem, e.g. extreme illness, death in the family, etc.

C.4. Computer Projects

- There is one computer project assigned worth 20% of the course grade.
- The computer projects will be done in teams of two and will be assigned approximately one month before it is to be collected.
- The projects will be performed using the programming platform of your choice. Recommended platforms are FORTRAN, C, and MATLAB. Other platforms and languages are discouraged and will not be supported by the instructor .

D. Getting Help

Although lectures and text are the primary means of instruction in this course, the instructor is here to help you successfully complete this course. When you do not understand something in class or have difficulty with an exam or homework, you are encouraged to seek out the instructor. Efforts will only be made to meet with students who regularly attend lecture.

D.1. Email

The best way to contact the TA or the instructor is via email.

- Questions regarding course content should be sent via email to the Instructor
- To guarantee that the email is read promptly, make the subject of the email "CBE 450"

D.2. Office Hours

- The Instructor holds office hours on Friday afternoon 3:30-5:00 in 617 Dougherty.