## Course overview

The course covers fundamental concepts involved in the sizing and operation of batch, semi-batch, continuous, plug flow and packed bed reactors. An analytical approach based on first principles is emphasized. The course is divided into 4 modules. The first module comprises introductory principles such as mole balances, stoichiometry, rate laws, thermochemistry, chemical equilibrium and derivation of rate laws. The second module introduces the different types of ideal reactors and instructs students about sizing reactors using concentrations and conversions. The third module covers non-ideal reactor design and chiefly focuses on steady-state non-isothermal reactors and residence time distributions. The fourth module, which runs contemporaneously with the other modules, covers mass transfer and allows students to approach topics such as heterogeneous catalysis and multiphase reactions with more proficiency.

## Course objectives

After the course, you will be able to:

- Explain the operating principles of different reactor types such as continuous stirred-tank, plug-flow and batch reactors
- Derive the mathematical equations that govern the operation of different reactor types
- Operate PFRs for gas-phase reactions
- Account for pressure drops in packed-bed reactors
- Non-dimensionalize reactor design problems through use of conversion and dimensionless numbers such as the Damköhler number
- Use numerical methods to solve system of ODEs that describe reactor performance
- Analyze reaction data to estimate rate parameters
- Derive rate expressions for enzymes and use this information to size bioprocesses
- Quantify the contribution of mass transport in reacting systems
- Account for molecular and macroscopic phenomena in the design a packed-bed reactor
- Perform energy balances on reacting systems to relate performance of the reactor to its operating temperature
- Diagnose and model non-ideal mixing in a reactor

## Course grading scheme

Assignments (3 in total) - 15%
Quizzes (3 in total) - 15%
Midterm examination (February 12, 11 am -1 pm in CHBE 101) - 30%
Final examination - 40%

***The midterm and final examinations will be open notes. You are permitted to use your notes in physical or electronic format. Use of any textbook is not permitted.***

## Meeting schedule

**Lectures:** Mondays, Wednesdays, Fridays 12-1 pm
**Tutorials:** Wednesdays, 11 am - 12 pm
**Mass transport tutorials:** Thursdays, 1-2 pm

***Quizzes will be announced 1 week in advance***

***All in-class lecture notes will be made available ~1 week after the lecture is held***

## Instructor

Vikramaditya G. Yadav (vikramaditya.yadav@ubc.ca)
**Office hours:** Fridays, 1:30-2:30 pm, CHBE 207

## Teaching assistants

Anish Karnik (anishk18@mail.ubc.ca)
Sahar Sakhaie (sahar.sakhaie.ss@gmail.com)
***Office hours by appointment***

## Textbook

H. S. Fogler, *Elements of Chemical Reaction Engineering*, 4th Edition or higher

## Good reference books

1. O. Levenspiel, *Chemical Reaction Engineering*, 3rd Edition
2. J. M. Smith, *Chemical Engineering Kinetics*
3. C. G. Hill, Jr., *An Introduction to Chemical Engineering Kinetics & Reactor Design*
4. R. B. Bird, W. E. Stewart & E. N. Lightfoot, *Transport Phenomena*, 2nd Edition
5. D. A. McQuarrie & J. D. Simon, *Physical Chemistry: A Molecular Approach*