

CBE 9110 – CHEMICAL KINETICS AND EQUILIBRIA
COURSE OUTLINE FOR FALL 2014

Description

This course is aimed specifically to graduate students who need a broad base introduction to the concepts of reaction rate, stoichiometry and equilibrium to the analysis of chemical reacting systems. Topics in this course include the synthesis of rate expressions using reaction mechanisms, equilibrium or steady state assumptions as well as the basic design of chemical reactors using concepts of thermodynamics, chemical kinetics, basic transport phenomena, and mass and energy balances. An introduction to Langmuir-Hinshelwood kinetics basic concepts on heterogeneous catalysis is also presented.

Prerequisite

UG degree in Engineering or Science related discipline.

Corequisite

None.

Antirequisite

CBE 9450 Advanced Reaction Engineering.

Note: It is the **student's responsibility** to ensure that all Prerequisite and Corequisite conditions are met or that special permission to waive these requirements has been granted by the Program. It is also the **student's responsibility** to ensure that they have not taken a course listed as an Antirequisite. The student may be dropped from the course or not given credit for the course towards their degree if they violate the Prerequisite, Corequisite or Antirequisite conditions.

Contact Hours/Location

3 Lecture hours a week, 2 Tutorial hours a week

Course Instructor

Dr. J. Herrera (TEB 463) Telephone: 519-661-2111 ext: 81262 email: jherrer3@uwo.ca

Graduate Coordinator

TEB 477, Telephone: 519-661-2111 ext: 88352 email: cbegrad@uwo.ca

Required Text

Roberts, G.W., Chemical Reactions and Chemical Reactors, Wiley, 2008

Specific Learning Objectives.

- I. Reactions and Introduction to Reaction Rates (Chapter 1) (3 hrs)
 - Stoichiometry
 - The extent of reaction
 - Definition of reaction rate and rate law
 - Homogenous vs. heterogeneous reactions

- II. The reaction rate (Chapter 2) (3 hrs)
 - The Arrhenius equation
 - Molecular collisions

- III. Thermodynamic considerations (5 hrs)
 - Equilibrium constants
 - Chemical reaction equilibria
 - Rate laws for reversible and non reversible reactions

- IV. Ideal reactors (Chapter 3 and 4) (8 hrs)
 - The mole balance
 - The batch reactor
 - Ideal isothermal reactors: PFR and CSTR
 - Intrinsic kinetics
 - Levenspiel plots
 - Reactor and reaction networks, yield, conversion and selectivity.

- V. Chemical kinetics and analysis of kinetic data (Chapter 5 and 6) (5 hrs-most content presented during tutorials)
 - Elementary reactions
 - Sequence of elementary reactions
 - The steady state approximation
 - Integral and differential analysis of kinetic data
 - Method of half lives, initial rates
 - Linear and non linear regression analysis of kinetic data.

- VI. Introduction to heterogeneous catalysis (Chapter 9) (6 hrs)
 - Catalysts and catalyst structure
 - Langmuir-Hinshelwood kinetics
 - Eley-Rideal kinetics
 - Internal and external transport effects

Course Material

Course notes and videos will be available at the course site in OWL/Sakai .

Units

SI units will be the primary units used in lectures and examinations.

Evaluation

The final mark will be calculated as follows:

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|--------------|-----|
| Homework | 20% |
| Midterm exam | 40% |
| Final exam | 40% |

Examinations will be 2 hours and will be closed book: only handheld non-programmable calculators may be brought to the examinations. Notes, textbook and other reference materials will not be allowed.

Repeating All Components of the Course

In accordance with Senate and Faculty Policy, students who have failed an Engineering course (i.e. <50%) must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted for grading by the student in subsequent years.

Use of English

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Attendance

Any student who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Associate Chair (Graduate), after due warning has been given. On the recommendation of the Department concerned, and with permission of the Associate Chair, appropriate action will be taken, with the possibility of course failure.

Cheating

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning (see Scholastic Offence Policy in the Western Academic Calendar).

Plagiarism

Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).

The University of Western Ontario has software for plagiarism checking. Students may be required to submit their work in electronic form for plagiarism checking.

Sickness and Other Problems

Students should immediately consult with the instructor or Associate Chair (Graduate) if they have problems that could affect their performance in the course. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

Notice

Students are responsible for regularly checking their Western email and notices posted on the OWL course site.

Consultation

Office hours will be arranged for the students to see the instructor. Other individual consultation can be arranged by appointment.

July 11, 2014/jeh