

The University of Western Ontario
Faculty of Engineering

DEPARTMENT OF CHEMICAL AND BIOCHEMICAL ENGINEERING

**CBE 9550 – DESIGN OF FLUIDIZED BED REACTORS AND PARTICULATE
OPERATIONS**

COURSE OUTLINE
Summer 2023

Description

This course is intended to provide graduate students with advanced knowledge on the design of fluidized bed reactors and particulate operations.

Prerequisites

Graduate Student Status or Special Permission of the department.

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.

Corequisites

None.

Antirequisites

None.

Contact Hours

3 lecture hours and 1 tutorial hour per week for a regular term, 0.5 course concentrated in May and June.

Course will be delivered in person but recorded lectures/tutorials will be available on OWL.

Course Instructor

Dr. C. Briens (TEB 371) Telephone: 519-661-2111 ext: 88865 email: cbriens@uwo.ca

Graduate Coordinator

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

Required Text

None.

Slides, detailed notes and recorded lectures will be provided on OWL.

Reference Texts

Coulson & Richardson's chemical engineering, J.M. Coulson and J.F. Richardson, with J.R. Backhurst and J.H. Harker, TP155.C69, 1999.

Particle size measurement, Terence Allen, TA418.8.A43, 1997.

Fluidization Engineering, Daizo Kunii, Octave Levenspiel, TP156.F65K8, 1991.

Fundamentals of fluidized-bed chemical processes / J.G. Yates TP156.F65Y37 1983.

Gas fluidization technology / edited by D. Geldart TP156.F65G37 1986a.

Fluidization / edited by J.F. Davidson, R. Clift, D. Harrison TP156.F65D35 1985.

Handbook of fluidization and fluid-particle systems / edited by Wen-Ching Yang TP156.F65H36x 2003.

Grace, J. R.; Bi, X.; Ellis, N., Essentials of Fluidization Technology. Wiley Online Library: 2020; p 604. Link for download: [Essentials of Fluidization Technology \(uwo.ca\)](https://uwo.ca/essentials-of-fluidization-technology)

Course Notes

Course notes and online lectures will be posted on OWL by the Instructor.

Laboratory

None.

Lab Notes

None.

Topics

Fundamentals

- Characterization of individual particles.
- Rheology of powders.
- Particulate-Fluid interactions.
- Flow of fluids through porous beds.
- Pneumatic transport.

Fluidized beds

- Fluidization regimes, minimum fluidization, minimum bubbling, powder classification.
- Two-phase theory, fluidized bed expansion.
- Gas bubbles in fluidized beds.
- Gas distributors.
- Entrainment from gas-solid fluidized beds.
- Heat transfer in fluidized beds.
- Fluidized bed reactors.
- Turbulent fluidized beds.
- Risers and Downers, standpipes.

Operations for particle separation

- Cyclones
- Filters

Operations to modify particle properties

- Size reduction, agglomeration, classifiers
- Mixing of solids

Evaluation

The final course mark will be determined as follows:

Design Project	100 %
of which:	
Report 1:	25 %
Report 2:	25 %
Report 3:	25 %
Report 4:	25 %

Notes

- 1) The design project reports are to be submitted in OWL by the specified due date and time provided by the Instructor.** This will be a group project and each student will be assigned to a group of 3 to 4 students. The design project will focus on the design of a fluidized bed and will be divided in 4 stages so that each group can get detailed feedback from the instructor after each stage.
- 2) Each group will be provided with the opportunity to distribute marks between its members.** Please consult: Project Team Grade distribution.pdf in OWL.

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 Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the

permission of the Associate Dean (Graduate), the student will be debarred from taking the regular examination in the course.

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.

Conduct

Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others.

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.

Notices

Students are responsible for regularly checking their Western email.

Consultation

Students are encouraged to discuss problems with their teaching assistant and/or instructor in tutorial sessions. Office hours will be arranged for the students to see the instructor. Other individual consultation can be arranged by appointment with the instructor. Because the instructor is usually off-campus, students are encouraged to come to class as the instructor will

be available for consultations after the class.

Accreditation (AU) Breakdown

Engineering Science = 50%

Engineering Design = 50%