Faculty of Engineering

CBE 3324 – MASS TRANSFER OPERATIONS

Course Outline 2017-2018

Description

This course introduces the fundamentals of molecular diffusion and convective mass transfer with and without chemical reactions, interphase mass transfer and the design of different mass transfer equipment with special emphasis on absorption, stripping, humidification and drying.

Course Summary:
This is the third of the three sequence transport courses offered in the Chemical Engineering as well as Green Process Engineering curriculum. Students enrolled into this course have already taken the first two transport courses (CBE 2221 Fluid Flow and CBE 3322 Heat Transfer Operations) that deals with momentum and heat transport. Students as well have taken CBE/GPE 3315 Reaction Engineering that deals with chemical kinetics, ideal reactors and catalytic reaction engineering. Students most likely will be taking CBE 3323 Staged Operation course simultaneously that deals with physical separation processes based on the ideal-stage concept such as distillation, extraction, and leaching. CBE 3324 introduces chemical engineering students to the basics with transport of a species in a mixture in a single phase or across a phase boundary in the presence of a concentration driving force. The course is taught and evaluated at the intermediate level. One of the major difficulties that junior undergraduate students frequently encounters is how to deal with a physical problem to translate it into tractable mathematical equations that can be solved using simple analytical or numerical tools. This course introduces formulation and solution of many real-life problems (to provoke the imagination of the students) and their physical understanding. Many problems of industrial relevance are solved from the conceptual types to those involving direct industrial applications.

General Learning Objectives: At the end of this course students should be able to:

- Formulate real-life mass transfer problems based on Fick’s law for the application of molecular diffusion to steady as well as unsteady state problems for diverse physical situations in dilute as well as concentrated solutions in which diffusion is complicated by the convection as well as chemical reactions.
- Understand the fundamentals of interphase mass transfer, formulate real-life mass transfer problems based on the concept of mass transfer coefficient, overall mass transfer coefficient, and the physical basis of the mathematical equations particularly that of the boundary conditions, and direct relevant industrial applications.
- Use mass transfer correlations under forced as well as natural convection situation to estimate mass transfer coefficient in diverse physical situations; dimensional analysis and
dimensionless groups in mass transfer, correlations for mass transfer coefficients mass transfer with variable driving force – co-current, counter-current and cross-current operations, analogy between transfer processes (Momentum, Heat and Mass), formulation and solution of simple real-life problems.

**Prerequisites:** CBE 2220 and CBE 2221

Unless you have either the pre-requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

**Corequisites:** None

**Anti-requisites:** None

**Contact Hours:** 3 lecture hours, 1 tutorial hour, 0.5 course

**Instructor**
Dr. Ajay K. Ray (TEB 469) Telephone: 519-661-2111 ext: 81279 email: aray@eng.uwo.ca

**Undergraduate Assistant**
(TEB 477) Telephone: 519-661-2131 email: cbeundergraduate@uwo.ca

**Required Text:** None.

**Course Notes**
Detailed course notes will be provided by the course Instructor.

**Units:** SI units will be used in this course.

**Specific Topics to be Covered**
- Molecular Diffusion
- Convective Mass Transfer and Mass Transfer Coefficient
- Fundamentals of Interphase Mass Transfer

**Evaluation:** The final course mark will be determined as follows:

Assignments 20%
Two (2) one-hour Mid-term Examinations 30%
Final Examination 50%

All exams will be CLOSED BOOK Exams. Equations required in solving problems during exams will be provided.
Notes
1) Students must pass the final examination to pass this course. Students who fail the final examination will be assigned 48% if the aggregate mark is more than 50% or the aggregate mark.
2) Assignments are to be handed in to the CBE 3324 locker in TEB on the specified due date provided by the Instructor.

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
Attendance in lectures, tutorials and laboratories is mandatory. 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 Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, 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 Department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented. The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair 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 and notices posted on Instructors' doors.

**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 and teaching assistants. Other individual consultation can be arranged by appointment with the appropriate instructor.

**Accreditation (AU) Breakdown**

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<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Engineering Science</td>
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<tr>
<td>Engineering Design</td>
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January 2, 2018