Faculty of Engineering

CBE 3323B - Staged Operations
Course Outline 2017-2018

Description
This course will focus on the staged unit operations in chemical engineering. It is designed to familiarize
the students with the nature and theory of chemical engineering unit operations, analysis and physical
separation processes based on the ideal stage concept.

Prerequisites
CBE 2220A/B, CBE 2221A/B.

Unless you have either the requisites for this course or written special permission from your Dean to
enrol 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

Antirequisites
None

Contact Hours
3 lecture hours, 1 tutorial hour, 0.5 course.

Instructor
Dr. J. Zhu (TEB 453) Telephone: 519-661-3807 email: jzhu@uwo.ca

Undergraduate Assistant
(TEB 477) Telephone: 519-661-2111 ext: 82131 email: cbeundergraduate@uwo.ca

Recommended Text
None

Course Notes
Course website will be used for summary notes and handouts.

Reference Texts

**Units**
SI and other engineering units.

**General Learning Objectives**

| A knowledge base for engineering | A | Individual and teamwork | A | Economics and project management | B |
| Problem analysis | A | Communication skills | B | Life-long learning | n.e. |
| Investigation | n.e. | Professionalism | n.e. | Key: |
| Design | I | Impact of engineering on society and the environment | n.e. | |
| Use of engineering tools | A | Ethics and equity | n.e. | |

**Specific Learning Objectives**

**Thermodynamics of Separation Processes**
At the end of this topic, students will be able to:
- understand the concepts of thermodynamics and its application in staged operations.
- understand equilibrium diagrams for ideal and non-ideal systems.
- understand non-ideal thermodynamic property models and their application in separation processes.
- apply graphical and analytical methods and mass balance to perform calculations.

**Single Stage Operations - Differential and Flash Distillation**
At the end of this topic, students will be able to:
- understand the concept of differential distillation.
- perform calculation for differential distillation for two-component systems.
- understand the concept of flash distillation.
- perform calculation for flash distillation for multi-component systems.
- use enthalphy-concentration diagrams.

**Continuous Distillation**
At the end of this topic, students will be able to:
- understand the concepts of continuous distillation.
- understand the principles of materials and enthalpy balance in a distillation column.
- use McCabe-Thiele method for distillation column calculations.
• understand such key concepts as reflux ratio, minimum and total reflux, number of theoretical stages, plate efficiency, feed conditions, optimal feeding plate, feeding at plate other than the optimal feeding plate.
• understand the principles and perform calculations for distillation with multiple feed streams and side streams.
• compare packed towers and plate columns performances in continuous distillation processes.
• understand the main design parameters in distillation columns.

Liquid-liquid Extraction
At the end of this topic, students will be able to:
• understand the concepts of liquid-liquid extraction.
• understand the equilibrium in three-component Liquid-liquid systems.
• understand the principles of materials balance in liquid-liquid extraction systems.
• perform essential calculations for single stage, multi-stage cross-current and multi-stage counter-current extractions.
• understand the key design parameters in Liquid-liquid extraction.

Leaching Extraction
At the end of this topic, students will be able to:
• understand the concepts of leaching.
• understand the equilibrium in leaching systems.
• understand the principles of materials balance in leaching systems.
• perform essential calculations for single stage, multi-stage cross-current and multi-stage counter-current leaching.
• understand the key design parameters in leaching.

Evaluation
The final course mark will be determined as follows:
Assignments and quizzes 20%
In-class workshops 10%
Mid-term Examination 20%
Final Examination 50%

Both examinations will be limited open book (one reference textbook, course notes and own assignments – all must be bound together), calculators of any kind will be permitted. The final examination will be 3 hours in length.

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 higher than 50%, or the aggregate mark.

2) Assignments are to be handed into CBE 3323B 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 and tutorials is mandatory.* Any student who, in the opinion of the instructor, is absent too frequently from class 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 Western University, Thompson Engineering Building, Room 477, 1151 Richmond Street, London, ON Canada N6A 5B9 t. 519.661.2111 ext. 82131 f. 519.661.3498 www.eng.uwo.ca/chemical/
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**

Engineering Science = 50%
Engineering Design = 50%

Jan 6, 2018/IT