The University of Western Ontario
Faculty of Engineering
DEPARTMENT OF CHEMICAL AND BIOCHEMICAL ENGINEERING

CBE 3318 – Chemical Process Simulation
Course Outline 2017-2018

This course aims to introduce and to develop student skills on modern methods for simulation of chemical process unit. Differential heat balance, mass balance. Energy and material balance methods in process unit. Executive systems for overall balance methods. Physical properties, computer packages.

Students should be able to:

- Identify the principles of modular representation, various types of modules available in the Hysis package, the properties and the limitations of the modules, the strategies for tearing streams and convergence.
- Translate a process flow diagram in a process flowsheet. Develop an understanding of flowsheeting, steady state models, stream variables, degree-of-freedom analysis, simulation of several units in chemical networks, partitioning and precedence order.
- Identify the extent of reaction variables, independent chemical reactions and the degree-of-freedom analysis for chemical reactors.
- Develop an understanding of the element balance approach, the algebra of element balances, the application of element balances in the context of a unit and a chemical process
- Perform mass and energy balances using Hysis package in a unit and in a network of units with consideration of degrees-of freedom, principles of decoupling of mass and energy balances, partitioning and precedence order.
- Identify the common factors in various simulation packages, the physical properties package capabilities, the available modules for quick design of various units.

**Prerequisites**
CBE 2220A/B, CBE 2221A/B, CBE 2224A/B, or GPE 2218A/B, ES1050.

**Note:** It is the student’s responsibility that all the Prerequisite and Corequisite conditions are met or that special permission to waive these requirements have been granted by the Faculty. It is also the student’s responsibility to ensure that they have not taken course listed as an Antirequisite. They students 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
Former CBE 3397

Contact Hours
2 lecture hours; 2 tutorial hours each week.

Course instructor
Dr. H. deLasa (CMLP 3331) Telephone: 519-661-2111 ext: 82144 email: hdelasa@uwo.ca

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

Required Text
None

Course Notes
Will be available (course website)

Reference Text

Units
SI and other units will be used

General Learning Objectives

| A knowledge base for engineering | A | Individual and team work | A | Economics and project management | n.e. |
| Problem analysis | A | Communication skills | A | Life-long learning | A |
| Investigation | B | Professionalism | I | Key: |
| Design/Simulation | I | Impact of engineering on society and the environment | I | B: evaluated at introductory level |
| Use of engineering | A | Ethics and equity | I | I: evaluated at intermediate level |
| | | | | A: evaluated at advanced level |

Key:
- B: evaluated at introductory level
- I: evaluated at intermediate level
- A: evaluated at advanced level
Specific Objectives
Simulation of a Chemical Process Unit
At the end of Topic 1, students should be able to:

- understand the basic concepts involved in the simulation of a unit in a chemical process
- establish the degree-of-freedom of a unit in a chemical process
- sole this unit using the Hysis package
- be introduced to the basic commands of the Hysis package
- be introduced to the techniques of drawing flowsheets including icons.

Overall Material Balances in Chemical Processes
At the end of Topic 2, students should be able to:

- understand the basic concepts involved in the simulation of a network of units in a chemical process
- establish the degree-of-freedom for the network of a unit
- be trained with several modules available in a computer package
- establish the order of calculation in a process network
- solve a process with several units using the Hysis package
- be introduced to the basic commands of the Hysis package
- be introduced to the techniques of flowsheeting

Chemical Reactors
At the end of Topic 3, students should be able to:

- understand the concept of extent of reaction variables
- perform calculations to establish the number of independent chemical reactions for a set of chemical reactions
- develop flowsheets involving chemical reactions and several chemical reactors
- develop Degree-of-Freedom analysis, partitioning and precedence order in processes with chemical reactors
- be able to perform mass balance calculations using Hysis in chemical processes involving chemical reactors
- be able to perform mass balance calculations using Hysis in chemical processes involving chemical reactors

Element Balances
At the end of Topic 4, students should be able to:

- understand the significance of the element balance approach. The advantages and limitations
- develop calculations to establish number of independent element balances
- develop Degree-of-Freedom analysis. Be able to establish partitioning and precedence order
- be able to perform mass balance calculations using Hysis in chemical processes involving chemical reactors

**Mass and Energy Balances in a Chemical Process**

At the end of Topic 5, students should be able to:

- understand the complexities and strategies for combined mass and energy balances in a unit and in a network of units
- develop Degree-of-Freedom
- be able to perform combined mass and energy calculations using the Hysis package. Be able to establish partitioning an precedence order
- be able to propose strategies for mass and energy balances decoupling
- apply combined mass and energy balances in the context of chemical process with and without chemical reaction

**Flowsheeting and Modular Representation**

At the end of Topic 6, students should be able to:

- use Hysis package for effective modular representation of a process
- be able to use various types of modules available in Hysis and the available icons
- be aware of module properties and their limitations
- be able to translate a process flow diagram in a process flowsheet
- perform calculations considering strategies for tearing streams and convergence

**Executive systems for Overall Mass and Energy Balances**

At the end of Topic 7, students should be able to:

- identify the common factors in various executive computer softwares for process simulation
- be aware of the various physical properties packages available in Hysis
- use quick design modules for various units
- be aware of short cut methods and detailed designs for separation units.

**Special Process Design and Simulation Project**

Students will develop throughout the term an individual special assignment. This assignment will consider specific application of the knowledge acquired on "Flowsheeting and Modular Representation".
Evaluation
Evaluation is on the basis of assignments and final examination. The final mark will be calculated as follows:

- Problems/Computer Assignments: 27%
- Top Hat Participation: 3%
- Special Assignment: 15%
- Final Examination: 55%

Examinations will be limited open book, as programmable calculators are permitted during the final examination. Be advised that the course instructor will be clearing all information stored. Otherwise, only non-programmable calculators will be permitted.

Note: 1) Students must pass the final examination to pass the 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 in the CBE 312 locker (#66) 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
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 (519) 661-2111 x82147 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 instructors in tutorial sessions. Office hours will be arranged for the students to see the instructor and teaching assistants. Other individual consultations can be arranged by appointment with the appropriate instructor.

Accreditation Breakdown
Engineering Science  =  50%

Engineering Design  =  50%

Total AU’s (38.2)  =  100%